AGRICULTURAL SOCIETY OF NIGERIA (ASN)

50th ANNUAL CONFERENCE
Abia 2016

PROCEEDINGS

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I.N. Nwachukwu, C.O. Amadi, J.E. Ewuziem, B.C. Okoye, S.O. Afuape, N.M. Agwu & O.U. Oteh

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AGRICULTURAL SOCIETY OF NIGERIA (ASN)

ABIA 2016

HOSTED BY

NATIONAL ROOT CROPS RESEARCH INSTITUTE (NRCRI), UMUDIKE
ABIA STATE, NIGERIA

THEME

ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

3RD – 7TH OCTOBER, 2016

EDITED BY

I.N. Nwachukwu, C.O. Amadi, J.E. Ewuziem, B.C. Okoye, S.O. Afuape, N.M. Agwu & O.U. Oteh

UMUDIKE 2016

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ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME I:

AGRIBUSINESS & ENTREPRENEURSHIP, AGRICULTURAL POLICIES & ADMINISTRATION, AGRICULTURAL FINANCE, RESOURCE ECONOMICS

ANALYSIS OF OCCUPATIONAL CHOICE AMONG FISHERMEN IN THE REVERIE AREAS OF ILAJE AND ESE-ODO LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA

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ABSTRACT
The study analysed the determinants of occupational choice among fishermen in the Riverie areas of Ilaje and Ese-odo Local Government Areas of Ondo State, Nigeria. Multistage random sampling technique was employed in the collection of data from one hundred and forty four fisher men from the study area through the use of a structured questionnaire. Data were analyzed using descriptive statistics of frequency counts and percentages. The results indicated that fishermen were mostly male (77.8%), married (75.5%) between the age of 30 and 39 (40-43%). The result also indicated that majority inherited fishing as family business (92.40%), to earn a living (90.30%), ready market for fish (90.30%) and involvement of less skill (86.80%) as the determinants of fishing as an occupation among the respondents while constraints faced in fishing industry include difficult access to credit (93.80%), lack of government assistance (93.10%), weed interference (92.40%) and unpredictable weather (90.30%). The study recommended that young people should be encouraged the more to go into fishing as this will increase food security as well as creating employment among other things. Government and other stakeholders should come to the aid of the fishermen in mitigating the constraints faced by the fishermen.
Key words: analysis, fishermen, gender, occupation, riverie

INTRODUCTION
Nigeria is a maritime country with tremendous aquatic and fisheries resources that make significant contributions to livelihood, food security and the overall economy of the nation. The country's fresh water and marine fisheries resources are enormous and offered tremendous opportunities for fish production through capture and culture fisheries. The freshwater bodies comprised of seasonal and perennial rivers, lakes reservoirs and dams, estimated at about 14 million hectares (Ipinjolu *et al*, 2014). Furthermore, the coastal waters, comprising of the creeks, lagoons and estuaries, have been estimated at about 37, 934km^2. (FDF, 2008). Capture fisheries involve the harvesting of naturally existing stocks of wild fish. This can be done either by small scale/artisanal fishers or by industrial/ commercial trawlers. In artisanal fisheries, production is achieved by individual or by small groups by the use of labour intensive gear (Anene *et al*, 2010). Characteristically, artisanal fishers operate from dug out, wooden carries that are more often than not unmotorised (Coates 2000). FAO (2005) has identified and opined that Nigeria is one of the countries in the West African region with great potentials to attain sustainable fish production since the country is blessed with large coastlines comprising lagoons, estuaries, wetland and series of interconnecting creeks. Fishing is a traditional activity involving the hunting and gathering of aquatic products for food. Fish and marine products include freshwater and ocean fish, shellfish, ocean mammals and seaweed as well as plankton. Economically, fish provides an important source of food and income for both men and women and fishing has an important social and cultural position in reverie communities. However, the tradition of fishing has been transformed over several decades of human civilization to become a resource extraction industry spanning the entire globe. Man first learned to catch fishes in traps and nets. These fishing activities were limited at first to the lakes and rivers, but as men improved on the boats and fishing technologies, they ventured into sheltered coastal areas, river mouths and eventually farther out on to the continental shelves, relatively shallow ocean plains between the land and the deeper ocean areas (Olubanjo *et al*., 2007).
Fisheries resources overexploitation and Coastal environmental degradation must be seen as vital issues in the long-run management and sustainability agenda of many developing countries if the contribution of the sector to real GDP and the welfare condition of the people in the coastal areas are to be maintained (Acqual and Abunyuwah 2011). This study therefore analysed the determinants of occupational choice among fishermen in the Riverie areas of Ilaje and Ese-odo Local Government Areas of Ondo State, Nigeria. Specifically, the objectives of the study are to: (i) examine the socio- economic characteristics of the respondents (ii) analyse the factors that determines the choice of fishing as an occupation (iii) describe the constraints militating against the respondents' operations in the study area.

METHODOLOGY
Study area
The study was carried out in Ilaje and Ese – Odo local government areas of Ondo State, Nigeria. About 80% of the study area is covered with water, Swamp and flood plains with a coastline of 80km long. This makes Ondo State qualify as a maritime state and makes it rank among the highest artisanal fish producers in the country.

Method of selection of respondents and data collection

Multistage random sampling technique was used to draw samples for the study. Two of the three local government areas that are predominately fishing communities were selected out of the eighteen local government areas (LGAs) in the State. Secondly, six fishing communities were selected from each of the two LGAs earlier chosen to give a total of 12 fishing communities covered in the study. Subsequently, 12 fishers were randomly selected from each of the 12 communities, to constitute a total of 144 respondents.

Data for the study were collected from fishers using interview schedules that were administered to the selected respondents with the assistance of trained enumerators that were fluent in the local dialects of the respondents. Data collected include personal characteristics such as gender, age and marital status, etc as well as constraints they face in their occupation. Data from the survey were analyzed using descriptive analysis such as frequency counts and percentages.

RESULTS AND DISCUSSION

Socio – economic characteristics of the fishermen in the study area

In Table 1, findings show that majority of the fishermen 77.8% were male and married (75.7%). The dominance of male in the profession could be attributed to the drudgery nature of fishing. Generally, males are physically stronger than their female counterparts and so the use of some fishing gear such as trawl and cast net are better operated by males, leaving out their female counterparts in fishing. Age distribution of fishermen between 30 – 39 years was the highest (40.3%). The implication is that young men dominate the occupation. This could mean that fishing in the study area is majorly engaged by those who are physically strong to be able withstand the stress and drudgery associated with it, thus increased productivity. Faridi and Gilani (2012) in a similar study in Pakistain reported the involvement of more male in fishing as well as joing the occupation at an early stage in life. This study corroborates with theirs. Majority (75.7%) of the respondents were married. By implication, majority of the respondents are responsible family members who are likely to spend their profits on their family.

Socio-economic factors influencing the choice of fishing as an occupation

Table 2 showed that 92.4% inherited fishing as a family business, 90.3% were in fishing to earn a living. Furthermore, 90.3% indicated available ready market for fish while 86.8% indicated that fishing involves less skill. Fishing as an occupation may have sustained their livelihoods for so many generations; therefore, the choice of fishing as an occupation is plausible. The result corroborated Acquah and Abunyuwah (2011) who reported that 87.8% of respondents are involved in fishing as a family business in their study.

Constraints faced by fishermen in their operations

Table 3 shows constraints faced in the fishing industry. Majority, (93.8%) indicated difficulties in accessing credit, 93.1% indicated lack of government assistance, while 92.4% indicated weed interference and unpredictable weather 90.3%. In a similar study, Adeokun *et al* (2006) indicated lack of credit as one of the major constraints faced by the fishermen.

CONCLUSION AND RECOMMENDATIONS

The study had shown some of the factors that influence people in the study area into choosing fishing as an occupation as well as the constraints faced by the fishermen. It is therefore; recommended that young people should be encouraged the more to go into fishing as this will increase food security as well as creating employment among other things. Government and other stakeholders should come to the aid of the fishermen in mitigating the constraints faced by the fishermen.

Table 1: Socio – economic characteristics of the fishermen in the study area

Characteristics	Frequency	Percentage
Gender		
Male	112	77.8
Female	32	22.2
Total	144	100.00
Age (years)		
20-29	49	34.0
30-39	58	40.3
40-49	21	14.6
50-59	14	0.7
Above 60	2	1.4
Total	144	144
Marital Status		
Married	109	75.7
Single	32	22.2
Divorced	1	0.7
Widowed	2	1.4
Total	144	100

Source: Field survey data, 2016.

Table 2: Socio-economic factors influencing the choice of fishing as an occupation

S/N	VARIABLES	YES	%	NO	%
1.	Inherited family business	133	92.4	11	7.6
2.	To earn a living	130	90.3	14	9.7
3.	Low capital to start	67	46.5	77	53.5
4.	Involves less skill	125	86.8	19	13.2
5.	Ready market for fish	130	90.3	14	9.7
6.	Easy access to credit	63	43.8	81	56.3

Source: Field survey data, 2016.

Table 3: Constraints faced in fishing industry by fishermen

S/N	VARIABLES	YES	%	NO	%
1.	High cost of transportation	126	87.5	18	12.5
2.	Lack of storage facilities	104	72.2	40	27.8
3.	Difficult access to credit	135	93.8	9	6.2
4.	Lack of government assistance	134	93.1	10	6.9
5.	Unpredicted weather	130	90.3	14	9.7
6.	Weed interference	133	92.4	11	7.6
7.	Pollution	127	88.2	17	11.8

Source: Field survey data, 2016.

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SOCIO-ECONOMIC DETERMINANTS OF YAM OUTPUT IN IMO STATE, NIGERIA

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ABSTRACT

The study examined the socio-economic determinants of yam output in Imo State, Nigeria. Multistage random sampling technique was used in selecting 120 yam farmers for the study. Data collected was analysed using descriptive statistics such as frequency, percentage and multiple regression. The results showed that farming experience, age of farmers, amount of capital invested, farm size and labour use level were strong determinants of yam output, explaining 73.6% of the total variation in yam output at 1.0 percent probability level. Findings revealed that the major problems affecting yam production in Imo Sate were scarcity and high cost of planting materials, inadequate capital, high cost of input, storage and poor road network. It is therefore recommended that increase in investment capital is needed for yam production.

Keywords: Yam production, output, socio-economic and Imo State

INTRODUCTION

Yam (Discorea spp) is a crop of immense importance in Nigeria. It is one of the staple foods, a good source of income and serves other social and cultural purposes (Nwoko *et al*., 2000). Annual production of yam in the country is estimated at 37.8 million tonnes (FAO, 2013). Nigeria is the largest producer of yam in the world and there is need for increasing production to satisfy domestic and export demand for yams (Okonkwo, 2011). Production of yam in the country had not been able to meet its demand especially in Imo State. This is due to the fact that the edible part of yam is used as its planting material (Ikeorgu *et al* (2010) and also as a result of challenges faced by farmers due to some of their socio-economic variables in yam production (Njoku *et al*., 2008). Hence scarcity of planting material and hindrances of some socio-economic variables of farmers are among the constraints in yam production. Therefore there is need to ascertain those socio-economic variables that affects yam production in the study area. The objectives of this study were to determine the socio-economic variables that influence yam output in Imo State; and to identify the problems of yam farmers.

METHODOLOGY

The study was conducted in Imo State. Imo state is located in the South-Eastern geo-political zone of the Nigeria, occupying the area between the lower River Niger and upper and middle Imo River. Imo State is bounded by the states of Anambra in the north, Abia in the east and Rivers in the south (Imo ADP, 2001). Imo State has an estimated area of 5,150 square kilometres. The state has 21 local government areas with three agricultural zones as Orlu, Okigwe and Owerri. Farming is the predominant occupation of the people. The area is favourable for the production of yam, cassava, cocoyam, maize, okro and other vegetables. In each of the three State's Agricultural Zones, two blocks were randomly selected and in each of the blocks, two circles were randomly selected. Ten yam farmers were randomly selected in each of the selected circles giving a total of 120 farmers. Primary data was collected through oral interview and structured questionnaire. Data was analyzed using descriptive statistics like frequency table, percentage, and multiple regression. The multiple regression model was specified implicitly as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, ei)$

Where:

Y = Output of Yam (tonnes/ha)
x_1 = Age of the farmer (years)
x_2 = Level of education (years spent in school)
x_3 = Marital status (Dummy variable; 1 = married, 0 = single)
x_4 = Years of farming experience
x_5 = Farm size (ha)
x_6 = Amount invested (₦)
x_7 = Labour use (mandays)

e = Error term.

The multiple regression was run in four functional forms: Linear, Semi-log, Double log and Exponential forms. The Double-log equation was chosen based on econometric and statistical reasons such as the number of regression coefficients that were significant, R^2 value, the significant level of F-ratio and agreement with a priori expectations.

RESULTS AND DISCUSSION

Estimation of Socio-economic Factors of Yam Output

Table 1 showed that five variables were statistically significant in the socio-economic determinants of yam output. The variables were farming experience, age of farmer, amount invested, farm size and labour use level. Farming experience has positive and significant relationship with yam output of the farmers. This indicates that with more farming experience, a farmer can become more or less averse to the risk involved in yam production. It also implies that experienced farmers are willing to explore their environment to boost their productivity (Obinne, 2007). Age of farmer has a significant positive effect on yam output. This shows that, older farmers had more yam outputs and are more productive than the younger ones. This result could be explained given the fact that older farmers have gained more experience in farming. Amount invested in yam production has positive and significant relationship with output. This indicates that as farmers invest more money in yam production the yam output increases. Farm size has positive significant relationship with yam output. This implies that as the farmer increases his farm size for yam production that will equally increase his output. Results in Table 1 also showed that labour use level had positive and significant relationship with yam output. This indicates that as farmers engage more labour in yam production, there will be a corresponding increase in yam output. This finding agrees with that of Yisehak (2008) that increase in labour enhances output and farm productivity.

Problems of Yam Production

Table 2 shows that the major problems affecting yam production in Imo Sate were scarcity and high cost of planting material (91.7%), high cost of input (81.7%), inadequate capital (75%), storage (62.5%) and poor road network (45%). This result revealed that scarcity/high cost of planting is a very serious challenge in yam production. This agrees with Ikeorgu *et al* (2010) that scarcity and/or high cost of healthy seed yams are the greatest constraints in yam production in Nigeria.

CONCLUSION

The results of this study have shown that farming experience, age of farmer, amount invested, farm size and labour use level were the socio-economic variables that positively and significantly affect yam output. The major problems affecting yam production in Imo Sate were scarcity and high cost of planting material, high cost of input, inadequate capital, storage and poor road network. It is therefore recommended that increase in investment capital is needed for yam production.

Table 1: Estimation of Socio-economic Factors Determining Yam Output

Variables	Linear	Semi-log	Double log +	Exponential
Constant	7.5941	8.2512	9.5729	18.2715
Age of the farmer X_1	1.9612	0.0017	0.0714	-9.2613
	(2.41171) *	(2.5712)**	(3. 4210)**	(-2.8982)**
Level of education X 2	2.5816	0.0027	0.0116	8.4459
	(1.2930)	(1.1248)	(1.0822)	(1.0977)
Marital status X 3	0.5840	0.0046	-0.0426	-1.5388
	(0.932	(1.2307)	(-1.0811)	(-1.4740)
Years of farming experience	-1.6732	0.0043	0.0427	3.6612
X4	(-1. 2288	(2.5880)*	(2.4738)**	(2.3446)**
Farm size X5	2.9175	0.0021	0.0275	7.1136
	(-1.1514)	(1.2938)	(2.6795)**	(1.1053)
Amount invested X6	0.5742	0.0315	0.0943	-18.2228
	(2.7295)**	(3.1045)**	(4.3501)**	(-2.1753)**
Labour use level X7	-1.5912	0.0054	0.0521	10.2214
	(-2.5882)**	(1.1427)	(3.0882)**	(2.0517)**
R^2	0.4876	0.5123	0.7356	0.5832
F-ratio	1.2015	1.9982	5.2889**	2.6396

Source: Field Survey, 2015 * = significant at 5%, **= significant at 1%., + = lead equation

Table 2: Distribution of Respondents according to Problems Encountered in Yam Production

Problems	*Frequency n = 120	Percentage
Scarcity/high cost of planting material	110	91.7
Pest and diseases	40	33.3
Inadequate capital	90	75.0
High cost of input (fertilizer, labour, agrochemical, etc)	98	81.7
Marketing problems	25	20.8
Storage problems	75	62.5
Poor infrastructural facilities (rural roads)	54	45.0

Source: Field Survey, 2015. *Multiple Responses were recorded

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FACTORS INFLUENCING ADOPTION OF YAM MINISETT TECHNOLOGY IN EBONYI STATE, NIGERIA

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ABSTRACT
The study assessed the factors influencing adoption of yam minisett technology in Ebonyi State, Nigeria with the following objectives: describe socio-economic characteristics of yam farmers in the study area; identify sources of information on yam minisett production technologies available to farmers in the study area; determine the factors that influence the adoption of yam minisett technology in the study area; and identify the constraints militating against the adoption of minisett technology by the yam farmers in the study area. A multistage random sampling technique was adopted in the selection of blocks, circles and yam farmers. First 4 blocks were randomly selected from each of the three zones to give a total of twelve (12) blocks. From the selected blocks, five (5) circles each were randomly selected to give a total of sixty (60) circles. Finally, two (2) yam farmers were randomly selected from the selected circles to give a total of one hundred and twenty yam farmers. Percentages, means, frequency distribution, regression analysis were used for the analysis of the data. Majority (69.17%) of the farmers received information on the technology and was aware of the technology; the study also established that there is significant relationship between farmers' social-economic characteristics and adoption level. The coefficient of the tobit regression model shows that farm income and contact with ADPs were positive and statistically significant at 1% level. The coefficient of gender, age, household size and farming experience were negatively related to the level of adoption of yam minisett technology and were statistically significant at 1% and at 5% respectively. Therefore, for the full potential of minisett technology to be realized in the study area constraints to yam minisett technology has been identified in this study, integration of farmers practices into yam minisett packages are very necessary since bases of research is to transfer the findings to the end users.
Keywords: adoption, technology, yam minisett, Ebonyi

INTRODUCTION

Yam is referred to as the "king" of all crops in Nigeria because of its monetary value per unit weight compared to food crops (Orkwor, 1998). This indicates that the crop could contribute to export earnings should production increase. However, one of the most critical constraints to increasing production is scarcity and high cost of healthy seed yams (NRCRI, 2004). In Nigeria, yams contribute significantly to the national economy and income by providing employment to many rural dwellers (Asumugha *et al*., 2010) and cheap carbohydrate staple food for over 80 percent of the populace (Nwachukwu, 2008). Seventy (70.0%) of the population live in rural areas where farming is their primary occupation (Okuneye, 2002; NPC, 2006; Nwachukwu, 2009). Majority of the farmers in rural areas produce yam and other food crops for their own consumption and income because their living standards are low arising from low agricultural productivity (Onyenweaku, 1991). Yam production in Nigeria has been observed to be more financially rewarding enterprise than groundnut, rubber and cotton production irrespective of its enormous constraints (Idaclaba, 2004).

According to Onwuka (2012), yam is one of Nigerians leading root crops, both in terms of land under cultivation, and value of production. Seed yams constitute over 33.0% of the cost outlay in yam production with small whole tubers of about 100-300 grams used as planting materials in production of about 1,000 grams weight of ware yam (Orkwor *et al.*, 1998).

Nigeria like other underdeveloped countries is still facing a persistent food shortage problem. Seed yams are the most important input required for yam production. The scarcity and high cost of planting materials constitute major constraints to yam production in Nigeria, especially Ebonyi State. Seed yams constitute as much as 40% of the total cost of production. As a result of the unavailability/high cost of seed yams, many yam farmers have resorted to planting their yam farm with any yam material they can lay their hands on which may be low yielding. Consequently the traditional yam barns that were once the prides of the rural yam producing communities in Ebonyi State have now disappeared.

Since the development of Minisett technique in the late 1970's, the level of awareness and adoption as a commercial production practice for seed yam is still very low (Okoro, 2008).

Otoo *et al*., (2008), observed a low rate of adoption of yam minisett technology as a result of high degree of risk, small size of minisett and other extraneous factors making them vulnerable when planted in the field and other socio – economic characteristics of farmers in spite the effort made by the Food and Agriculture Organization (FAO) through the root and tuber improvement and marketing programme to promote the adoption of this technology.

The study therefore, has the following objectives and they ate to: examine the various sources of yam minisett technology recommendation used by farmers in the study area; estimate the factors that influence the adoption of seed yam technology by farmers in the study area; and describe the constraints faced by farmers in yam minisett technology in the study area.

METHODOLOGY

The study was conducted in Ebonyi State. The State is located in the South Eastern geo-political zone of Nigeria. The State has a population of 2.3 million people and a land mass of 5,9300km^2 (NPC, 2006). The state shares boundary with Cross River State on the East, Enugu State on the West, Benue State on the North, Abia State on the South. Ebonyi State lies between latitudes $5^0 10^1$N and $6^0 35^1$ North of the equator and longitudes $7^0 10^1$E and $8^0 5^1$E of the Greenwich Meridian. The state has three agricultural zones in Ebonyi State are Ebonyi North, Ebonyi Central and Ebonyi South. It is a leading producer of rice and yam in South Eastern Nigeria. The state is also endowed with artisanal fishing practices because of rivers, streams, lakes and flood plains prevalent in the state, thereby making fishing a revenue earner for the state.

Sampling Technique

A multistage random sampling technique was adopted in the selection of blocks, circles and yam farmers. First 4 blocks were randomly selected from each of the three zones to give a total of twelve (12) blocks. From the selected blocks, five (5) circles each were randomly selected to give a total of sixty (60) circles. Finally, two (2) yam farmers were randomly selected from the selected circles to give a total of one hundred (120) yam farmers in Ebonyi State.

Data Collection and Analysis

Primary data were collected by the use of questionnaires in eliciting information from the participating farmers. Inferential and Descriptive statistics were used for the data analysis. The factors that influence the adoption of yam minisett technology packages by farmers were determined using tobit regression analysis.

Since the level of adoption of yam minisett technology packages, cannot be negative (the threshold is zero) the dependent variable can be written using an index function approach in accordance with Onyenweaku *et al*., (2010).

$Ii = B^T X + ei$... (1)

$Yi = O$ if $Ii = T$... (2)

$Yi = I$ if $I > T$.. (3)

Where;

Y represents a limited dependent variable, which simultaneously measures the decision to adopt the technologies and intensity of adoption.

I^x is an underlying latent variable that indexes adoption.

T is an observed threshold level

X is the vector of independent variables affecting adoption.

βi is a vector of parameters to be estimated

ei = error term.

If the non variable T becomes a continuous function of the independent variables and O otherwise for the generated case, the value of log likelihood function is stated explicitly as;

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, + ei)$

Where:

Y = level of adoption of technologies (measured by numbers of adoption scores of the respondents)

X_1= Gender (Male = 0, Female = 1)
X_2 = Age (in years)
X_3 = Educational status (measured by the number of years of farmer spent in school)
X_4 = Household size (numbers)
X_5 = Farming experience (years)
X_6 = Farm size (hectares)
X_7 = Farm income (₦)
X_8 = Contact with ADP extension officers (Yes=1, No=0)
ei = Error term

RESULTS AND DISCUSSION

Sources of Information Available to Farmers

The distribution of respondents by sources of information on yam minisett technology available to them is presented in Table 1.

The results showed that the major sources of information on yam minisett technique to farmers were the ADPs (66.67%). About 12.5% of the farmers received their own information from the research institute and 5.83% from radio/television and cooperative society respectively. This implies that majority of the farmers got their information from the ADPs, this agrees with Bolarinwa and Oladeji, (2009) who also reported the ADPs as a good source of information on yam minisett technology to the farmers in Osun, Oyo and Kwara States of Nigeria.

Socioeconomic factors influencing the Level of Adoption of Yam Minisett Technology among Farmers in Ebonyi State

The socioeconomic factors influencing the level of adoption of the minisett technology among the farmers in the study area is presented in the Table 2. The result indicates a chi-square value of 9527.69 and was significant at 1% level. This implies a good fit for the regression model used for the analysis.

The coefficient of the Tobit regression model shows that the coefficient of farm income and contact with ADPs were positive and statistically significant at 1% level to the level of adoption of yam minisett technology. This implies that farmers with higher income are more likely to adopt the minisett technology as well as farmers that had regular contact with ADPs extension agents. The coefficient of gender, age, and household size were negatively related to the level of adoption of yam minisett technology and were statistically significant at 1% and at 5% respectively. This implies that more males are likely to adopt the minisett technology in the study area than females. The coefficient of age was significant at 1% but inversely related to the level of adoption. This implies that the older the farmer, the lower the level of adoption, this further explains that youths are likely to adopt the minisett technology than aged farmers. Hartley (2003) stressed that respondents within productive age were likely to adopt innovations better because they are still active and dynamic against the ones that are of age. These factors could be as a result of the low adoption rate of yam minisett technology in the study area. FAO, (1997) asserted that farmers adopted only those practices they have been familiar with and which are in line with existing practices. This study also agrees with Bolarinwa and Olajide (2009) and Tiamiyu *et al.*, (2010) who reported similar trend in their work on adoption of yam minisetts and NERICA rice production technologies respectively.

CONCLUSION

Farmers in the study area received information on ministt technology majorly from ADPs. However, gender, age, household size, farm size, farm income and contact with ADPs were the socio-economic factors influencing the adoption of yam minisett technology in the study area. Therefore, the ADPs/extension agents should be empowered by the government to reach out to farmers with the full package of the technology.

Table 1: Distribution of Respondents According to their Sources of Information

Sources	Frequency	Percentage
Ministry/ADP	80	66.67
Research institutes	15	12.5
Fellow farmers	5	4.16
Radio/Television	7	5.83
Cooperative society	7	5.83
NGOs	6	5.0
Total	**120**	**100.00**

Source: *Field Survey, 2015*

Table 2: Summary of the Tobit Regression Result of Factors Influencing Adoption of Yam minisett Technology among Farmers in Ebonyi State

Variable	Coef.	Standard error	t-value	P>{t}
Gender	-.114	.022	-5.063***	-.158
Age	-.017	.001	-12.664***	-.020
Educational level	.001	.002	.737	-.002
Household size	-.073	.007	-10.507***	-.087
Farming experience	-.004	.002	-1.939	-.008
Farm size	-.142	.010	-14.343***	-.162
Farm income	.000	.000	26.727***	.000
Contact with ADPs	.323	.027	12.013***	-.376
intercept	-3.003	.075	-40.169	-3.078

Source: *Field Survey, 2015*

Key: ***= significant at1% level, ** = significant at 5% level.

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DETERMINANTS OF FISH PRODUCTION IN IKOT EKPENE LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

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ABSTRACT
The study was conducted to examine the determinants of fish production in Ikot Ekpene Local Government Area of Akwa Ibom state. The data used for the study were collected from 80 fish farmers randomly selected from the study area. .Descriptive statistics (tables and percentages) and multiple regression analysis were the tools of analysis adopted. The major findings of the study were that fish production was mostly practiced by men, with 75.5% between 31-50 years of age, 68.75% were married and 92.5% having formal education. Most of the respondent (63.75%) had above 15 years production experience and 48. 75% relying on inherited farmlands. Stock density, quantity of feed used, labour, educational level and farming experience were found to have significant effect on fish production. High cost of feed, unavailability of quality fingerlings, poor access to credit and poor storage facilities were major constraints to fish production in the study areas. The study recommended the establishment of modern fishery hatcheries and feed mill by the government in the area to reduce cost of production and increase farmers productivity.
Keywords: Fish production, determinants, Akwa Ibom State, Nigeria

INTRODUCTION
Fish farming or culture which is an aspect of aquaculture is an integral component of the overall agricultural production system in Nigeria. The major species cultured in Nigeria include tilapias, catfish and carp; however the African catfish *Clariasgariepinus* is the most farmed (*Agbede et al., 2003*). Fish and fish products constitute more than 60% of the total protein intake in adults especially in rural areas (Adekoya, 2004). FAO (2003) indicates that fish is very important in nutrition, as it provides vital nutrients and source of animal protein especially to the poor who are unable to purchase other more expensive sources such as beef, pork or chicken.
Nigeria has over 14 million hectares of inland water surface, out of which about 1.75 million are available and suitable for aquaculture (FAO, 2006). Olaoye *et al* (2013) reported that, aquaculture is predominantly an extensive land based system, practiced at subsistence levels in fresh waters in Nigeria. Commercial farming is yet to become widespread (Fagbenro, 2005). At present, most fish farmers operate small-scale farms ranging from homestead concrete ponds (25-40 meters) to small earth ponds (0.02-0.2 hectares).
In spite of the great potentials of fish farming in Nigeria, Nigeria is still unable to bridge the gap in the short fall between total domestic fish production and the total domestic demand. In Nigeria, total domestic fish production is far less than the total domestic demand. According to Zango-Daura (2000), as cited by Rahji *et al* (2001) the country requires 750,000 tons of fish annually while domestic production amounted to 350,000 tons. Importation is thus often used to bridge the fish supply-demand gap. FDF (2008) reported that the quantity of fish imported in Nigeria increased from 557, 884.00 tons to 739,666.12 tons between 2000 and 2007. The amount of foreign exchange on fish importation also increased from ₦ 48.3 billion in 2000 to ₦ 115.88 billion in 2007. In 2008, 681 metric tons was imported into the country. This constitutes a huge avoidable drain of Nigeria's scare foreign exchange.
FAO recommended minimum fish consumption rate of 12.5 Kilograms per head yearly to satisfy basic protein needs (Zango-Daura, 2000). For Nigeria to meet this recommendation, policy actions geared towards improving domestic productions by providing solution to factors militating against aquaculture in the country are required. It is against this background that this study was undertaken to determine the factors affecting fish production in the study area to encourage participation

METHODOLOGY
The study was conducted in Ikot Ekpene Local Government of Akwa Ibom State. The area is located between latitude 5^0 10' and 5^0 30' North of the Equator and longitude 7^0 30' and 7^0 45'.The local government is bordered on the East and North by Obot Akara Local Government Area on the west by Essien Udim Local Government Area and on the South by Abak and Uyo Local Government Areas of the State. The annual precipitation ranges from 200- 300mm per annum. This rainfall regime received in most parts of the State encourages farming throughout the year. There are available local feedstuffs that could be compounded for fish feed. The area has a total land mass of 305km^2 and population of over 145,077 people (NPC 2006) in five clans and 91 villages.
Data Collection: Data was collected by the use of structured questionnaire administered to fish farmers in the study area. Multi-stage random sampling technique was used to select towns, villages and respondents. Firstly, four clans (Utu EdemUsung, IkotObongErong, Ifuho and IkotAbia Idem) were randomly selected out of the five

(5) clans in the area. In the second stage, two (2) villages were randomly selected from each of the clans. Lastly, ten (10) farmers were randomly selected from each of the selected villages. This gave a total of eighty respondents. **Analysis procedure:** Descriptive statistics (Tables and percentages)was used to analyze socio-economic characteristics of the respondents. Multiple regression analysis was used to determine the factors that affect output of fish farmers. The multiple regression model is stated thus: $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, ei)$. Four functional forms of the model are explicitly represented as follows: Linear: $Y = a+b_1X_1+b_2 X_2+b_3X_3+b_4\log X_4$-----+ei; Semi Log: $Y=a+b_1\log X_1+b_2\log X_2+b_3\log X_3+b_4\log x_4$-----+ei; Double Log:Log Y= $a+b_1X_1+b_2X_2+b_3 X_3 +b_4 \log X_4$ -----+e. Where Y= Output of fish produced (kg); bo = constant; b1-b7 = coefficients to be estimated; X_1 = Age of the farmer (years); X_2=Stock Density (number of fish per period size); X_3 = Feed used (kg); X_4=Labour (Md); X_5= Educational Level (in years); X_6=Farming Experience (years); X_7= Gender and ei = error term.

RESULTS AND DISCUSSION

Table 1shows the socio- economic characteristics of the respondents. The table indicated that 85% of the respondents were males. This indicates that fish farming is a male dominated activity. Result is in consonance with Oladoja *et al* (2008) who assert that fish farming is a male dominated activity. Majority (72.5%) of the farmers fall between the ages of 31-50 years, indicating that most of them are within the economically active population and therefore constitute a good labour force for fishery enterprise with the expectation that they would be good managers of limited available resources (Amazan *et al*,2000). Married people participated more (68.75%) in fish farming than singles, Divorced, Widows and widowers. Oladoja *et al* (2008) asserted that marriage confers some level of responsibility and commitment on individual who are married. About 92.5% of respondents acquired formal education. Education increases the farmers' production through evaluation and adoption of new production techniques (Amazan and Olayemi, 2000). Data on production experience shows that 63.75% of farmers have above ten years production experience and are expected to have acquired skill in fish farming and should have better approaches to fish farming business. Daramola and Olorunfemi (2004) reported that farmers count more on their farming experience than educational attainments in order to increase their efficiency. About 40% of respondents used both family and hired labour in production.

Table 2 shows result of regression estimates of the determinants of fish production in the study area. Semi- log functional form was chosen the lead equation based on the high R^2 estimate, number of significant variables and agreement with a priori expectation. The R^2– value of 0.636 implies that about 63.6% of the variation observed in fish production was explained by the independent variables included in the model, while the remaining percentage was due to error term. F-value 2.501 was also highly statistically significant at 1% probability level indicating goodness of fit of the model. Coefficients of stock density(X_2), feed used (X_3), labour (X_4), educational level of the farmer (X_5) and farming experience (X_6) had positive signs and were significant at 5% level of probability. This implies that a one unit increase in any of these variables will result to an increase in output by a corresponding coefficient of the variable. Result is in line with a priori expectations and supports findings of Olawumi *et al* (2010).

Information on production constraints was presented in Table 3. High cost of quality fish feed and unavailability of quality fingerlings were the major problems that affected fish farming in the study area. Most feed used by the farmers were brought in from other states and were formulated. This increased the cost of feed. There were few hatcheries that produce fingerlings in the L.G.A. Some fingerlings were brought from outside the area at a high cost. Insufficient capital and poor storage facilities were reported by 82.5% and 85% respectively. Most of the farmers source their credit from their personal savings, local money lenders, friends and relatives. Banks are often reluctant to deal in agricultural credit because of inherit risk and prospect of loss of investment. Preservation problems create seasonality scarcity and price instability. Finding is consistent with Adedeji and Owoigbe, (2005) who also observed preservation and marketing to be major problems in fish marketing and distribution in Nigeria. These problems constitute hindrance to farmers and invariably lead to increase in production cost and generally reduced their revenue.

CONCLUSION AND RECOMMENDATIONS

Stock density, quantity and quality of feed used, labour, education level and farming experiences were found to have positive and significant effect on fish production. High cost of feed, unavailability of quality fingerlings, insufficient capital and poor storage facilities were the major problems of fish production in the study area. Based on findings of the study, the following recommendations were made.

1. There is need for establishment of modern fishery hatcheries by the government in the area for supply of quality fingerlings
2. Government and private investors should establish feed mill in the area to reduce the cost of feed.
3. Credits should be made available to farmers through Micro-finance banks, Agricultural cooperative banks and other government agencies at reduced interest rate.
4. Provision of good storage facilities where the perishable fish can be stored. This will also help in stabilizing the price of fish in the area.

Table1: Socio- Economic Characteristics of Fish Farmers

Variable Frequency-		Percentage
Gender		
Male	68	85.
Female	12	15
Age		
20-30	10	12.5
31-50	20	25.5
41-50	38	47.5
51 and above	13	15.2
Marital status		
Single	8	10.0
Married	55	68.75
Divorced	6	7.5
Widow	7	8.5
Widower	4	5.0
Education		
No formal education	6	7.5
Primary	20	25.0
Secondary	44	55
Tertiary	10	12.5
Farming experience		
1-5	11	13.11
6-10	18	22.5
11-15	84	42.5
16 and above	17	21.25
Source of labour		
Family + friends	28	35.0
Family	22	27.5
Hired	20	25.0
Communal	10	12.5

Source: Field data, 2014

Table 2: Regression Estimates of Determinant of Fish Output in the Study Area

Variables	Linear	Exponential	Double log	Semi log
Constants	4.527	8.484	7.914	8.759
	(8.766)***	(11.961)***	(7.964)***	(8.451)***
Age (years)	0.268	-064	-0523	-0.083
	(1.443)	(-1.965)	(-1.631)	(-1.556)
Stock density	-0.239	-0.457	-0.720	0.739
	(-1.456)	(-1.520)	(-2.146)***	(1.921)**
Feed used (kg)	-0.168	0.116	0.345	0.209
	(-1.132)	(0.419)	(1.060)	(1.772)**
Labour (Md)	0.025	0.032	0.042	0.041
	(1.296)	(0.964)	(1.211)	(1.724)**
Educational level	0.380	0.064	0.083	0.307
	(2.997)***	(0.288)	(0.337)	(1.826)**
Farming experience	-0.017	-0.107	_0.150	0.097
	(-0.612)	(-0.662)	(_0.808)	(2.531)**
Gender	0.842	0.522	0.269	0.039
	(4.027)***	(1.616)	(1.003)	(0.157)
R2	0.436	0.462	0.332	0.636
F-value	7.955***	3.654***	3.114***	5.201***

Source: Field survey, 2015

** and *** implies significant at 5% and 1% respectively. The values in parenthesis are the t- values

Table 3: Constraints associated with fish production in the study area.

Problems	Frequency*	Percentage
Insufficient capital and poor access to credit	66	82.5
Unavailability of quality fingerlings	69	86.5
High cost of quality fish feed	78	97.5
High cost of labour	33	41.25
Poor storage facilities	68	85.0
Market price fluctuation	34	42.5
Water supply during dry season	37	46.25
Pest and diseases	19	23.75
Poor road network	10	12.5

*= Multiple responses
Source: Field survey, 2015

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LAND TENURE SYSTEMS AND TECHNICAL EFFICIENCY FARMERS IN NIGERIA

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ABSTRACT
This study examined the effects of land tenure systems on technical efficiency of farmers in Nigeria using stochastic frontier model. The data were obtained from 1381 farmers that cut across 36 states in Nigeria. The data were extracted from General Household Survey (GHS 2013). The results showed that the average technical efficiencies of farmers operating under communal, purchase and leasehold land tenure systems were 89.36%, 3.48% and 7.16% respectively. The results also showed that. Farm size, fertilizer were responsible for inefficiencies among the farmers
Keywords: Land tenure systems, technical efficiency, stochastic frontier, Nigeria

INTRODUCTION

Nigeria is the largest country in West Africa and the most populous country in Africa. It is eight most populous country in the world with a population of over 160 million (NPC, 2006).At present the nation is still grossly an agrarian society. About 60% of the workforce is employed in the agricultural sector, which largely dominated by the subsistence non-commercial farming. Several land tenure systems had been operated in various regions of Nigeria from the colonial era to the promulgation of the Land use Act in 1978. The pre-colonial LandSystem in Nigeria is characterized by appropriation and adjudication by might of warfare, occupation and rulership in which princes and religious adventurist carved out dominion for their followers and communities. Community and warlords had great influence in the administration of the land for communal living, farming and grazing purposes. In the Northern part, as the predominantly nomadic Fulani rare their cattle over large expanse of Land they found settlement and markets (as they move) without defining boundaries for any group of communities or settlements (Mabogunkeand Oguntoyinbo, 1997, Adedeji2006). In Southern Nigeria, land was held by the community, village or family,particularly extended lineage with individual having only usufructuary rights by virtue of their membership of the group.

The introduction of freehold in the Southern states and the consequence economics development resulted in land becoming an economics commodity and the evolvement of many and varied interest of rights in land. Subsequently, ownership of Land especially in urban areas becoming a great economic venture and speculators made it very difficult for other Land users and even various government and their agencies to acquire Land for development purposes (Atilola, Fajemirokkun 1979).

In an attempt to halt the contrasting land tenure system, the country and the attendant litigations, fraudulent practice, and difficulties being experienced by various governments in accessing Land for public good that the Federal Military Government promulgated the Land use Decree (now Act) of 1979. The philosophy of the Act is encapsulated in the preamble,which goes thus: "whereas it is in the public interest that the rights of all Nigerians to the land of Nigeria be asserted and preserve by law and whereas it is also in the public interest that the right of all Nigerians to use and enjoy Land in Nigeria and the natural fruit thereof in sufficient quantity to enable them to provide for sustenance of themselves and their families should be assured, protected and preserved" (Federal Republic of Nigeria, 1978).

The Land use Act with all its potentials and promises to transform the land tenure system in the country did not work as intended for various technical, institutional and social reasons and lack of sincerity and political will on the part of various government to implement the Act (Fabiyi 1978a)

The philosophy of the Land use Act that all Land belong to the state and should be held in trust by the governor for the people, and that undeveloped Land has no value, constitute a great obstacle to the development of the dynamic market Land economy and therefore needs surgical review for the current initiatives of unlocking the commercial potential of Land in Nigeria to be realized. It is the current dysfunctional nature of Land administration dynamics in Nigeria and concerns arising from its unproductive nature as noted here in call for the need to provide a better strategy that make Land administration work and provide benefits to all citizens in Nigeria. Emanuel *et al* (2014), Bugri (2008), Ubink and Quan (2008) observed that economic development will be stagnated in countries and societies where land tenure systems did not evolve properly to accommodate changes in agriculture, industry and services. It is against this background that the study was set out to estimate the effect of land tenure system on the farmers' level of technical efficiency in the country.

METHODOLOGY

The present study employed stochastic frontier analysis to examine the effects of land tenure system on the technical efficiency of farmers in Nigeria. The analysis involves three in first, the parameter of the production function are estimated simultaneously with that of an inefficiency model, in which inefficiency effects are specified as a function of variables such as land tenure system and other socio economic characteristic of the farmers.

$$L_n y = f(x_{ij}, \beta)^{e(\phi - n_i)}, U = \phi_i - \eta_i and i = 1,2,3...N; \; j = 1,2...j ....(1)$$

Where Iny denotes the output of the ith farm

X_{ij}(i = 1,2,….N; j= 1,2….j) represent a(1 ∗ K)

Vector of inputs and β is (K X I) vector of the unknown parameters to be estimated. Equation (1) is linearized by taking the natural logarithm of both sides and manipulating the relevant terms to give

$$\ln Y = \alpha = \sum_{j=i}^{j} \beta \ln x_j = \phi_i - \eta_{i,} u_i = \phi - \eta_i ....(2)$$

here ϕ is the systematic random error that accounts for measurement error and other factors that are not under the control of household and η_i denotes the asymmetric non-negative random error component that measures technical inefficiency effects. The systematic random error variable ϕ is assumed to be independently and identically distributed with zero mean and variance σ^2 (Coelli, 1995). The non-negative variable η_i is assumed to be independently and identically distributed with zero mean and truncation (at zero from below) of the N ($\sigma^2\eta_i$) distribution (Coelli, 1995). Moreover ϕ and η_i are assumed to be independent of each other and also independent of the input, X_j. The variance parameter of the model are parameterized as in (3)

$\sigma^2 = \sigma^2\phi + \sigma^2\eta, \gamma = \sigma^2\eta/\sigma^2\mu$ and $0 \leq \gamma \leq 1$ …………(3)

The technical efficiency of farm denote by TE_i can be estimated as

$$TE_i = \frac{R_i}{R_i^*} = \frac{f}{f} \frac{(x_{j,} \beta)^{e(\phi - \eta)}}{(x_{j,} \beta)^{e(\phi_j)}} = \quad \ell^{-\eta_i} \text{ (so that } 0 \leq \gamma \leq 1 \text{ ....(4)}$$

RESULTS AND DISCUSSION

The choice of truncated was based on variance (σ_r) which is 229.0842 for truncated and 3.40699 for half normal distribution. Also the likelihood for normal is less than that of truncated distribution-1460.0806 and -1459.0516.The decision rules is that the distribution with small variance and higher likelihood will be the lead equation

The variance δ^2 and γ (gamma) are 229.084 and 0.999.This can be interpreted that 99% of the variation in output among farmers in Nigeria are due to the difference in technical efficiency for the distribution. They are significant at 1% level, the sigma square δ^2 indicates the goodness of fit and correctness of the distribution form, assumed that the systematic influences that are un-explained by the production.

Fertilizer was significant at 1% and positively correlated with farm size. The coefficient of 0.509246 indicated that 1% increase in fertilizer would increase the farm output by 49% in Nigeria. The result was in agreement with Donkoh *et al*.(2013), who observed a positive relationship. The findings concur with those by Everson and Mwabu (1998) that demonstrated positive and significant relationship between fertilizer used and productivity. Farm size was significant at 1% level and positively related to output. This indicates that percentage increase in farmsize will increase productivity by 0.2734.

The coefficient of farm size (B_3) was found to be positive and significant at 1% level. The result is in line with the findings from Okike's (2000) study of farmers in the savanna zone of Nigeria reported farm size to be significant and positive for low-population-high market domain. The result could mean that it is possible to expand farming activity in the study area.

Statistically, the magnitude of the coefficient of farm size shows that output is inelastic to land or farm size. If the farm size is increased by 1%,output level will improve by less than proportionate (by margin of 2.72%).This means that there is still some scope for increasing output per plot by expanding farm land.

Fertilizer (β_1).The production elasticity of output with respect to quantity of fertilizer is 0.50925.By increasing the quantity of fertilizer by 1%, output level will improve by margin of 5.091%.The estimated coefficient is highly significant at 1% level. The finding is variant with the report by Winrock (1992), which showed a non significant contribution of the livestock manure and crops residues in semi-arid sub-Saharan. Though not certain, it may be possible that non separation of fertilizer into their different forms e.g crop residue, livestock manure, inorganic fertilizer etc) account for the difference in the findings of this study and as reported by Winrock (1992).

Coefficient of labour was not significant and had a negative sign. Labour is expressed as person-days and is the summation of family labour and hired labour. It is expected that labour will positively influence the level of output. This is in contrast with Okike, (2000), and Awoyemi, (2000) that shows the importance of labour in farming, particularly in developing countries where mechanization is only common in big commercial farms.

The result of technical mean scores of land tenure system (Figure 1) revealed that purchases are more technically efficient (0.667) than communal (0.298) and leasehold (0.521). Those, who rented were more likely to invest in short term land improvement measures, since they would benefit in the short run. Farmers who rent lands have to make little effort to break even and pay for their rent charges. The farmland owners had acquired their land through the family marriage inheritance or as gift. This confirms that most of the land belonged to family (particularly the family head). This implies that, when a man dies and his properties including farmland are inherited by his next of kin. The law of inheritance is central to most small-holder farmers and this relates to problems stemming from land partition and fragmentation. To this end, Fabiyi (1978) has advocated the formulation of cooperatives by the farmers so as to enjoy the economies of large scale production. According to Idowu (1990) reported FAO 1969 that the tenure arrangement affect agricultural productivity in many ways. Leasing is also common practice under this system that is the landlord (lessor) conveys or allows to be conveyed, his right of use and possession of land to tenant (lessee) for a definite period of time, during which a certain amount is paid (Famoriyo, 1979)

CONCLUSION

The study examined the effect of land tenure system on the resource use productivity and technical efficiency in Nigeria. Various level of efficiency were tested under various land tenure system and concluded that farmer are technically inefficient in Nigeria. However, farm size and fertilizer tends to influence production efficiency in Nigeria. Higher inefficiency is associated with the socio-economic characteristics of the respondents. Farm size , fertilizer are major production factors that influence agricultural productivity in Nigeria It is therefore worthy to mention that the recommendation of land reform committee in Nigeria should be follow to the letter to enhance adequate distribution of land to serious minded famers; this will promote efficiency in Nigeria agricultural sector.

Table 1: Estimates of Cobb-Douglas Stochastic Production Frontier of Farmers in Nigeria

Variable	Parameter	Coefficient	Standard error	Z- statistics	P>(Z)
Constant	β_0	6.19055	0.370716	16.72	0.000***
Fertilizer	β_1	0.5092456	0.0355627	14.32	0.000***
Labour (Man/day)	β_2	-0.033513	0.44142	-0.81	0.418
Farmsize (ha)	β_3	0.2721779	0.0255428	10.66	0.000***
Chemical (litres)	β_4	-0.0038309	0.0320439	0.12	0.905
Observation		848			
Log likelihood	-1459.0516				
Sigma square	229.0842		316.4125		
Gamma	0.99945132		0.0075907		
Sigma u^2	227.8272		3164107		
Sigma V^2	1.256935		0.1269424		

Source: author computation
*** are significant level at 1%

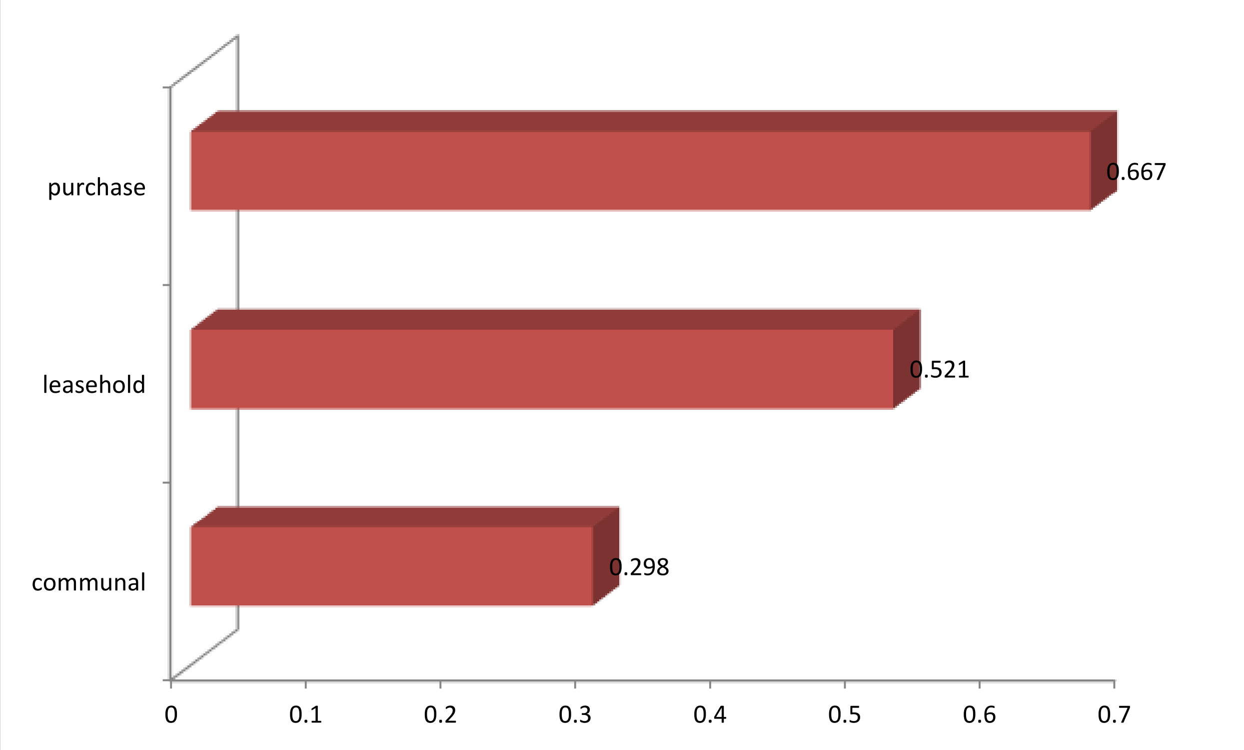

Fig 1: **TE Mean Scores of farmers by Land Tenure System**

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COST AND RETURNS OF MARKETING POULTRY FEED (TOP FEED) IN AFIKPO EBONYI STATE, NIGERIA

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ABSTRACT
The study was to assess the cost and returns of marketing poultry feed in Afikpo, Ebonyi State. Data for this study were collected from activities of poultry feed marketers for the year 2015. The data were collected using structured questionnaire. Twenty (20) feed marketers purposively selected, were administered with questionnaires. Data collected were on socio-economic characteristics, cost and returns, and problems associated with feed marketing. Percentages were used to describe the socio-economic variables and problems associated with feed marketing. While marketing margin analysis were used to determine market performance. Major findings revealed that majority of respondents (75%) were male and literate (35% and 40% respectively). While over 40% have between 6 – 10 years marketing experience. The percentage marketing margin for starter, grower and finisher mash were 12.72, 16.67 and 9.26 respectively. This indicates that, marketers obtained 12.72%, 16.67% and 9.26% of the final sales which was paid by the consumer. Major problems faced were inadequate capital, high cost of transportation and feed spoilage. The study recommends provision of soft loans to marketers, storage facilities and periodic road maintenance to ease vehicular movement.
Keywords: Cost, Returns, poultry feed, marketing, market margin.

INTRODUCTION

Nigeria with a population of over 140 million people is Africa's most populous country and agriculture is the centre of activity of her people (Ugwu, 2009). The poultry industry is currently one of the most important agribusiness enterprise that has a great potential for providing additional income to our farming community and educated unemployed persons of the rural areas through creating self employment opportunities (Ahmed and Hamid, 1992). The value of the annual output of the commercial poultry sector was estimated at about N170billion naira (Adene and Oguntade, 2006), hence poultry production is one of the important subsectors in the Nigerian economy (Rahman and Yakubu, 2005).

In addition to its contribution to the Gross Domestic Product (GDP) and provision of employment opportunities, poultry production is a major source of protein in the country (Ohajianya *et al*, 2013). Poultry is found to be one of the most nutritious and most complete food known to man as it provides a means by which rapid transformation of animal protein intake can be achieved (Murtala *et al*., 2004).

Despite the nutritive value of poultry meat, its production in the country is grossly inadequate as reflected in the wide gap between demand and supply of the product. This could be attributed to numerous problems that poultry farmers in Nigeria are facing. These problems include low capital base, inefficient management, diseases, poor housing, poor quality of day old chicks (DOC), and high cost of feeds (Alabi and Isah, 2002, Bamgbose *et al*., 1998).

Poultry feed is a kind of balanced livestock feed which aid proper development of chicks and pullets and hence used for feeding the domesticated birds such as chickens, turkeys, ducks, geese, etc that serve as a source of eggs and meat (FAO, 2012). It is a major component of any livestock production enterprise as it accounts for an average of 60 – 70 percent of cost of production (Taiwo, 1989; Mafimisebi, 2002; Unang, 2003 and FAO (2012).

The commercial poultry sector in Nigeria is feed dependent and requires about 1.87 million tones of feed per annum (Adene and Oguntede, 2006). Current high prices of poultry feed coupled with occasional scarcity calls for improvement in the efficiency of producing and marketing poultry feeds.

Recently, there has been a surge in poultry business especially in Afikpo, Afikpo North Local Government Area, of Ebonyi State. This is due to government agricultural support programmes which encourages civil servants and others to go into agriculture coupled with the recent ban on importation of frozen chicken in Nigeria by Federal Government. Despite government intervention programmes, the production output of this industry has been hampered by insufficient, irregular and lack of adequate feed supply (Okonkwo, 2013).

Markets and marketing activities are very essential for the distribution of poultry feed to the final consumers. Poultry feed marketing is a crucial human invention. It embraces the activities engaged in order to satisfy the economic needs and wants of the people. Hence,feed marketing encompasses all business activities which direct the smooth flow of feed between producers, wholesalers, retailers, and consumers so as to accomplish the producer's objectives (Girei *et al*; 2013). According to Rewoldt (1977), marketing can better be described as those activities involved in getting goods and services from the producers to the consumers. As the economy grows agricultural marketing will become more and more complex and its efficiency will depend on the managers of the marketing system who themselves must be well informed about what is takes to have efficient marketing system. Since poultry feed accounts for about 60 – 70% of the cost of commercial poultry production, an assessment of the cost and returns of poultry feed marketing in the study area.

i. What are the socio-economic characteristics of poultry feed marketers?
ii. What were the cost and returns associated with poultry feed marketing?
iii. What were the constraints associated with poultry feed marketing?

METHODOLOGY

The study was carried out in Afikpo, Ebonyi State. Afikpo has a land mass of 164sqkm, with an estimated population of 156,611 based on 2006 census. It lies between latitude $5^0 89^1$N and longitude $7^0 94^1$E (NPC, 2006). Their predominant occupation is farming which encompasses fishing, cropping and farming, the inhabitants also engage in various other occupations such as civil service, trading and commerce. The population of the study was made up of all the poultry feed marketers in the area. Twenty (20) poultry feed marketers were purposively chosen because they constitute major marketers. The study made use of primary data. Primary data were obtained from poultry feed marketers with the use of structured questionnaires.

Both descriptive (frequency, percentage and mean) and inferential statistics (Marketing margin and percentage market margin) were used for analyzing the data generated from the study. Marketing margin analysis was used to measure market performance of the feed marketers. Adekanye (1988), defined marketing margin as the difference between the price consumers pay and the price the producer get.

$$MM = CP - MP$$

$$\%MM = \frac{CP - MP}{CP}$$

Where:

MM	=	Market Margin
%MM	=	percentage Market margin
CP	=	Consumer Price
MP	-	Market Price

RESULTS AND DISCUSSION

Cost – Returns Analysis of Poultry Feed Marketing

Table 2 presents the cost and returns associated with feed marketing. Marketing margin and percentage market margin was used respectively to determine profit and market performance. The result showed that the market margin for 1 bag of poultry feed sold, for starter, grower and finisher were N200, N270 and N120 respectively. While the percentage market margin was 12.72, 16.67 and 9.26 for starter, grower and finisher respectively. This means that for every bag of poultry feed sold, 12.7%, 16.67% and 9.26% is what accrues to the marketers, while the remaining 87.28%, 83.33% and 90.74% goes to the producer.

Constraints Associated with Poultry Feed Marketing

Constraints associated with poultry feed marketing in the study area during the period under review includes; capital, transportation, price fluctuation, and spoilage.

Analysis as shown in Table 3 revealed that 40% of the respondents indicated inadequate capital as their major problem. According to Maianguwan, (2013), insufficient access to capital forces the poor to engage in less productive farm and non-farm enterprises, thus forgoing income. Similarly, about 25% of them reported high transport cost. While others complained of price fluctuations which accounted for 20%, with spoilage constituting 15%.

CONCLUSION

Despite the various constraints experienced in the study area, poultry feed marketing was identified as a profitable venture. However, the profit margin can be improved if consideration is geared towards addressing all the identified constraints that tends to increase the marketing cost and thereby causing losses to the trader. High transportation cost, inadequate capital, price fluctuation and spoilage of feeds were identified as problems faced by the marketers.

The study recommends that government and other lending agencies should do more and assist the marketers with accessible and affordable soft loan in order to reduce the problem of inadequate capital. High transport fares and bad roads should be address in order to improve, sustain and make the business more attractive.

Table 1: Analysis of Marketing Margin for poultry feed (1 bag)

Starter Mash	Amount (₦)	Growers Mash	Amount (₦)	Finisher Mash	Amount (₦)
Cost of feed	2,400	Cost of feed	2,000	Cost of feed	2,450
Transport Cost	100	Transport Cost	100	Transport Cost	100
Cost of Loading	10	Cost of Loading	10	Cost of Loading	10
Cost of off loading	10	Cost of off loading	10	Cost of off loading	10
Security Cost	5	Security Cost	5	Security Cost	5
Sanitation Cost	5	Sanitation Cost	5	Sanitation Cost	5
Selling Price	2,750	Selling Price	2,400	Selling Price	2,700
Total Cost of marketing	2,530	Total Cost of marketing	2,130	Total Cost of marketing	2,580
Net Margin	220	Net Margin	270	Net Margin	120
% Market margin	12.72%	% Market margin	16.67%	% Market margin	9.26%

Summary of Marketing Margin Analysis of Poultry Feed Marketing in Table 1

Poultry Feed Top feed	Marketing margin (₦)	Percentages marketing margin
Starter mash	220	12.72
Grower	270	16.67
Finisher	120	9.26

Source: Market Survey, 2015.

Table 2: Distribution of responds according to problems of poultry feed marketing

Problems	Frequency	Percentages
Capital	8	40
Transport	5	25
Price fluctuation	4	20
Spoilage	3	15
Total	**20**	**100**

Source: Market Survey, 2015.

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ECONOMICS OF OKRA MARKETING IN IVO LOCAL GOVERNMENT AREA, EBONYI STATE, NIGERIA

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ABSTRACT
Economics of okra marketing in Ivo Local Government Area in Ebonyi State was studied. Percentage response, marketing margin and marketing efficiency were used to address the objectives. The result showed that marketers were inefficient in marketing margin but efficient in marketing efficiency. The major constraints to okra marketing for the marketers were multiplicity of okra sellers, commission agent and credit problems. Therefore, there are needs to improve marketers' access to credit provision of improved storage facilities and control the activities of commission agents by government.

Keyword: Economics, Okra, Marketing

INTRODUCTION
Agricultural marketing according to Arene, (2002) include all those legal, physical and economic services that make it possible for produce to get to consumer at the price agreeable to producers and consumers for the change of ownership and possession. Marketing occupies a significant position in an exchange economy, especially in areas where increasing commercial activities and high rate of urbanization exist (Essien and Essien, 2010).Okra is rich in vitamins A. B and C, 86% moisture, 9.7% carbohydrate, 2.2% protein, 10% Fibre, 0.2% Fats and 0.9% Ash . Anuebunwa, (2004); reported that immature okra pod is used for human consumption, treatment of ulcer, salad dressing, as substitute for coffee and matured types is stored for next season planting material (Tiamiyu *et al*, 2010). Apart from dietary importance, okra provides employment for different categories of people in the areas of production, processing and marketing (Eke *et al*, 2005). The marketing of okra is limited by high cost of transportation, seasonality of supply, inadequate credit facilities, price fluctuation and perishability of the commodity (Anuebunwa; 2006).In spite of the importance of okra in the study area, no significant studies had been carried out in the activities surrounding the marketing in the area. The specific objectives were to determine the marketing margin and efficiency of okra marketers and to identify the constraints of the marketers

MATERIALS AND METHODS
Ivo Local Government Area (LGA) of Ebonyi State, Nigeria was the study area and located between Latitude $5^1 – 55^0$, $6^1 – 55^0$ North of equator and Longitude $7^1 – 31^0$, $7^1 – 46^{0-}$ East Greenish Meridian. The annual rainfall is 1200 – 1600mm and the relative humidity of 88%. The LGA has many towns, villages and markets. The data needed to carry out this project were obtained through the use of primary sources. The primary source was collected through the use of structured questionnaires and oral interview administered to the respondents (Wholesalers and Retailers). Multi-stage random sampling technique was used to select markets and marketers. In the first stage, a random selection of two markets Eke Ishiagu and Ngwo Agharagu Market out of the three markets. In the second stage, from each market 25 wholesalers and 25 retailers were randomly selected. A total of 100 respondents were selected. The part of objective (i) and (ii) were captured using descriptive statistic such as percentage. Objective (i) was captured using marketing margin.

$$\text{Wholesaler Marketing Margin} = \frac{Selling\ Price - Purchase\ Price}{Selling} \ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\text{Retailers Marketing Margin} = \frac{Selling\ Price - Purchase\ Price}{Selling} \ldots\ldots\ldots\ldots\ldots \quad .(2)$$

The Objective (ii) was addressed marketing efficiency

$$\text{Wholesaler Marketing Efficiency} = \frac{Marketing\ Benefit\ X\ 100}{Marketing\ Cost} \ldots\ldots\ldots\ldots\ldots \ (3)$$

$$\text{Retailers Marketing Efficiency} = \frac{Marketing\ Benefit\ X\ 100}{Marketing\ Cost} \ldots\ldots\ldots\ldots\ldots (4)$$

RESULTS AND DISCUSSION

Table 1 shows that wholesalers had selling price of ₦93, 600 while the retailers ₦78,400. The purchasing price of the wholesalers and retailers is ₦69, 900 and ₦58, 900 respectively. The wholesalers and retailers had marketing margin of 0.25 each. This implies that both wholesalers and retailers were inefficient since the value is less than 1. Marketing efficiency is marketing benefit divided by the marketing cost multiply by 100. The marketing benefit is selling price minus purchasing price which is equal to ₦23, 700 and ₦19, 500 for wholesalers and retailers respectively as contained in Table 2. Table 2 shows that the total marketing cost was ₦59, 980 for wholesalers and ₦25, 280 for retailers. Among the cost items considered wholesalers showed that transportation was the highest (26.00%). This finding is in line with Tiamiyu (2009) who reported that high transportation cost could be associated with poor road network in most rural areas.

For the retailers, material cost (48.42%) was the highest. Materials which include baskets, basins, and bags are limited in supply compared to demand. However, the marketing efficiency is 39.51% for wholesalers and 77.14% for retailers. This implies that both wholesalers and retailers of okra marketing were efficient in the study area.

Table 3 revealed that multiplicity of okra sellers was the highest (100%) constraint for wholesalers and retailers respectively. This is because of the law of supply which states that; the more the number of suppliers, the lower the price of goods. Okeke, (1986); agrees with this assertion. Bulkiness of okra affects its transportation. This was reported by 96% and 80% of wholesalers and retailers respectively. Furthermore, 90% of respondents, (both wholesalers and retailers) reported on poor access to credit. Credit is needed to offset marketing costs Nwaru, (2004) made a similar assertion.

The problem of commission agents was complained by 56% of the wholesalers and 20% of the retailers. Their financial extortions increased marketing costs, subsequently causing reduction in profit (Okeke, 1986).

CONCLUSION AND RECOMMENDATIONS

The study concluded that okra marketers had high marketing margin but very low marketing efficiency. Also, multiplicity of okra sellers, nature of okra, poor access to credit were the major constraints to okra marketing. The result of marketing margin was inefficient while marketing efficiency were efficient for both wholesalers and retailers. Based on the results, the following recommendations were proffered; there is need to improve marketer's access to credit and an improved storage facility to reduce post harvest loses. There is need to checkmate the excesses of commission agent fee by the appropriate authority.

Table 1: Distribution of Respondent According to Marketing Margin

Items	**Values**	
	Wholesalers (N)	**Retailers (N)**
Selling price	93, 600	78, 400
Purchasing price	69, 900	58, 900
Marketing margin value	0.25%	0.25%

Source: Field Survey, 2015

Table 2: Distribution of Respondents according to Marketing Cost

ITEMS	**WHOLESALERS**		**RETAILERS**	
	Value (N)	**(%)**	**Value (N)**	**(%)**
Transportation	15, 600	26.00	1, 330	5.26
Loading	1, 050	1.75	-	-
Off – loading	1, 300	2.17	-	-
Communication	1, 260	2.10	600	2.37
Commission	3, 170	5.29	900	3.56
Sanitation	5, 000	8.34	850	3.36
Cost of feeding	10, 350	17.26	8,300	32.83
Cost of grading	990	1.65	-	-
Cost of processing	8010	3.35	860	3.40
Security	900	1.50	200	0.79
Material cost	13, 250	22.00	12, 240	48.42
Total	59, 980	22.28	100	100

Source: Field Survey, 2015

Table 3: Distribution of Respondents according to Constraints to Okra Marketing

Variables	WHOLESALERS		RETAILERS	
	Frequency	(%)	Frequency	(%)
Access road to market	31	62	37	74
Commission Agent	28	56	10	20
Multiplicity of Okra Sellers	50	100	50	100
Bulkiness of Okra	48	96	40	80
Lack of Storage facilities	40	80	35	70
Poor access to credit	45	90	40	8

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ANALYSIS OF INCOME AMONG FADAMA III ROOT AND TUBER CROP FARMERS IN CENTRAL STATES, NIGERIA

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ABSTRACT
This study examined the income of Fadama programme among root and tuber crop farmers in central States of Nigeria. A multi-stage sampling procedure was used to select 934 farmers with 427 respondents from programme participants and 507 respondents from the non-participants. Primary data were collected on socioeconomic variables, (age, and educational level, farm size, farming experience and non-farming activities of the respondents); input – output of participants and non-participants using structured questionnaires and interview schedules. Data collected were analyzed using net farm income analysis. The result of net farm income (NFI) for Fadama III root and tuber crop participants and non-participants before programme intervention is ₦268,195.04 /Ha and ₦287,768.09 /Ha respectively before the programme intervention, while the net farm income after the programme intervention is ₦639,584.75,584.75 and ₦511,515.40/Ha for participants and non-participants respectively. The change in income is 50% and 38% for participants and non-participants respectively while the change in net farm income (NFI) was 58% and 44% for participants and non-participants respectively. Z-statistics analysis shows that the income of Fadama III programme participants is significantly different from the non-participants. The problems encountered by the farmers in the study area are high cost of input, limited finances, bad roads, low produce prices, inadequate fixed inputs, poor marketing practices, high cost of labour, poor storage facilities, and non-availability of water and shortage of fertilizer. The study recommends that farmers should be advised through the Agricultural Development Programme of Benue, Kogi and Plateau States on how to allocate and the use of their resources in other to enhance their net farm income, there is the need for the National Orientation Agencies at both federal and state level should embark on vigorous enlightenment programme , farmers are encouraged to form cooperative societies to enhance bulk purchase of input which will reduce input cost and ensure timely supply of same, high costs of inputs were identified as a problem in root and tuber crop production and there is the need for policy makers to pursue opportunities for regional cooperation in international input procurement and to facilitate privatization and competition in input distribution.
Key words: Income, Fadama III programme, root and tuber crops, Participants, Central States, Nigeria.

INTRODUCTION
In Nigeria, despite agricultural policies and strategies, food insecurity remains a fundamental challenge (.Machethe, 2004). For instance, although agriculture remains a key component of the Nigerian economy, contributing about 37% of GDP and employing about 70% of the active population, it receives less than 10% of the annual budgetary allocations (Adebayo and Okunneye, 2005). As a result, the agricultural sector has significantly underperformed given its vast potential (Machethe, 2004). Consequently, Nigerian agriculture has failed to supply sufficient food in quantity and quality to feed the constantly growing population. Therefore, the level of food insecurity in Nigeria has continued to increase steadily since the 1980s.Raising agricultural productivity, reducing food insecurity and poverty is an important policy goal for concerned government since agriculture plays a major role in the economy of many developing countries, as it is a significant source of nourishment for citizens and a means of livelihood for the most vulnerable members of this country (Adewuyi, 2002). Increasing agricultural productivity requires one or more of the following; an increase in output and input with output increasing proportionately more than inputs; an increase in output while inputs remain the same; a decrease in both inputs and output with input decreasing more; or decreasing input while output remains the same (Adewuyi, 2006; Oni *et al*, 2011) Increasing inputs in order to expand output involves raising both the quality and quantity of inputs, examples of which will include the mechanization of agricultural processes, use of high yield varieties of crop seeds or planting materials, use of fertilizers, irrigation in areas where rainfall is inadequate, and the use of agrochemicals such as herbicides and pesticides.

Although, concerted efforts have been made by past and present governments of Nigeria towards improving agricultural productivity and production efficiency and in alleviating poverty among the rural farmers, millions of people in Nigeria are still poor and hungry (Simonyan, 2008). Hence, the role of increased efficiency and productivity of root and tuber crop farms is no longer debatable but a great necessity in order to reverse the low technical, economic and allocative efficiency of small farms in Nigeria, since root and tuber crops (e.g. cassava, yam and irish potato) have the potential for bridging the food gap, as they have been discovered from research that famine rarely occur where these crops are widely grown (Simonyan, 2008).

METHODOLOGY

The study was conducted in north central geo-political zone or the middle belt region of Nigeria. It is made up of Benue, Kwara, Kogi, Nassarawa, Niger and Plateau states and Federal capital territory. The temperature throughout the year in the area ranges from 28°C – 34°C and the annual rainfall varies from 1500mm to 1200mm. Ethnically, Benue State is dominated by Tiv, followed by Idoma, Igala, Yoruba, Egbira, Nupe and Bassa form the main ethnic groups in Kogi State. Plateau State is dominated by Beroms in the northern zone, the Magavhus in the central and the Taroks in the southern zone. It is situated between latitude 110 20'. The zone has a population of 17 million (NPC, 2006), with a projected population of 22.3 million (2015) . A multi-stage sampling technique was used for this study. In the first stage, three states namely; Benue, Kogi and Plateau States under the Fadama III root and tuber crop programme were purposively selected from the states in the central state based on the targeted root and tuber crops adopted for the National Fadama Development Project. In the second stage, four local government areas were purposively selected from Benue state agricultural zones with at least one from each zone, three local government areas from Kogi state with one each agricultural zone and one local government area was purposively selected from northern agricultural zone being the zone where irish potato is grown. In the third stage, from the sample frame, 10% representing a total of 427 and 507 of the participants and non-participants were randomly selected. Primary and secondary data was collected from participants and non-participants of Fadama III root and tuber crop scheme in the study area were used for this study. Primary data was collected from participants of Fadama III programme and non-participants involved in root and tuber crop production through interview method using questionnaire, which was administered on the two groups of respondents' socioeconomic, demographic and institutional characteristics and participants and non-participants output and inputs used in root and tuber crop production and associated sales of output. Secondary data in the form of base line and end line data on the income of the programme participants and non-participants obtained from Fadama III programme coordinating offices in Makurdi, Lokoja and Jos were also used for this study.

Analytical Techniques

Net farm income measures the return to unpaid family labour, operator's land, labour, capital and management Olukosi and Erhabor (2008). It is notationally represented as Net Farm Income (NFI).

NFI $=\sum P_y - \sum P_X - \sum P_K$ ………….…………………………………………… (1)

Where:

NFI = Net Farm Income (₦/hectare)

$\sum$ = Summation sign

$P =$ Unit price

$y =$ Output

X= Input (Variable)

K= Input (fixed)

The fixed cost is the depreciation for farm tools used by the farmer (hoes cutlasses, wheel barrows and knapsack sprayers). The straight line method of depreciation was used to calculate the rate of depreciation. This method of depreciation assumes that an asset loses value at a constant rate. Depreciation by this method is the difference between the purchase price (P) and the salvage value (S) divided by the number of years of the life of the asset (n).

Note: % change in income = $\frac{Income\ After - Income\ Before}{Income\ After} \times 100$ ……………………… (2)

% change in Net Farm Income (NFI) $=\frac{NFI\ After - NFI\ Before}{NFI\ After}$ ………………….. (3)

The fixed cost is the depreciation for farm tools used by the farmer (hoes cutlasses, wheel barrows and knapsack sprayers). The straight line method of depreciation was used to calculate the rate of depreciation. This method of depreciation assumes that an asset loses value at a constant rate. Depreciation by this method is the difference between the purchase price (P) and the salvage value (S) divided by the number of years of the life of the asset (n).

Z – **Statistic**: The Z statistic was used to test for the significance of income between the Fadama III root and tuber crop participants and non-participants

Where:

Z = the value of the statistic, Y_1 = mean of the annual crop production by the programme participants, Y_2 = mean of the annual crop production by the non-participants, S_1 = variance of the annual crop production by the programme participants, S_2 = variance of the annual crop production by the non- participants, N_1 = number of participants, N_2 = number of non-participants.

$$Z = \frac{Y_1 - Y_2}{\sqrt{\frac{S_{12} + S_{22}}{n_1 + n_2}}} \text{.......................................} (4)$$

Where:

$\bar{X}$ and $\bar{Y}$= two paired sample of beneficiary and non-beneficiary income respectively.

n = sample size

n – 1= degree of freedom

RESULTS AND DISCUSSION

The result of net farm income analysis in Table 1 below shows that the total cost of production per hectare of participants and non-participants root and tuber crop before Fadama III programme intervention was ₦113, 087.65/Ha and ₦117,614.73/Ha respectively while the total cost after the Fadama III programme for the participants and non-participants was ₦128, 233.30 and ₦137,756.57/Ha respectively. The total revenue/ha before the programme intervention is ₦381, 282.69/Ha and ₦405, 382.82/Ha while the total revenue/ha after the programme was ₦767, 818.05 and ₦649, 271.97/Ha for participants and non-participants respectively. The total revenue before the programme obtained by the non-participants was higher than that of the participants while the total revenue obtained by the participants was higher than that of the non-participants after the programme. The change in total revenue was 50.34% and 37.56% for participants and non-participants respectively. The net farm income (NFI) for Fadama III root and tuber crop participants and non-participants was before the programme is ₦268,195.04 /Ha and ₦287,768.09 /Ha respectively, while the net farm income after the programme is ₦639,584.75 and ₦511,515.40/Ha for participants and non-participants respectively. The result indicates that root and tuber crop production is profitable in the study area. This is in agreement with the work of (Ajayi, 2014) titled comparative economic study of mixed and sole cassava cropping systems in Nigeria. The change in net farm income (NFI) is 58.34% and 43.74% for participants and non-participants respectively. This percentage is however lower than the 134% and 52% respectively for participants and non-participants obtained by (Simonyan, 2008) in her findings titled ‗impact assessment of Fadama II project on income and productivity of beneficiary farmers in Kaduna State, Nigeria. The return on investment for Fadama III root and tuber crop scheme participants and non-participants before programme intervention is ₦2.37 and ₦2.44 respectively while the return on investment after programme intervention is ₦4.98 and ₦3.71 programme participants and non-participants respectively. The interpretation of this result for Fadama III participants is that for every ₦1.00 invested, ₦2.37k is their profit while for the non-participants, for every ₦1.00 invested, ₦4.98k is their profit before the programme intervention while for every ₦1.00, ₦4.98 and ₦3.71 is their profit for the programme participants and non-participants respectively after the programme intervention. The higher difference in net farm income of participants over that of non-participants may be attributed to the increase in farm output realized by the participants after the Fadama III programme. Participant‘s profitability index is higher because they may have been taught better farming techniques which had impacted on their yield and revenue. The result of the Z-test shows that the income of Fadama III root and tuber crop participants is significantly different from that of the non-participants.

CONCLUSION AND RECOMMENDATIONS

From the findings of this study, it is concluded that root and tuber production under the Fadama III production was profitable and the participants earned more naira to everyone naira invested in it root and tuber production. Its income is significantly different from that of the non-participants. It is recommended that policy makers to pursue opportunities for regional cooperation in international input procurement and to facilitate privatization and competition in input distribution.

Table 1: Net farm income analysis of respondents

	Participants Total cost (₦/ha)		Non-participants Total cost (₦/ha)	
Input	**Before**	**After**	**Before**	**After**
A.				
Land Rent	5,395.00	6,743.80	6,990.31	6,341.54
Planting mat.	18,511.60	15,498.07	20,647.42	21,836.33
Fertilizer	19,255.15	19,632.27	18,287.32	19,125.21
Pesticide	5,446.40	6,400.00	6,998.42	8,408.23
Labour	61,853.30	76,836.45	49,906.00	79,215.87
Total Variable Cost/Ha	**110,461.45**	**125,110.59**	**115,529.47**	**134,927.18**
B. Depreciated cost	2,626.20	3,122.71	2,085.26	2,829.39
C. Total cost (A+B)	**113,087.65**	**128,233.30**	**117,614.73**	**137,756.57**
D. **Revenue/Ha**				
Cassava	110,065.69	323,722.61	154,538.26	259,292.39
Irish Potato	64,975.61	120,325.20	56,468.95	93,675.30
Yam	206,241.39	323,770.24	194,375.61	296,304.28
Total Revenue/Ha	**381,282.69**	**767,818.05**	**405,382.82**	**649,271.97**
E. Net Farm Income/Ha (D – C)	**268,195.04**	**639,584.75**	**287,768.09**	**511,515.40**

Note: Farm tools include Hoe, cutlasses, Wheel barrows and Knapsack sprayers

Table 2: Z-test of hypothesis on the profitability of the participants and non-participant.

	Participants	Non-participants
Variable	**Net farm income (₦)**	**Net farm income (₦)**
Mean	1,821,798	1,404,417
Known Variance	5.26E+12	3.23E+12
Observations	427	507
Hypothesized Mean Difference	0	
Z-stat	3.05***	
P(Z<=z) one-tail	0.00114	
Z-Critical one-tail	1.64485	
P(Z<=z) two-tail	0.00228	
Z-Critical two-tail	1.96	

***P<0.01

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PERFORMANCE DIFFERENTIALS AMONG COCOYAM FARMERS IN EZEAGU LOCAL GOVERNMENT AREA OF ENUGU STATE; A CASE STUDY OF COOPERATORS AND NON-COOPERATORS

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ABSTRACT

The study analyzed the differences in performance among cocoyam farmers in Ezeagu LGA in Enugu State, Nigeria. The study obtained data from 120 (60 cooperators and 60 non cooperators) respondents using a multi-stage randomized sampling techniques. The study described the socio-economic characteristics of the cocoyam farmers. Majority of the cocoyam farmers were still young and active (21-30) and (41-50), educated, married with large household sizes. The results show that marketing margin (₦154.800) and marketing efficiency (394.318%) of the cooperators were higher than those of the non-cooperators (127,000) marketing margin and ((238.889%) marketing efficiency. This study therefore recommends more awareness on the importance of cooperative membership to the rural farmers by the government and cooperative societies through extension services.

Keywords: Cooperators, Performance, Cocoyam, Farmers

INTRODUCTION

Cocoyam originated from Asia and about forty (40) species are mostly grown in West Africa (Asumugha and Mbanasor, 2002).Cocoyam, both *Xanthosoma* species and *Colocasia* species belong to the family (Aracea). Cocoyam is a stem tuber that is widely cultivated in the tropical regions of the world and is a well-known food plant which has a long history of cultivation with Nigeria being the largest producer in the world and accounting for about 40.0% of the total world output (Ademiluyi, 2013) Cocoyam contributes significantly to carbohydrate content of the diet of individuals in developing countries, and provides edible starchy storage corms. According to Opera (2002), cocoyam though less important than other tropical root such as yam, cassava and sweet potato, yet a staple food in most part of tropics and sub tropic. It contains calcium, phosphorus, vitamins A and B. Despite the economic importance of cocoyam as a source of food in most parts of the tropics and sub tropic, there is still limited information on their cultivation which perhaps contributes to the scarcity of cocoyam in the market (Ekpo *et al.*, 2001). Cooperative can be defined as a social enterprise or organization created voluntarily by members with the full support and assistance from members in order to cater for the economic needs and interests of the members. The idea was to pull members economic resources together to ease their access to finance, other socio-economic resources and easy marketability of their produce. The basis for instituting a cooperative organization includes common business interest, location, professional goals and objectives, need for social interaction on common interest, exploitation of common resources through group strategy. The simplest and most basic benefit of cooperative societies is the creation of an avenue for members to borrow money and obtain loans with minimal interest to meet their business and social needs and serves as an avenue for savings and easy access to marketing of their produce. It is a powerful instrument that ensures that loans are adequately and timely available to members Akpan (2005). However, In Nigeria, farmers face many problems including high transaction costs which prohibit their access to better-paying markets and worsen their poverty level. Lack of information on prices and linkages between farmers and other market actors, credit constraints and other market imperfections are some of the problems faced by cocoyam farmers. They have been selling their crops at a low price through intermediaries who have taken advantage of market imperfection for their own benefits (Mensah *et al.*, 2012). To overcome these constraints, cooperative societies were formed by farmers. Most studies on cocoyam had been done in the areas of production, nutrient constituent, yields and suitable soils. Therefore, this study aims at investigated performance differentials amongst cocoyam farmers in Ezeagu LGA Enugu State, Nigeria

METHODOLOGY

The study was carried out in Ezeagu Local Government Area of Enugu State. It is one of the seventeen Local Government Areas of the state. Ezeagu is bounded in the North by Uzo-uwani in the south by Orji-River in the West by Udi and in the East by Anambra State. It comprises twenty one communities and these are: Olo, Amagu-Umuolokpa, Iwollo, Oghe, Okpogho, Ihionyia, Akama, Imezi-Owa, Aguobu-owa, Mgbagbu-owa, Awha-Ndiagu, Awha-Imezi, Umana-Ndiagu, Umaana-Ndiuno, Obeleagu-Umana, Obinuofia-Ndiuno, Aguobu-Umunba, Isingwu-umuana and Umualor. It is located at the south-west part of Enugu state. It has a humid hot air temperature. The Local Government Area is inhabited by Igbo people with a population of about 169,718 people and landmass of about 633sqkm (633km^2). The soil is mainly sandy-loam and the vegetation is a thick rainforest. About 85% of the entire population of Ezeagu is engaged in Agricultural activities like crop production, processing, marketing to animal husbandry. A multi-stage sampling technique was used to select 120 cocoyam respondents from Ezeagu Local Government Area, Enugu State. The first stage involved purposive selection of five communities from the twenty-one communities listed and the five communities were; Aguobu-Owa, Mgbagbu-Owa, Imezi-Owa, Akama, Umana-Ndiagu. These five communities were purposively selected because they produce cocoyam in good quantities. The second stage involved random selection of six villages each from the five communities. Finally, four respondents, two (2) cooperative cocoyam farmers and two (2) non-cooperative cocoyam farmers were randomly selected from each of the thirty villages, giving a sub total of 60 cooperative cocoyam farmers and 60 non cooperative cocoyam farmers with a grand total of 120 respondents. Primary method of data collection was adopted for the study. The primary data was obtained through a well-structured questionnaire. The analytical techniques include descriptive statistical techniques such as frequency distribution, mean and percentage. Marketing efficiency and marketing margin were used as performance indices to determine the marketing performance of both the cooperator and non-cooperators.

Marketing efficiency was estimated using the Shepherd's index formula developed by Shepherd (1965) the formula is given by: $ME\ INDEX = \frac{GM}{MC} - 1$

Where: ME = Marketing Efficiency index , GM = Gross marketing margin in Naira

MC = Total marketing cost in Naira. The higher the ratio, implies the higher the marketing efficiency and vice versa. The net marketing margin accruing to the retailer of cocoyam is the difference between the gross marketing margin and the total marketing costs.

RESULTS AND DISCUSSION

The result in Table 2.0 show that majority of the cooperators (53.33%) were males while majority of the non-co-operators (73%) were females respectively. Generally, this implies that many cocoyam farmers in the study area were interested in membership of cooperative societies which definitely enhanced their profits. They must have been benefiting from shared resources like obtaining farm inputs and finances together. Some researchers concluded that the ratio of female-to-male performance in terms of capacity utilization, revenue and annual investment spending indicates that women and men are influenced by many of the same variables when making entrepreneurial decisions (Vossenberg,2013and Ogunleye,2005). The results shows that 3.33% and 6.66% of the cooperators and the non-cooperators had age brackets of 21-30 years while 10.00% and 46.67% had age brackets of 31-40years . About 53.33% and 36.67% of the cooperators and non –cooperators had age brackets of 41-50years respectively. This result shows that majority of the cocoyam farmers were still young and active. This implies that they can pursue business activities aggressively (Ike, 2012). According to Oloruntoba (2000), Age is very important in Job performance. The results show that about 70% of the cooperators attended secondary education. While about 46% attended both secondary and tertiary education for the non-cooperators The percentage of the cooperators that attended secondary education is an indication of the positive influence of education on the cooperators. Amara *et al* (1999) noted that schooling is a crucial factor in the adoption of innovation and technology. Education has also been shown to enhance the skills and experience needed for business (Akanji, 2002; Kuzilwa, 2005).

The results in Table 2.0 show that the purchase price per kg of cocoyam among the cooperators was ₦40.866 and ₦65.667 for the non cooperators. There were no wide margin between the selling price (₦195.667) for cooperators and non cooperators (₦192.667). This could be due to the fact that, to certain extent, some characteristics of perfect competition market exist. For instance, the commodities could be homogenous, you have many buyers and sellers and perhaps some access to market information.

The marketing margin (₦154.800) for the cooperators was greater by 17.95% compared to the marketing margin for non cooperators (₦127.000). The reason for a higher marketing margin for the cooperators could be attributed to the fact that the cooperators had more access to resources like finance and other imputs, resulting from their association. On the other hand, the non-cooperators probably could not access such resources because individual find it difficult to access farm inputs especially from the government. Results show that the marketing efficiency for cooperators was 394.318% compared to their non-cooperators counterpart (238.889%). This shows that the cooperators were more efficient than their non-cooperator counterparts in the study area.

CONCLUSION

The study analyzed the performance differentials among cocoyam farmers in Ezeagu LGA, Enugu state, Nigeria. The results show that about 70% of the cooperators attended secondary education while about 46% attended both secondary and tertiary education for the non-cooperators. The percentage of the cooperators that attended secondary education is an indication of the positive influence of education on the cooperators. The results show that 3.33% and 6.66% of the cooperators and the non-cooperators had age brackets of 21-30 years while 10.00% and 46.67% had age brackets of 31-40years. About 53.33% and 36.67% of the cooperators and non –cooperators had age brackets of 41-50years respectively. The marketing margin (₦154.800) for the cooperators was greater than the marketing margin of non cooperators (₦127.000). Results show that the marketing efficiency for cooperators was 394.318% compared to their non-cooperators counterpart (238.889%).

Table 1.0 socio economic characteristics of cocoyam farmers

Variables	cooperators Frequency	Percentages	Non cooperators Frequency	Percentages
Male	32	53.33	16	26.67
Female	28	46.67	44	73.33
Total	60	100	60	100
Age				
21 – 30	2	3.33	4	6.67
31 – 40	6	10.00	28	46.67
41 – 50	32	53.33	22	36.67
51 – 60	20	33.33	6	10.00
Total	60	100	60	100
Education				
Primary	10 16.67	16.66	12	20.0
Secondary	45	75.00	42	70.0
Tertiary	5	8.33	6	10.0
Total	60	100	60	100
Marital Status				
Married	48	80.00	44	73.33
Single	4	6.67	4	6.67
Widow	8	13.33	12	20.00
Total	60	100	60	100
Household size				
1 – 10	44	73.33	38	63.4
11 – 20	16	26.67	22	36.6
Total	60	100	60	100

Source: Field survey, 2016

Table 2.0 Performance of the respondents in the study area

Variables	**Cooperators**	**Non-cooperators**
Cost price ₦	40.866	65.667
	(10.882)	(100.530)
Selling price ₦	195.667	192.667
	(246.049)	(189.145)
Marketing margin(%)	154.800	127.000
	(245.502)	(89.335)
Marketing efficiency(%)	394.318	238.889
	(623.200)	(59.244)

Source: field survey data, 2016.

Figures in parentheses are standard deviations.

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IMPACT OF GOVERNMENT SPENDING ON AGRICULTURAL OUTPUT AND ECONOMIC GROWTH OF NIGERIA (1981 - 2012)

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ABSTRACT

This work estimated the impact of government spending on agricultural output and economic growth of Nigeria. The objectives of the study are to analyze government allocation to agriculture for the period under study and determine the effect of government allocation to agriculture on economic growth. Data used for the study were obtained from CBN and NBS (National Bureau of Statistics) from 1981 to 2012. Descriptive statistics (line graph) and regression analysis was used to analyse the data. The Durbin-Watson statistic was used to test for autocorrelation among the independent variables and the dependent variable. The results showed that government allocation to agriculture within the period under study was discouraging, but had a significant effect on the output of the agricultural sector. From the regression analysis, Agricultural Credit Guarantee Scheme Fund (ACGSF) was significant and positively related to GDP while average annual rainfall was also significant but had a negative relationship to GDP. Government should be more proactive in insisting on the private sector, especially, the financial sector to set aside funds annually for agricultural financing to compliment government efforts.

Keywords: Government spending, agricultural output, economic growth, Nigeria, Allocation

INTRODUCTION

Agriculture is a key sector in the Nigerian economy. Its importance is particularly glaring in a developing economy like Nigeria where land and labour resources are relatively abundant and the industrial sector is poorly developed (Tamuno, 2006). The contribution of agriculture to overall development especially in developing countries like Nigeria include provision of increased food supplies, provision of gainful employment, provision of capital and capital formation, increasing foreign exchange for development and increasing rural welfare. The agricultural sector's contribution to economic growth and sustained rural development remains to be fully exploited (FMARD, 2006). The contribution of agriculture to GDP was 64% in 1960, declined to 35% in 1988, and presently, the agricultural sector in Nigeria contributes less than 30% to GDP, with crop production accounting for an estimated 85% of this total, livestock 10%, with forestry and fisheries contributing the remaining 5% (Awotide and Akerele, 2010). Mejeha and Nnanna (2010) attributed this declaring trend of agricultural production to inefficient traditional practice by smallholder farmers. However, the facts remains that government precisely the commercial banks have not come to grapple with the problem because much has not been felt in the area of credits to agriculture. The accusation was that government prefers granting credit to commerce or trading to agriculture and where the credit was allowed, the interest payable seems outrageous with some tight securities, which place restrictions and scare many prospective farmers (Ebere *et al*., 2014).

Farm credits are however important means for improving farm capital investment in Nigeria, with which there may be no progress in the agricultural sector to adequately fulfill its expected roles or millennium development goals (Musa *et al*., 2010)..Not until recently, government seriously thought and attempted to mobilize potential savings for the rural farmers. Commercial banks themselves have given little attention to the approval of loans to farmers for fear of defaults. Where credits are received from other sources apart from government and commercial lending, the interest rates have been too high. These reported high interest rates are stark realities to the peasant farmers.

Objectives of the study

1. analyze government allocation to agriculture for the period under study
2. determine the effect of government allocation to agriculture on economic growth

METHODOLOGY

Method of data collection: Secondary data used for the study were obtained from Central bank of Nigeria (CBN) Statistical Bulletins, National Bureau of Statistics (NBS) annual abstract of statistics, and Food and Agricultural Organization (FAO) Statistical Year Books.

Methods of Data Analysis

Objective 1 was achieved with a line graph which gave a graphical presentation of the trend of government expenditure on agriculture for the period under study. To realize objective 2, a multiple regression model was specified, and estimated through an ordinary least square (OLS) procedure.

Model Specification

The implicit form of the model was specified as follows:

GDP = f(GDPA,RIR,ACGS,GEA,AAR,t) (1)

The four functional forms of the model were specified in the explicit form as follows:

Linear: $GDP = Bo + b_1GDPA + b_2RIR + b_3ACGS + b_4GEA + b_5AAR + t + Ui$ (2)

Exponential: $LogGDP = Bo + b_1GDPA + b_2RIR + b_3ACGS + b_4GEA + b_5AAR + t + Ui$ (3)

Semi-log: $GDP = Bo + b_1logGDPA + b_2logRIR + b_3logACGS + b_4logGEA + b_5logAAR + logt + Ui$ (4)

Double log: $LogGDP = Bo + b_1logGDPA + b_2logRIR + b_3logACGS + b_4logGEA + b_5logAAR + logt + Ui$

(5)

Where,

GDP = Gross Domestic Product (1981-2012) in Naira
GDPA = Gross Domestic Product of Agriculture (1981-2012) in Naira
AOP = Agricultural Output (1981-2012) in Naira
RIR = Real Interest Rate (1981-2012) in Naira
GEA = government expenditure in agriculture (1981-2012) in Naira
CRE = volume of credit to the agricultural sector, under the Agricultural Credit Guarantee Scheme (1981-2012) in Naira
AAR = annual average rainfall for the country (1981- 2012) in mm
t = time (in years)
B_0 = constant term
$b_1 – b_5$ = parameters to be estimated
Ui = stochastic error term

RESULTS AND DISCUSSION

In Fig.1 it can be seen that recorded government expenditure to the agricultural sector did not really reflect the output from the sector. This agrees with Mogues *et al.,* (2008) that public spending in the agricultural sector is astronomically low. According to them, less than 2 percent of total federal expenditure was allotted to agriculture during 2001 to 2005; far lower than spending in other key sectors such as education, health, and water, contrasting dramatically with the sector's importance in Nigeria's economy and the policy emphasis on diversifying from oil-based economy, and also far below the 10 percent goal set by African leaders in the 2003 Maputo agreement. A lot of arguments have been put forward on whether government spending can boost economic growth. Although this work's focuses is on the agricultural sector financing through public instruments, Eboh *et al.,* (2012) are of the opinion that financial economists and policy makers are divided on whether government spending helps or hinders economic growth and stability. According to them, proponents of more government spending opine that government programs provide valuable public goods such as education, health, roads and other infrastructural facilities. To boost agricultural production and enhance its contribution to the country's Gross Domestic Product (GDP), a lot more has to be done in the area of increasing allocation and expenditure to the agricultural sector.

Agricultural GDP, government expenditure in agricultural sector, and real interest rates were not significant at levels tested. The non-significance of these variables on total GDP can be attributed to the apparent neglect of the agricultural sector through irresponsive policies towards the macroeconomic variables that directly impact on the agricultural sector. The Agricultural Credit Guarantee Scheme Fund (ACGSF) was significant and had a positive relationship with GDP. Its impact on the GDP is shown by its regression coefficient of 0.516 that is significant at 1%, indicating that if the amount of money guaranteed under the scheme is increased by a unit of its measure, total GDP will increase by the value of the coefficient. This is in consonance with Ebere *et al*., 2014 where it was found out that Agricultural Credit Guarantee Scheme Fund (ACGSF) was positively related to economic growth. A negative coefficient was obtained for average annual rainfall which was significant at 1%. This is contrary to a priori expectations, given that increased rainfall would lead to improved agricultural production. However, given that agricultural output did not have a significant effect on total output, this result may stand. Agriculture in Nigeria is highly seasonal and rain-fed, and adequate rainfall should positively relate to output from the agricultural sector. However, the relationship between agricultural GDP and total GDP has not been determined. That relationship, when established, will give support or disregard this result.

CONCLUSION

From the study, it was observed that government spending and allocation to agriculture is below what can boost the agricultural sector for commercial production. The Agricultural Credit Guarantee Scheme Fund has helped in sustaining the agricultural sector. However, the contribution of agriculture to total GDP decreased over the period studied. The study further reveals that in spite of poor investment in the agricultural sector, yet it has potentials to contribute about 73% of total GDP. This is presumed to be the contributions of small holder-farmers who constitute about 80% of the farming population in Nigeria. Government is therefore called upon to reinforce its efforts in increasing budgetary allocation for agriculture as this can support rural farmers in the acquisition of farm inputs and credit facilities this can help to boost agricultural productivity.

Fig.1.0 Government expenditure versus agricultural GDP (1981-2012).

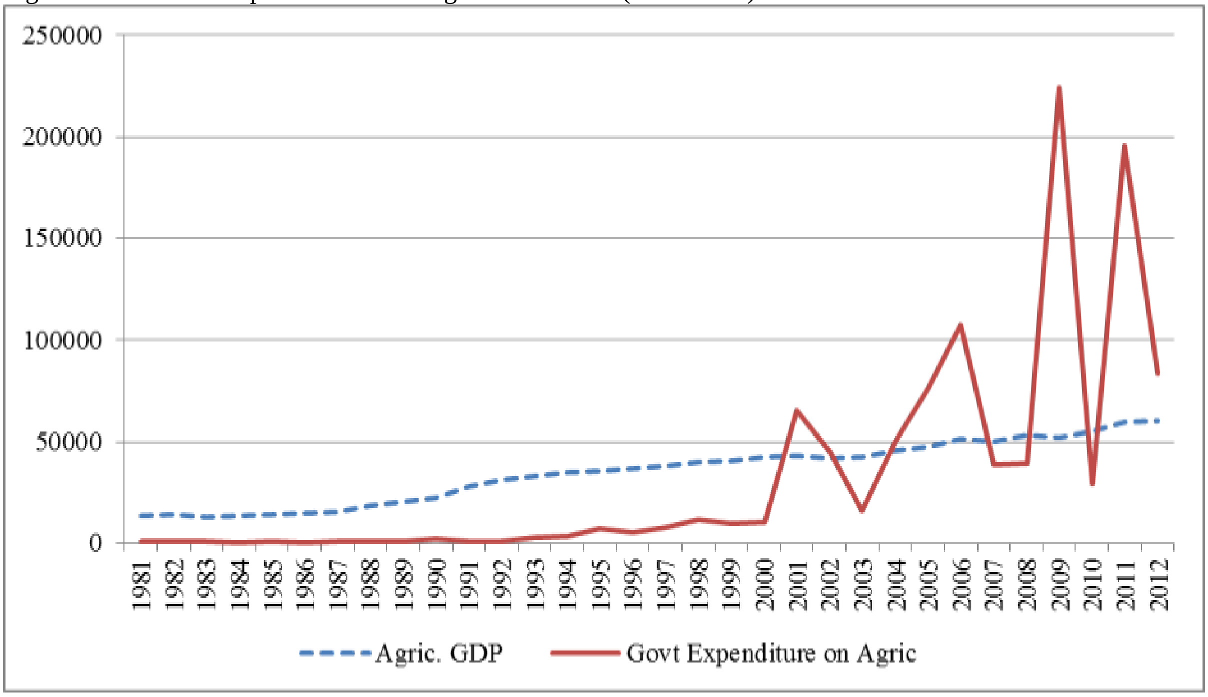

Figure 1: Computed from CBN Statistical Bulletin, 2013

Table 1:Analysis of effect of agricultural indices on GDP

Parameters	Linear	Exponential	Semi log	+ Double log
(Constant)	324228149421.82	29.24	632049461673.04	35.12
	(4.420)***	(23.195)***	(1.875)*	(5.999)***
GDPA	146960619.42	-0.02	14528262354.67	-0.06
	(0.054)	(-0.401)	(0.370)	(-0.090)
GEA	-4611.16	-1.557E-07	4102704817.35	0.04
	(-0.245)	(-0.482)	(0.682)	(0.414)
RIR	-1976124687.65	-0.02	-19521468746.58	-0.04
	(-1.636)	(-0.019)	(-0.836)	(-0.091)
ACGS	10519.74	1.825E-07	28104992448.20	0.52
	(2.009)*	(2.028)*	(3.438)***	(3.633)***
AAR	-2152396652.36	-0.04	-173311060885.77	-3.16
	(-2.839)***	(-2.908)***	(-2.235)**	(-2.346**
T	1355319665.23	0.05	-46468323931.02	-0.75
	(0.308)	(0.618)	(-2.548)**	(-2.377)**
R^2	65.50	61.50	76.50	73.20
Adjusted R^2	56.60	51.50	70.40	66.20
F-ratio	7.29	6.13	12.49	10.48
Durbin-Watson	1.31	1.26	1.36	1.32

*Source: Computed from data. *, ** and *** indicates significance at 10%, 5% and 1% respectively.*
$DW_{0.01}$ (n =32, k =6) D_L = 0.856; D_U = 1.690; $DW_{0.05}$ (D_L = 1.041; D_U = 1.909).

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DETERMINANTS OF FERTILIZER USE INTENSITY AMONG SELECTED ARABLE CROP FARMERS IN IKWUANO LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

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ABSTRACT
The study analyzed determinants of fertilizer use intensity among arable crop farmers in Ikwuano Local Government Area of Abia State, Nigeria. Primary data were obtained from 10 arable crop farmers randomly sampled from 8 villages which gave a total of 80 farmers. Descriptive statistics and multivariate linear regression analysis were used to analyze data collected. The result showed that the fertilizer use in the study area was moderately high due to enormous demand on the limited land. Age, gender, educational level, household size and price of fertilizer were the significant factors that influenced fertilizer use intensity among the arable crop farmers. The study recommends that government and policy makers invest on increased knowledge and skill of farmers through avenues such as field days, extension agents contact with farmers or any other capacity building mechanism. Rural credit should be emphasized in order to mobilize savings and maximize the availability of credit to the farmer and to facilitate the distribution and uses of fertilizers, the agro-services centers should be opened in the rural areas. In addition, mechanism should be put in place to ensure that the subsidized fertilizer reaches the right target at the subsidized price. Fertilizer records at state and local government level over the years could be scrutinized to ensure and instill a sense of accountability and determine the true fertilizer situation at the levels.

Keywords: ***socioeconomic, fertilizer, use intensity, arable crop, farmers, government***

INTRODUCTION

Soil, which is the top most part of the earth, is an essential resource for mankind particularly; agricultural activities are carried out intensively on soil. The level of crop yield depends largely on the fertility of a given soil. According to Oguwole *et al.*, (2002), the inability to incorporate soil improvement technique into farming practices degrades the soil. It does not only frustrate efforts at achieving higher productivity but also undermine the carrying capacity of the environment to sustain the welfare of humans. It is obvious that environmental sustainability and sustainable agriculture brings about wellbeing of the people, particularly the rural dwellers whose basic survival are Hinged upon by environmental dynamics. The environment in its various conceptualization includes the social, physical, economic, political and policy environment (Adebayor, 2006). As a matter of fact, this environmental component has impact on the welfare of resource-poor rural farmers. Consistent depletion of soil nutrients in several rural farming communities has prompted the unavoidable reliance on chemical fertilizers in order to sustain crop production. The use of chemical fertilizers have made significant contribution to increase production largely. Akpoko, (2004) noted that traditional bush fallow system as well as inaccessibility to other soil improvement techniques like organic manure, mulching, zero tillage, minimum tillage have been sustainable hence make the use of organic fertilizer popular. Although organic fertilizer has impacted greatly on crop yield hence its wide spread. Inorganic fertilizer has become a major source of soil nutrient improvement for many farmers, but its high cost made it inaccessible. These have resulted to low level of production among framers. Halley (1992) had noted that many Nigerian soils have no sufficient qualities of nutrient necessary for high yield in crops. Therefore fertilizer is the key to rapid improvement in agricultural production and productivity (Husain, 1987).

In recent times, there is an increase in the awareness of the use of chemical fertilizers in order to augment for the depleted soil nutrients and sustain soil fertility for crop yield. This has led the government to increase a budgetary commitment to fertilizer procurement. However, procurement of chemical (organic fertilizer) by government is just a subset of the fertilizer-rural farmer-livelihood matrix. Accessibility of rural farmers to the procured fertilizer is the most important issue. Okoji and Ayichi, (2000) opined that the major bottlenecks to fertilizer accessibility are inadequate physical infrastructure, absence of well-organized rural institutions to handle input-distribution, political interference, fraudulent practices by staff of ministry and local government directly involved in fertilizer distribution and delay in procurement due to cumbersome procedure and bureaucratic process in decision making. These have affected the availability and usage of chemical fertilizers. Hence the main objective of the study is to examine fertilizer use intensity among arable crop farmers in Ikwuano Local Government Area of Abia state, Nigeria, using the fertilizer use intensity (FUI) adopted from Maingwa *et al*. (2007) and Olayide *et al*. (2009) in estimating the determinants of fertilizer use intensity.

METHODOLOGY

The study was conducted in Ikwuano LGA of Abia State, Nigeria. The main occupation of the people is farming. The major crops cultivated are cassava, melon, yam, maize, rice vegetables and cocoa which is an important cash crop. A simple random sampling technique was used to select 8 communities from the LGA. Thereafter 10 respondents each were selected randomly from the 8 communities to give a total of 80 arable crop farmers for the study. The arable crop farmers in the study area cultivate crops either solely or mixed cropping. In specific terms, the socio-economics was realized using percentages and tables, the fertilizer use intensity was achieved using the fertilizer use intensity (FUI) adopted from Maiangwa (2007) and Olayide (2009) stated thus

$$FUI = \frac{\text{Quantity of fertility used by the farmer measured in Kg}}{\text{Area of land cultivated by the farmer measured in hectare}}$$

The determinants of fertilizer use intensity were realized using multivariate linear regression analysis. The model is stated thus:

$FUI = B_1Age + B_2GEN + B_3EDU + B_4HHS + B_5LANS + B_6PRD + B_7OUT + B_8PANI + U_i$

Where FUI = Fertilizer use intensity, X_iAGE = Age of farmers (in years), X_2GEN = Gender of a farmer (1 = male, 0= female), X_3EDU = level of education (years), X_4HHS = Household size of farmers, X_5LAN = Land size cultivated by farmers (in hectares), X_6PRD = Perceived price of fertilizer by farmers (1 = high price, 0 = low price), X_7OUT = Output of fertilizer (in Naira (₦)), X_8PANI = Poultry owner (1 = owned poultry enterprise, 0 = otherwise) and U = error term

RESULTS AND DISCUSSION

Socioeconomics characteristics of the fertilizer users in the study area

The average farmer in the study area had a mean age of 43years, implying to be in active age, which could be positively related to farming and the adoption of new technologies like fertilizer usage. This is in line with the study of Nwaiwu *et al.* (2004) who work on problems and prospects of large scale plantain banana marketers production in Abia State show that the farmers were at their middle age of 46 years. This active age group usually undertake decision that concerns resource allocation in their venture across all Endeavour.. The male dominated the female counterparts in the use of fertilizer with a percentage of 80 to 20 respectively. This is as expected because the farm lands are usually owned by the men. The farmers in the study area were literate with a mean value of 11.8year. This implies that most of the farmers spend about 12years acquiring formal education. The level of education will reflect their technology adoption level positively. The arable crop farmers in the study area had a mean value of 0.43hectare of land. This implies that, they are smallholder farmers. The result is similar to the findings of Nwaiwu *et al* (2004), who observed that plantain/banana farmers in Abia State are smallholder with a mean value of 1.4hectares and therefore they are limited in capital, scope of operations and production. The arable crop farmers in the study area had a mean income of N76,487 per annum. This implies low income level of the farmers. This could be the reason why they could not have savings that could be reinvested into their farm business, hence appear to operate in a somewhat vicious cycle of poverty. The findings showed that 85% of the farmers use fertilizers representing more than half of the sampled farmers and this implies that the farmers adopted the use of fertilizers in the study area. Only about 50% of the sampled farmers do not use fertilizers.

Level of Fertilizer Use by Sampled Farmers

Table 2 showed that 52.6% of the arable crop farmers use a minimum of 50kg fertilizer. The mean value obtained was 88.9kg. This implies that the level of fertilizer usage in the study area was moderately high indicating high demand for fertilizer because fertilizer is one the important technologies used in increasing food production (Obiesesan *et al*., 2013).

Determinants of Fertilizer Use Intensity among Arable Crop Farmers

From Table 3:,Age of the arable crop farmers was significant at 1% level and had a positive relationship with fertilizer use intensity (FUI).This implies that a unit increase in the age of the farmers increases the fertilizer use intensity by 0.4867.It also means that older farmers use more fertilizer than younger farmers. This is in line with the findings of Ugwuja *et al.*, (2011).The variable gender was significant at 1% level but inversely related to fertilizer use intensity. This indicated that a unit change in the gender of the farmers will change the fertilizer use intensity by 0.137. This showed that majority of the farmers were female, as females tend to be involved in cultural practices during farming. Education level was significant at 1% level and was positively related to FUI, indicating that higher educational level influenced higher fertilizer use. This is in agreement with (Ugwuja *et al*., 2011) who reported that education correlates positively with adoption of improved practices. This is expected since most of the farmers in the study were educated The coefficient of Household size was significant at 10% level and had positive relationship with FUI. This implies that, the higher the number of the household size of the family, the higher the use of fertilizer. This conformed to *a priori* expectation because higher household members would require more food and this would mean more fertilizer use to grow more crops. Price of fertilizer was significant at 10% level and was positively related to FUI. This implies that a unit increase in price of fertilizer would increase the use of fertilizer by 0.077. This is contrary to apriori expectation. It is plausible however because fertilizer is an essential commodity to these farmers and as demand for fertilizer increases, its prices also increases but would not stop farmers from using them. This is contrary to the work done by Obisesan (2013) who reported that farmers use more fertilizer when the price of fertilizer is low than when the price is high. The R^2 value was 0.906 indicating that about 90.6% of total variation in the dependent variable was explained by the exogenous variables in the model. The F-ratio was also significant at 1% level. This indicated the goodness of fit of the model.

CONCLUSION

It is concluded that arable crop farmers in the study area were at their active age, literate, had mean income of about N76,487 and showed high use of fertilizer despite its high cost. Age, education and household size were significant factors that had positive relationship with fertilizer use intensity while high cost of fertilizer, limited access to credit and inadequate supply of fertilizer were the constraints to fertilizer use by farmers. Therefore, it is recommended that government and other policy makers should initiate capacity building programme to increase knowledge and skill of farmers through avenues such as field days, extension agents contact with farmers;emphasize rural credit mobilization to boost farmers savings and maximize the availability of credit to farmers; establish functional agro-services centers near to rural areas as sources of fertilizer supply to farmers, by this government can monitor the distribution and uses of fertilizer and ensure that subsidized fertilizer reach the farmers that need them at subsidized price.Fertilizer record at state and local government level over the years should be scrutinized to ensure and instill a sense of accountability and determine the true fertilizer situation at these levels.

Table 1: Socio-economic characteristics of fertilizer users in Ikwuano local Government Area

Variables	Frequency	Percentage	Mean
Age			
20-29	15	18.7	
30-39	12	15.0	
40-49	27	33.8	
50-59	26	32.5	
Total	80	100	43
Gender			
Male	64	80	
Female	16	20	
Total	80	100	
Educational level			
Primary	18	22.5	
Secondary	38	47.5	
Tertiary	24	30.0	
Total	80	100	11.8
Farming experience			
0-9	27	33.8	
10-19	34	42.5	
20-29	13	16.2	
30-39	06	7.5	
Total	80	100	14.3years
Farm size			
0.1-0.2	3	3.8	
0.3-0.4	27	33.8	
0.5-0.6	32	40.0	
0.7-0.8	18	25.4	0.43ha
Income level of respondents			
10,000-49,999	12	15.0	
50,000-89,999	43	53.8	
90,000-129,999	25	31.2	
Total	80	100.00	76,487
Fertilizer use			
Fertilizer users	68	85.0	
Non-fertilizer users	12	15.0	
Total	80	100	

Source: Field survey, 2014

Table 2: Level of fertilizer used by farmers

Quantity of fertilizer	Frequency	Percentage
40-49	3	3.8
50-55	16	20.0
60-69	8	10
70-79	3	3.8
80-89	15	18.8
90-99	2	2.5
100-109	3	3.8
110-119	19	23.8
120-129	5	6.2
130-139	6	7.3
Total	80	100
Mean	88.9kg	

Source: Field survey, 2014

Table 3: Determinants of fertilizer use intensity among arable crop farmers.

Variables	Coefficient	t-value
Constant		-1.734
X_1 (AGE)	0.487	8.123***
X_2 (GEN)	-0.137	-3.111***
X_3 (EDU)	0.551	8.826***
X_4 (HHS)	0.068	1.772*
X_5 (LANS)	0.010	-0.243*
X_6 (PRI)	0.030	2.103
X_7 (OUT)	-0.016	-0.711
X_8 (PANI)		-0.447
f-ratio		96.055***
R – value		0.915
R^2		0.906

Source: Field survey, 2004

Note;***, **,* are significant level at 1%,5%,and 10% respectively

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PROFITABILITY ANALYSIS OF CASSAVA PROCESSING AMONG RURAL HOUSEHOLDS IN SOUTHEAST, NIGERIA

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ABSTRACT
This study analyzed the profitability of cassava processing among the rural households in the South East, Nigeria. Data used for the study were obtained from 120 respondents using a multistage random sampling technique. The data was analyzed using descriptive statistics and cost and returns analysis. The cost and returns analysis showed that he estimated total cost was ₦250, 465 while the estimated total revenue was ₦544,490.94 for the garri enterprise. Result of the analysis showed a gross margin of ₦326, 814.53/tonne and an estimated Net Income (NI) of ₦294, 025.19. Furthermore, the estimated profitability index (PI) of 0.5400 implies that for every ₦1.00 earned as revenue, 54 Kobos were returned as net income. Hence, the cassava processing enterprise was profitable. The rate of return on investment (ROI) was calculated as a percentage ratio of the Net Income to the Total Cost (TC). The estimated ROI for the garri enterprise was 117.39. This implies that the garri enterprise made more than double the amount on every ₦1.00 invested. However, cassava processing have some constraints, prominent among which are; inadequate capital, high cost of transportation, high input price, high interest rate and high cost of labour . Provision of credit support to investors in cassava processing not only as agricultural loans but as part of small and medium scale enterprises (SMEs) development grant, to expand their capacities, adopt new technologies / innovations, improve scale of operation and income is recommended.
Keywords: Profitability, Cassava processing, Rural Households, Cost and Returns

INTRODUCTION
Cassava (manihot esculenta) variously designated as Manioc, Tapioca or Yucca has been acknowledged as one of the most popular staple crops in the African diet (Nweke *et al*., 2002). Its production is characterized by small scale producers who use old varieties and traditional production technologies which largely accounts for low yield. The South Eastern region accounts for about 20 percent of the total cassava output in the country with Abia, Enugu and Imo states producing a total of 634 metric tonnes, 2599 metric tonnes and 2315metric tonnes of the crop annually (NBS, 2007). The crop is produced in many forms both in the fresh and processed forms, starting from the producers through myriads of processors to the end users. Acceptance of cassava as a low cost food in urban centres and as a source of steady income for rural households will depend on how it can be processed into a safe form (Bokanga, 1995). It also depends on how far it can be presented to urban consumers in an attractive form at prices which are competitive with those of wheat, cereal and yam . If cassava can be processed in a more efficient manner, it stands to gain in domestic demand as well as a potential export. However, the lack of appropriate and affordable technologies (especially for use by farmers and processors), a weak private sector (especially, intermediary processors and bulking agents that link small scale producers and processors with end user industries), trade policies, consumer preferences and policy volatility threaten this transition (Porter, 1980). In addition, if producers could harvest cassava and process them into staple commodities (such as garri) that could be stored for several months, they would earn high profits during the periods of scarcity. The acquisition of even simple processing, equipment is an investment which the majority of the small scale cassava processors cannot afford. Consequently, poor credit facilities and high interest rate make such investments risky and financially unattractive and hinder the development of the economic potential of the crop. More so, the inability to analyse effectively the cost benefit returns from the activity, coupled with poor access to productive inputs according to Oyewole and Philip (2006) stagnate expansion and investment opportunities. Therefore, this study analysed the cost and returns for cassava processing into garri and identified the constraints militating against the enterprise in South East, Nigeria.

METHODOLOGY
The study was done in South Eastern part of Nigeria. The zone lies between latitude 6º and 9ºE and 4º and 7ºN longitude and has a total land mass of 10, 952, 400ha with over 16 million people (NPC, 2006). Cassava production is a common business in this zone, usually processed into different forms like garri, fufu, abacha, flour, chips and starch A multi- stage sampling technique was used to randomly select 120 processors from four Local Government Areas in three states (Abia, Enugu and Imo).. Data were collected from primary sources with the use of structured questionnaire designed in line with the objective of the study. Data collected were analyzed using budgetary techniques and descriptive statistics. Descriptive statistics used include percentages and frequencies.

Budgetary technique was used to estimate the gross margin, profitability index, rate of return on investment, operating expenses ratio, net income and benefit-cost ratio. The Gross Margin technique was given thus:

$$GM = GR - TVC \quad \text{.....(1)}$$

Where; GM = Gross Margin in naira per kg
GR = Gross Revenue in naira
TVC = Total Variable Cost in naira

The result of the budgetary analysis was used to obtain the following ratios;

PI = Profitability Index = NI / TR ....(2)

RRI = Rate of Return on Investment $= \frac{NI}{TC} \times \frac{100}{1}$ ....(3)

OR = Operating expenses ratio $= \frac{TVC}{TR}$ ....(4)

Where; NI = Net Income
TR = Total Revenue
TC = Total Cost
TFC = Total Fixed cost
TVC = Total Variable Cost

RESULTS AND DISCUSSION

Profitability Analysis of Cassava processing

The budgetary technique was used to analyze the profitability of cassava processing into garri, while BC ratio, profitability index and rate of return on investment were calculated. The result of the analysis is presented in Table 1.

Findings showed that the cost incurred in cassava processing included cost of raw materials (cassava tubers, firewood, fuel, water, bags, palm oil etc), labour (peeling, washing, grating (soaking, drying, sieving, frying etc), and cost of depreciated assets. An average of 2730.63kg of cassava was processes into garri and this accounted for 29.17 percent of TVC and 25.35 percent of TC. Labour cost accounted for 37.84 percent of TVC and 32.89 percent of TC while other raw material inputs accounted for 32.99 percent of TVC and 28.67 percent of TC. The remaining 13.09 percent of the TC were accounted for by other inputs. The estimated total cost was ₦250,465 while the estimated total revenue was ₦544,490.94 for the garri enterprise. Result of the analysis showed a gross margin of ₦326, 814.53/tonne and an estimated Net Income (NI) of ₦294, 025.19. Furthermore, the estimated profitability index (PI) of 0.5400 implies that 54 percent of total revenue generated constituted Net Income for the garri enterprise and for every ₦1.00 earned as revenue, 54 Kobos were returned as net income. Hence, the cassava processing enterprise was profitable. The rate of return on investment (ROI) was calculated as a percentage ratio of the Net Income to the Total Cost (TC). ROI ratio in this study was used to estimate earnings per ₦1.00 investment. The estimated ROI for the garri enterprise was 117.39. This implies that the garri enterprise made more than double the amount on every ₦1.00 invested. This could also be seen in the estimated Benefit-Cost ratio for the enterprise. For every N1.00 spent, there was a return of N1.17 (2.17:1.0) for the garri enterprise. This confirms the findings of Ehinmowo *et al.* (2015) that the processing of cassava is profitable, returning a BCR of between 1.75 and 2.24 in Southwestern, Nigeria. Operating Ratio (OR) is a profitability indicator which measures percentage of variable cost per N1.00 sale. The OR for the enterprise was 0.40 (40%). This result indicates that for every N1.00 sale/revenue, the percentage of variable costs was 40 percent. This could be attributed to the prices and quantities of the inputs of variable cost items used in the production process.

Constraints to Garri Production

Garri production in the study area is faced with numerous challenges affecting its productivity which can also result to various levels of inefficiencies. The problems associated with garri production in the study area include inadequate capital, high cost of labour, high cost of transportation, lack of processing and storage equipments among others. Findings from Table 2 showed that inadequate capital, high cost of transportation, high input price, high interest rate as well as high cost of labour were the major constraints faced by the processors. The result showed that 65 percent of the respondents ranked first in terms of problems faced in garri production. Capital serves as the major back bone in any business enterprise. High cost of transportation and high input prices ranked second and third respectively.

CONCLUSION

Based on the findings, the enterprises were profitable at varying levels with garri and abacha enterprises returning more than double the amount invested in them. while problems such as high cost of labour, lack of basic amenities, inconsistent government policies and high cost of processing were among the major problems faced by the processors. Provision of credit support to investors in cassava processing not only as agricultural loans but as part of small and medium scale enterprises (SMEs) development grant, to expand their capacities, adopt new technologies / innovations, improve scale of operation and income is recommended. The amount of credit used by the processors in most of the cases had significant effects on their performance. Therefore the relevance of credit in strengthening the processors is fundamental.

Table 1: Cost and Returns Analysis for Cassava processing into garri in the study Area

Item		Garri value
A	Revenue	544490.94
B	Variable cost items (₦)	
	Cassava root	63487.15
	Other raw material cost	71818.28
	Labour Cost	82370.98
	Total Variable cost (TVC)	217676.41
C	Fixed cost items (₦)	
	Grater	50083.70
	Weighing scale	
	Others	113862.99
	Total fixed cost (TFC)	163946.69
	Depreciation	32789.34
	Total Cost (₦)	250465.75
	Net Income (NI) = TR-TC	294025.19
	Gross Margin (Revenue –TVC)	326814.53
	Benefit Cost Ratio (Revenue/Total cost)	2.17:1.00
	Profitability Index = NI/TR	0.5400
	% of Net profit to total sales/revenue	54%
	Rate of return on Investment (%) = NI/TC X 100/1	117.39%
	Operating Ratio (TVC/TR)	0.3998

Source: Field Survey, 2015.

Table 2: Problems Affecting Garri Production

Challenge	Frequency*	Percentage (%)	Ranking
Inadequate Capital	78	65	1
High Cost of Labour	55	45.83	5
Lack of Market Outlet	20	16.67	9
Weather Conditions	14	11.67	11
High Cost of Transportation	65	54.17	2
Lack of Basic Amenities	40	33.33	6
High Input Prices	64	53.33	3
Lack of Processing/storage equipment	39	32.5	7
High interest Rate	61	50.83	4
Lack of Extension Service	15	12.5	10
Low level of Income	20	16.67	9
Inconsistent Government Policies	32	26.67	8

Source: Field Survey, 2015
* Multiple Responses

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AGRIBUSINESSES ENTERPRISES: A ROADMAP TO SELF-RELIANCE AND SUSTAINABLE ECONOMIC DEVELOPMENT

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ABSTRACT

Presently the economic situation in Nigeria is deplorable and has manifested in the exchange rate of dollars high level of unemployment, double digit rate of inflation. More than 25 states in the federation cannot even pay workers salaries. There is so much hunger in the land. A discussion on agribusiness enterprises as a road map to self reliance and sustainable economic development is therefore a welcome idea to the present issue of economic diversification in Nigeria. Agribusiness enterprise is a collective business activities that are performed from farm to fork and involves processing, packaging, production, marketing and so on. Its objectives and benefits to the nation were highlighted in this study. Notable considerations in moving forward include integration of agribusiness enterprises into policy formulation agenda, technological innovations in various areas of agriculture, organization of seminars and trainings for farmers and so on. The study, however, is of the opinion that government should promote policies and programmes to energize agribusiness in the country.

Keywords: Agribusiness, enterprise, roadmap, sustainable, self-reliance, economic, development

INTRODUCTION

Nigerian government over the year, that is since after the discovering of crude oil in Nigeria, have relied so much on income from crude oil than on agricultural produce. This is one of the major reasons why almost all agricultural programmes established to resuscitate the economic condition of Nigerians, failed to be fruitful. Presently the economic situation in Nigeria is deplorable and has manifested in the exchange rate of dollar, high level of unemployment, double digit rate of inflation. Today many state governments are unable to pay their workers salaries and the resultant effect of this is acute poverty and hunger in the society. This however calls for the need for economic diversification in Nigeria, and it has been found out that one of the basic ways of doing this is through establishment and development of various agribusiness enterprises in the different communities in Nigeria.

Agribusiness enterprising involves complex business activities that are performed from farm to fork, that involves processing, packaging, production, marketing and so on. There are several objectives for establishment of agribusiness ventures in any nation and all of them aimed at making the country to be self-reliance. Its importance to the Nigerian society, when actually adopted, as has been found out, would not only create wealth, but will also make individuals, farmers and Nigerian society as a whole to be self-reliant.

The objectives of this study therefore were:

i. to give an overview of agribusiness(es);

ii. evaluate self-reliance and economic development through agribusiness(es);

iii. examines the roadmap to sustainable economic development through agribusiness ventures;

METHODOLOGY

The major sources of information presented in this study were obtained from conference papers, journal publications, magazines, books of proceedings and textbooks.

Overview of Agribusiness Enterprises

Agribusiness is any type of business involved in agricultural production. This finding however, goes in line with the definition given by the free dictionary (2016), where agribusiness is defined as a large scale farming. This definition was also similar to the definition given by Wikipedia (2016), where agribusiness was defined as the business of agricultural production. According to Wikipedia (2016), the term "agribusiness" was coined in 1957 by Goldberg and Davis. It includes agro-chemicals, breeding, forestry projects, horticulture, livestock farming, crop production, (farming and contract farming), distribution, farm machinery, processing, and seed supply, as well as marketing and retail sales.

According to the Department of Agriculture, Jomo Kenyatta University of Agriculture and Technology (2016), agribusiness is the business of food, agricultural commodity and fiber production and the technology necessary to change raw materials (a commodity) or an idea into a new product or business for the world's consumers. This however, shows that agribusiness is a complex enterprise that integrates agricultural production, processing, packaging, distribution and marketing activities (APO, 2003). APO (2003) goes on to state that agribusinesses entail greater risk that simple farming and require specific skills and experience.

On the other hand, agribusiness is also seen as the collective business activities that are performed from farm to fork (FAO, 2016). It covers the supply of agricultural inputs, the production and transformation of agricultural products and their products to final consumers. Agribusinesses include firms that are involved in production of plants and animals. Its approach involves examining farming problems in a new and more compressive setting. The major benefit of this approach is the release of workers (farm manpowers) from agriculture to employment in new non-farm operations (Encyclopedia, 2016).

Objectives for Agribusiness Enterprise Development in Nigeria

According to ATC (2016) the major objectives for agribusiness enterprise development are:

- To enable farmers develop positive attitudes towards agribusinesses.
- Enable farmers determine real market demand for their agricultural produce.
- Sensitize farmers about the value chain(s) of their chosen agribusiness enterprise(s) and the possibilities of value addition.
- To determine current skills and knowledge that farmers possess, to establish the gap and suggest possible ways of acquiring such skill and knowledge to close the gaps.
- Assist farmers learn how to scan internal and external business environmental factors.
- Sensitize farmers on profitability and risk analysis regarding agribusiness enterprises.
- Highlight requirements for starting up and budgeting for agribusiness enterprises.
- Sensitize farmers on how they can mobilize resources for their agribusiness enterprises.

Roadmap to Sustainable Economic Development through Agribusiness Enterprises

Having looked at the concept of self-reliance, economic development and agribusiness enterprises, it is also necessary to look at various ways of promoting agribusiness enterprises for self reliance and sustainable economic development in Nigeria. Some of the ways are:

Policy Formulation: Agribusiness enterprises should be considered in policy formulation in Nigeria and policies formulated should always be in favour of such enterprises. There should be an adequate interaction between the rural community development officers and professionals in agricultural policy formulation, programme implementation and evaluation for rural areas in Nigeria, in any areas of need before they are established and implemented (Ajakemo, 2015).

Technological Innovation: There should be on the farm technological development in order to solve some problems encountered on the farm. Use of electronic gadgets for making animals in the farm is a example. There should also be some innovations in various areas of agriculture such as in the use of milking machines, animal breeding practices, irrigation and drainage system etc. Some of the technologies when introduced should be tested, trailed before being adopted for use by man.

Research and Development: Government should invest large sum of money on research and development institutions. This will help to improve agricultural productivity and profitability.

Development of Business Skills: Development of business skills could be achieved among farmers and youths through seminars and trainings. Such training should be designated to empower small holder individual farmers and farm groups with the basic entrepreneurial skills to enable them identify and select feasible agricultural enterprises to engage in within their locality.

Re-establishment and Development of co-operative Societies: Rural farmers, families and individuals should be encouraged to establish and develop the already existing co-operative societies in their localities. This medium will help them to take up one or more agricultural ventures especially medium scaled enterprises easily. Such medium will not only help them to assist themselves financially, it will also help to attract the government to help them financially where need be.

CONCLUSION

Having assessed agribusiness as roadmap to economic prosperity, the study has identified a number of factors as possible panacea to the economic downturn. In the light of the foregoing, the study recommends that government should promote policies and programmes to energize agribusiness in the country.

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DETERMINANTS OF INVESTMENT BEHAVIOUR AMONG SMALLHOLDER PIG FARMERS: IMPLICATIONS FOR IMPROVING THE FARMING SYSTEMS OF ABIA STATE, NIGERIA

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ABSTRACT
Over the years, pig farming has emerged as an effective enterprise and can be a reliable one due to certain attributes of pigs and the Nigeria production system. Pigs are known to be prolific producers realizing twenty to thirty (20-30) piglets from 2½ litter per year. Its ability under efficient management and balanced nutrition to reach slaughter weight of about 80 to 90kg in about 7 to 8 months makes it one of the most efficient feed converters. The demand for pork in Abia State has remained higher than supply as most shops that deal on processed pork are always running short of supply due to excess demand. Inadequate supply of feed has been one of the problems militating against pig production in Nigeria. The study examined the determinants of investment behavior among smallholder pig farmers in Abia State. A total of 120 farmers were purposively selected using a well structured questionnaire, information sought were on the socio –economic characteristics and other quantitative variables of interest. Descriptive statistics such as percentages, mean, frequencies and multiple regression model were used in analyzing the data. The results of the analysis revealed that Age and interest rate were significant and negatively related to investment while farm profit, farming experience, farm income and depreciation were significant and positively related to investment. it was recommended that government should adjust their monitory policy to bring about reduction in interest rate so that farmers can have access to loan at cheaper and affordable rate. This will encourage farmers to invest more in pig farming, thereby boosting the farming system through diversification of enterprises and improved income generation.
Keywords; Determinants, Investment, Pig Farmers

INTRODUCTION
Agriculture in Nigeria is practiced at subsistent level and its characterized by numerous farmers operating several scattered small and fragmented land using traditional methods such as lands rotation, bush burning and crude implements (Odoemenen *et al*, 2013).
According to OLuwepo,(2012); majority of the rural populace in Nigeria either depend entirely on farming and farming activities for survival and generation of income, or depend on other non farming activities to supplement their main sources of income. The validity of this statement becomes evident when it is realized that over 90.0% of the countries local food production comes from small farms which are usually not more than 10 hectares in size, while at least 60% of the population earn their living from these small farms. It could then be seen that most farmers have limited resources, a factor that limits their production outputs, income and investment.
Investment in agriculture is highly dependent on credit factors and other variables. Some of the factors according to Foster, (1996) are internal to the firm and others are a function of the economic environment. Managers can influence agricultural investments to some extents by developing strategies to effect variability, products divergent, amount of product innovations, input price variability, and fixed cost. Investments are being made in agriculture to improve the quality of rural assets and enhance productivity. The ability, willingness and opportunity of household to save and invest overtime can therefore significantly influence the rate and sustainability of capital and accumulation and economic growth in developing countries (Oluwakemi, 2012).
Over the years, pig farming has emerged as an effective enterprise and can be a reliable one due to certain attributes of pigs and the Nigeria production system. Pigs are known to be prolific producers realizing twenty to thirty (20-30) piglets from 2½ litters per year. Its ability under efficient management and balanced nutrition to reach slaughter weight of about 80 to 90kg in about 7 to 8months makes it one of the most efficient feed converters. The production of pigs in an economically viable livestock system, therefore calls for the provision of nutritionally balanced ration. This however, represents 50 to 83% of the production cost in a commercial pig enterprise (Tewe and Adesehinwa, 1995).
The demand for pork in Abia State has remained higher than supply as most shops that deal on processed pork are always running short of supply due to excess demand. Inadequate supply of feed has been one of the problems militating against pig production in Nigeria due to high cost of feed ingredients (Ngoka, 1979). Therefore this study is expected to provide relevant information that would encourage individual (farmer) not only those that are already in piggery, but also new entrants to venture into pig farming. The broad objective of the study was to

access the determinants of investment behavior among smallholder pig farmers in Abia State and to examine the socio-economic characteristics of farmers in the study area

METHODOLOGY

The study was conducted in Abia State of Nigeria. Abia State belongs to one of the states in the South –eastern Nigeria. The population according to the 2006 Census was about 2833999 comprising 1,434,193 males and 1399,086 females (NPC, 2006).Abia State is divided into 167 local Government Areas. The State shares common boundary with Rivers State in the South, Imo State in the west, Ebonyi and Enugu States in the North and Akwa Ibom and Cross River in the East. There are (3) Agricultural Zones namely Aba, Ohafia and Umuahia. The people of the state are mostly farmers. Farmers grow major crops such as Maize, Yam, Cassava, Rice, Vegetable etc, Livestock e.g. Goat, Pigs, Sheep, etc and Plantations, such as oil palm production, cocoa plantation and rubber.
Multistage sampling techniques was employed for the study, three local Government areas were selected from each of the (3) agricultural Zones, four communities were selected in the Second stage from the Local Governments given a total of Twelve communities. The last stage was a selection of 10 respondents from each of the communities. 120 respondents were employed and their represented the sample size for the study. Primary data were collected using a well structured questionnaire. Analysis was carried out using descriptive statistics such as tables, frequencies, percentages, mean and multiple regression model.

To estimate the determinants of investment the following model was specified in line with Ezeh (2007).
Where $Q=X_1, X_2$……………………….X_9+ei.
Q= Amount Invested (N `
X_1= Age of Farmer (Yrs)
X_2 = Cost of Variable Input
X_3 = Farm profits (N)
X_4 = Education of Farmers (Yrs)
X_5 = Household Size (No)
X_6 = Farming Experience (Yrs)
X_7 = Farm Income (N)
X_8 = Interest Rate (%)
X_9 = Depreciation (N)
ei = Error Term

RESULTS AND DISCUSSION

The Functional forms of multiple regression model namely linear, exponential, semi log and double log were tried and the semi log regression model was chosen as the lead equation based on the value of R^2 (coefficient of multiple determinations), F-Statistics, the number and degree of significant variables. The R^2 is 0.853 shows that 85.3% of the variation in the dependent variable was accounted for by the independent variables included in the model. Age and interest rate were significant and negatively related to investment while farm profit, farming experience, farm income and depreciation were significant and positively related to investment.

The results in Table 1 depicts that, Age had a negative coefficient and significant at 1% probability level, indicating that as the age of the respondent increased, investment decreased , the implication is that as the farmer gets older it could be constrained by energy and the greater the level of constraints it could face. As such, the less time he has to attend to his farm; this also affects his level of investment in the farm. Interest rate was significant at 1% risk level and negatively related to investment indicating that as interest rate increased, amount invested decreased. this could be due to the fact that interest rate which is the cost on borrowed funds increased, the burden of borrowing and the greater the burden of borrowers on the amount of money borrowed, the less the amount they borrow from lending institution, the less their investment. According to Aluko,(1987),increased interest rate will lead to under investment or low investment. Farm profit was significant at 5% risk level also and positively related to investment, indicating that as farm profit increased, investment also increased and vice versa. Under normal condition increased farm profit could be as a result of the maximization of economic benefits. Higher rates of maximizing economic benefits lead to availability of fund for investment in the farm investment. Farming experience was also significant at 1% probability level and positively related to investment. Increase in farming experience could be an indication of the practical knowledge which has been acquired by the farmer Olomola (1988). In line with a prior expectation, farm income had a positive coefficient and was statistically significant at 1% level of probability. The results revealed that the higher the income the farmer realizes from his farm, the greater his level of farm investment. This result consolidates the findings of Ezeh (2004) who obtained a similar outcome Depreciation was significant at 1% probability level and positively related to investment, indicating that the more depreciation value increased, the more investment. This implies that the effort by the farmer to keep the fixed assets in good working condition has a long run effect on his farm business, although the reverse is the case in the short run.

CONCLUSION

The study was carried out to analyze the determinants of investment behavior among pig farmers with a view to enhance the farming systems of Abia State. The results revealed that Age and interest rate were significant and negatively related to investment while farm profit, farming experience, farm income and depreciation were significant and positively related to investment. It was recommended that government should adjust their monitory policy to bring about reduction in interest rate so that farmers can have access to loan at cheaper and affordable rate. This will encourage farmers to invest more in pig farming, thereby boosting the farming system through diversification of enterprises and improved income generation.

Table 1: Regression Analysis on Determinants of Investment Behaviour Among Smallholder Pig Farmers in Abia State, Nigeria

Variables	Linear	Exponential	+ Semi log	Double log
Constant	-40215.371	10.113	-1030.710	0.114
	(-0.794)	(25.573)***	(-7.124)***	(0.191)
Age	330.424	0.008	-41866.345	0.001
	(0.617)	(2.030)**	(-3.105)***	(0.015)
Cost of Var. Input	-8.44E-00.5	2.58 E0.008	-3280.408	0.003
	(-0.011)	(0.434)	(-0.678)	(0.169)
Farm Profit	0.007	6.21E-008	-3280.408	0.003
	(1.679)*	(1.850)**	(2.203)**	(2.364)**
Education	1290.933	0.017	-6704.845	0.004
	(0.775)	(1.286)	(-0.777)	(0.106)
Household Size	-5183.925	-0.073	6885.890	-0.062
	(-1.472)	(-2.660)***	(0.619)	(-1.347)
F. Experience	4995.642	0.042	106903.75	0.990
	(2.485)***	(2.654) **	(9.680)***	(19.404)***
Farm Income	0.392	4.35 E.006	2278.047	-0.004
	(1.300)	(1.846) **	(5.734)***	(-0.161)
Interest Rate	98799.931	-0.0802	-940.816	-0.030
	(0.622)	(-0.647)	(-6.537)***	(-1.033)
Depreciation	3.219	2.70 E-005	110285.87	0.944
	(9.208)***	(9.879)***	(17.531)***	(36.549)***
R^2	0.847	0.859	0.853	0.988
F-Ratio	14.097	15.550	52.159	212.508

Source: Computed from Field Survey, 2008.
Note: Figures in parenthesis are T-Values ***-Statistical Coefficient Significant at 1%
** - Statistical Coefficient Significant at 5% *- Statistical Coefficient Significant at 10%
+= Lead Equation

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CONSTRAINTS MILITATING AGAINST PRODUCTION AND COMMERCIALIZATION OF COCOYAM IN ABIA STATE

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ABSTRACT
The study examined the determinants of production and commercialization of Cocoyam in Abia State. The specific objectives include to; determine the socio-economic characteristics of Cocoyam Farmers, examine the factors that affect cocoyam production, categorize the farmers based on the level of commercialization, identify the constraints in cocoyam Production and Commercialization. The study was carried out in Abia State. Multistage random sampling technique was used in selecting the respondents. The data collected were analyzed using descriptive statistics, ordinary least square method and commercialization index as detailed below. The result indicates that female household heads (76.7%) dominated farming in the area. Many (48.9%) of cocoyam farmers are married. The farmers are educated. About 52.2% attended secondary schools while 21.1 % attended tertiary education. Highest farming experience ranged between 11 to 20 years (45.6%) and the majority of the respondents are aged between 51 to 60 years (46.7%). Cocoyam farmers are moderately oriented towards market production (42.1%). Marketing problems (81.1%), low soil fertility (80.0%), high incidence of pest and disease infestation (74.4%), small farm size (72.2%) high cost of inorganic fertilizer (72.2%), difficulty in obtaining credit facilities (61.1%) and poor access to good roads for transportation (60.0%), in the order listed, are identified as the constraints to cocoyam production and commercialization by the respondents.
Keywords: Commercialization, cocoyam, constraints, Abia State

INTRODUCTION
Nigeria is an agrarian nation but still face an ever increasing food crisis as the level of food production is yet to keep pace with demand. There is worsening food insecurity, even with massive food importation as evidence by rising food import bill (Okoye, et al 2008). Akan Sunmi (2009). Nigeria faces acute food shortage and its accompanying ravaging malnutrition. Though endowed with vast expanse or arable land for crop production report still shows that Nigeria cannot produce food crops her population requires and thus being depending of food-importation to meet her domestic demands (Adepeju and Awodumuiyila, 2008). Cocoyam is an important staple in Nigeria and rank third in importance after cassava and yam among the root and tuber crops cultivated and consumed Echebiri 2004, Okoye, Asumugha, Okezie, Tanko and Onyenweaku, (2008).
It is the most widely grown crop in both western and eastern region of Nigeria in terms of area cultivated and number of producer and it is not only a major source of food but also income especially in the rural area (Oguniyi, 2008). Nigeria is the world leading producer of cocoyam with an estimated 3.5 million metric tones in 2003. This was about 40% of the world cocoyam production (Eze and Okorji, 2003). As a food crop cocoyam has some inherent characteristic, which make it attractive to consumers in Nigeria. It has a multiplicity of end uses; for example, it can be used for making starch, flour, soup, confectionaries and so on.

METHODOLOGY
Study Area
The study was carried out in Abia State, South-Eastern Nigeria. The state is located between longitudes 5° and 7° East of the Greenwich meridian and attitude 5° and 7° North of the equator. Abia State is in rainforest belt with a temperature range of 21°c to 28°c and high humidity. The state occupies about 5,834 square kilometres, is bounded on the north and north east by the states of Anambra, Enugu and Ebonyi. To the west of Abia is lmo state, to the east and south east are Cross River State and Akwa lbom State and to the South is River State. The Southern part of the state lies within the riverine part of Nigeria. It is low-lying with a heavy rainfall of about 2400mm/year especially intense between the months of April through October. The rest of the state is moderately high plain. The major soil types commonly found in these areas includes clay soil, loamy soil, sandy soil and sandy loam soil. The population of Abia State as reported by National population Commission 'NPC' (2006) is 2.4 million people; mainly Christians with more than 85% of the population engaged in farming as main source of livelihood. It has 17 administrative local government area divided into three (3) agricultural zones namely: Zone, Umuahia, Isiala Ngwa, Ohafia, it is suitable for livestock rearing, production of cash crops such as oil palm, cocoa, kola nut and food crops such as yam, cassava, cocoyam, plantain etc.

Sampling Procedure
Multistage random sampling technique was used in selecting the respondents. Two local government areas were randomly selected from each of the three agricultural zones making six local government areas. From each of the six local government areas, one community was selected making six communities with the assistance of key

informants, the list and location of cocoyam farmers in each community was compiled from which the sample for the study was drawn. Fifteen (15), farmers were sampled from each of the six communities across the state totaling 90 cocoyam farmers in all.

Method of Data Collection

Data was collected through the primary source by the use of well structured questionnaire that were administered to cocoyam farmers. The questionnaire was used to obtain information on the socio-economic characteristics and other quantitative variable such as size of cocoyam farm cultivated, labour input used, expenses on planting materials, fertilizer and fixed capital inputs.

Data was collected through visits, personal interviews and direct observations, on the production of cocoyam planting season by the researcher. These will help to facilitate the correct interpretation of questions and proper recording of responses.

RESULTS AND DISCUSSION

The socioeconomic characteristics of the respondents are presented in Table 4.1 and the results show that the farmers are predominantly married, literate and middle aged female farmers with relatively high farming experience. In terms of constraints, marketing problems alongside low soil fertility cum high incidence of pests/diseases were reported to be the major problems militating against commercialization.

RECOMMENDATIONS

It is recommended that the level of education and experience of cocoyam farmers be increased through awareness campaigns and dissemination of research information and findings of research institutes through extension services, television and radio programs.

Table 4.1: Socioeconomic Characteristics of the Respondents

Socioeconomic characteristics		Frequency	Percentages
Gender	Male	21	23.30
	Female	69	76.70
Marital status	Single	19	21.1
	Married	44	48.9
	Divorced	16	17.8
	Widowed	11	12.2
Education	Primary Secondary	24	26.7
	Tertiary	47	52.2
		19	21.1
Farming Experience	01-10	10	11.1
	11-20	41	45.6
	21-30	18	20.0
	31-40	21	23.3
Age	20-40	4	4.4
	41-50	21	23.3
	51-60	42	46.7
	61-70	23	25.6

Source: field survey, 2014

Table 4.2 Constraints to cocoyam production and commercialization

	Constraint to Cocoyam Production and Commercialization	YES		
		Frequency	%	**Rank**
1.	High cost of inorganic fertilizer	65	72.2	4
2.	Lack of finance	44	48.9	8
3.	Poor extension Service	38	42.2	9
4.	Low soil fertility	72	80.0	2
5.	Small land size	65	72.2	4
6.	Poor access to good roads for easy transportation	54	60.0	7
7.	Difficulties in obtaining credit facilities	55	61.1	6
8.	High incidence of pest and disease infestation	67	74.4	3
9.	High cost of hired labour	32	35.6	10
10	Marketing problems	73	81.1	1

Source: Field Survey, 2014 (multiple Responses)

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EFFECT OF NATIONAL DIRECTORATE OF EMPLOYMENT-RURAL EMPLOYMENT PROMOTION (NDE-REP) ON POVERTY STATUS OF AGRIBUSINESS ENTREPRENEURS IN ABIA STATE

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ABSTRACT
The study analyzed the effect of NDRE-REP on the poverty status of agribusiness entrepreneurs in Abia State. A purposive sampling technique was used to select 60 beneficiaries and 60 non beneficiaries of NDE-REP in the state. Data were collected through personal interviews, focus group discussions and well-structured questionnaire. The data was analyzed by means of descriptive statistics such as frequency tables, percentages and Tobit regression analysis. The coefficients of membership of cooperatives and farm size have an indirect relationship with poverty intensity at 5% level of probability each and business experience and age at 10% level each. The coefficient of beneficiaries of NDE-REP had an indirect relationship with poverty intensity at 1% level. The coefficients of native of community and household size had a direct relationship with poverty intensity at 10% and 5% level of probability.The results therefore call for policies aimed at land reforms by allocating more land especially to the youths, formation of cooperatives and sustaining the NDE-REP programme to improve the welfare of the farmers and poverty reduction.
Keywords: NDE-REP, Poverty Status and Agribusiness Entrepreneurs

INTRODUCTION

Poverty is a global phenomenon which threatens the survival of mankind. Majority of the poor people live in the rural areas. The poverty situation in the country has reached such a monumental crisis that it has become a great concern to the government at all levels (Ogunlela andOgwumike 2006).It has been observed that one of the principal causes of poverty in the country is unemployment resulting from joblessness and under-employment. The rate of unemployment has been on the increase in the last few years. For example, the labour forces sample survey conducted by the National Bureau of Statistics (2010) indicated an increase from 14.7% in March 2008 and 19.7% in 2009.

A number of government programme have been put in place to improve basic services. Such as infrastructure, housing facilities, access to credit, and provision of farm inputs and creating employment for the rural population. Such programmes includes; farm settlement scheme, River Basin Development Authorities (RBOA), Agricultural Development Programme (ADP), Better Life Programme and NDE-REP etc, all these were established by different administrations in the country to address various manifestation of poverty such as unemployment, lack of access to credit and rural and gender dimension of poverty. (Ogwumike, 2002).The National Directorate of Employment (NDE) is a skill formation and credit granting scheme, with consequences on alliterating Agribusiness entrepreneurship development. NDE-REP was targeted towards alleviation of poverty in rural areas which is based on that of engagement of Agribusiness entrepreneur skills. (Mbam et.al, 2010). Therefore, the objective of this study was to determine the effect of National Directorate of Employment-Rural Employment Promotion (NDE-REP) on poverty status of agribusiness entrepreneurs in Abia State.

METHODOLOGY

The study was carried out in Abia State. Abia State is one of the South-East Geo-political Zone of Nigeria. the state is made of 17 local government areas with the capital in Umuahia. It lies between longitude 4°45 and 0.6°17 North and Latitude 07^0 .00 and 08^0 10 East bounded by Imo State on the West, Ebonyi and Enugu State, on the North, Cross River and AkwaIbom State on the East, Rivers State on the South. The major occupation of the people is agriculture due to the rich soil, which stretches from yam, cocoyam, plantain, rice, vegetables, okro, maize etc, (NPC, 2006).

A multi-stage sampling procedure was used for the study. In the first stage, the three zones of the state were selected based on the evidence of NDE-REP consistency since the last 5 years. In the second stage, one local government areas were purposively selected also from each zone given a total number of three local governments. In the third stage two communities from each local government where NDE-REP has taken place were selected given a total number of six communities. A total of 60 beneficiaries were randomly` selected through the help of local governments officials of NDE in each local government and 60 non beneficiaries were also selected through the aid of Extension Agents of ADP given a sample size of 120 respondents.Data was analyzed by means of descriptive statistics such as frequency tables, percentages and Tobit regression analysis. The descriptive statistics was used to analyze variables like the socio-economic characteristics of the respondents, Tobit regression was used to analyze the determinants of poverty status among entrepreneurs in the study area.

RESULTS AND DISCUSSION

Table 1 shows the socio-economic characteristics of the respondent, which indicates that monthly income of the beneficiaries wasN45,119.29 while monthly income of non-beneficiaries N31,135.35. This implies that the beneficiaries earned higher income than the non-beneficiaries. The result also shows that majority of the beneficiaries belong to cooperatives societies (62.50%) compared to (40%) for the non-beneficiaries. This institutions help to address gender inequalities by mobilizing savings from members, donor agencies, NGOs and development agencies to develop member's business. The beneficiaries and non-beneficiaries had an average farm size of about 1.07 and 1.3ha respectively. This implies that they are small-holder farmers. The average years of business experience was 10 and 11 years for the beneficiaries and non-beneficiaries respectively. This indicates they have long years of business experience. The beneficiaries and non-beneficiaries had a household size of 5 and 8 persons respectively. This indicates that large household sizes have correlation with food insecurity, especially when the head of the family is engaged in agriculture as the main source of income and livelihood.
The results in Table 2 show the Tobit regression estimates of the determinants of poverty status among entrepreneurs in the study area. The result shows that the coefficient of household size was positive and significant at 5% level. This implies that any increase in household size will lead to increase in poverty intensity among the respondents.The coefficient of business experience was negative and significant at 10% level. This implies that increase in business experience will decrease the poverty intensity of the respondents. The coefficient of membership of cooperatives was also negative and significant at 10% level. This implies that respondents who are members of cooperatives have a decreased probability of staying below the poverty line than their counterparts who are not members.The coefficient of farm size was negative and significant at 5% level. This implies that any increase in farm size will lead to a corresponding decrease in the poverty intensity of the respondents with more output leading to more income and reduction in poverty among them. The coefficient of beneficiaries of NDE-REP has a lower probability of stay below the poverty line than non-beneficiaries. Being beneficiaries decreased the poverty line of the respondents.

Table 1: Average statistics of the respondents

Variable	Beneficiaries	Non beneficiaries	Pooled
Age	38.28	37.35	37.82
	(13.83)	(9.93)	(11.98)
Education	13.02	12.00	13.01
	(1.09)	(1.18)	(1.04)
Household size	5.10	8.13	6.11
	(1.74)	(2.65)	(7.16)
Experience	10.84	11.30	11.05
	(12.47)	(11.42)	(11.92)
Monthly income	45,114.29	31,135.35	37,930.94
	(22,795.17)	(23,867.81)	(24241.48)
Farm size	1.07	1.31	1.13
	(0.63)	(0.72)	(0.66)
Membership of crop (%)	62.50	40.00	51.25
Gender (% males)	62.50	65.00	63.75
Marital status (% married)	57.50	42.50	50.00
Native of community	52.50	55.00	53.75

Source: Field Survey, 2016

Table 2:Tobit Regression estimates of the Determinants of Poverty Status among entrepreneurs in the Study Area

Variables	Coefficient	Standard error	t-value
Constant (bo)	14808.08	6502.38	2.28*
Gender (X_1)	5280.73	3270.41	1.61
Age (X_2)	-313.83	172.61	-1.82*
Education (X_3)	-53.53	1.328.69	-0.04
Native of community (X_4)	1316.24	771.86	1.71*
Household size (X_5)	5718.83	1567.04	3.64**
Business experience (X_6)	-472.79	200.29	-2.36*
Membership of cooperatives (X_7)	-8277.13	3843.84	-2.15*
Farm size (X_8)	-11108.41	2988.61	-3.72**
NDE-REP	-2310.05	408.481	-5.87***
Chi^2	42.97***		
Pseudo R^2	0.1184		
Log likelihood	-160.031		

Source: Computed from STATA 4A

***, ** and *** is significant at 10%, 5% and 1% level respectively**

CONCLUSION

The study analyzed the effect NDE-REP on poverty status of agribusiness entrepreneurs in Abia State. Important variables related to poverty status include age, household size, business experience, membership of cooperatives, native of community and form size. Therefore there is need for policies aimed at land reforms by allocating more land especially to the youths for agribusiness activities, encouraging the formation of cooperatives and sustaining the NDE-REP programme by bringing it closer to the people and introduction of adequate practical's to aid training.

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RURAL CREDIT AND TECHNICAL EFFICIENCY AMONG YAM FARMERS IN ISUIKWUATO LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA

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ABSTRACT
This study was designed to examine rural credit and production efficiency among yam farmers in Isiukwuato Local Government Area of Abia State. The objectives of the study were to describe the socio-economic characteristics of credit-users and non-credit users in yam production and to determine the relative technical efficiency among them. A purposive sampling of ten yam producing villages in the study was done. A list of yam farmers who obtained credit from the two banks and cooperative societies was obtained. Six credit users were randomly selected from the ten village and six non-credit users were also randomly selected from the ten villages. Descriptive statistics was used to analyze the socio-economic characteristic of the yam farmers. However, regression analysis using additive multiplicative dummy variable approach was used to analyze the technical efficiency of the yam farmers. Cobb-Douglas functional form was chosen as the lead equation for technical efficiency because it had a high R^2 of 63%. Farm size(X_2), value of fertilizer (X_3) value of other inputs (X_4) and Dummy for labour (X_1D) were statistically significant at 5percent level. The credit users and the non-credit users operated under the existing technology and were factor biased or non-neutral in their production function. On the basis of the findings, government should ensure that agricultural credit facilities and incentives are given to yam farmers. Policies that will enhance acquisition of large farm size by credit-users should be formulated and implemented.

Key words: Rural credit, Technical efficiency, Production efficiency.

INTRODUCTION
Rural development is a process of not only increasing the level of per capita income in the rural sector, but also the standard of living of the rural population. With adequate financial capital, farmers can become more efficient in their resource allocation and uses (Eze, 2006). According to Okigbo (1981), it is generally acknowledged that the availability of financial capital is a pre-requisite for increased production and rapid economic development of any nation. It follows therefore that banks have a vital role to play in making vast financial resources available for financing and promoting crop production such as yam.

Inadequate credit facilities have long been identified as one of the major constraints to agricultural production in Nigeria. (Nwajiuba, 2000). A number of agricultural policies have been adopted by the Nigerian government in an effort to provide credit facilities to farmers. The policies emphasize the need to make credit available to farmers through formal and non-formal credit institutions so as to boost agricultural production.

Nigeria is by far the world's largest producer of yams, accounting for over 70-76 percent of the world production (Oluwatusin and Shitu, 2014).According to Akoroda and Hahn (1995), the production of yam in Nigeria is grossly inadequate and cannot meet the ever increasing demand for it under the present level of input use. One of the major factors that contribute immensely to this fallout in the productivity of yam over the years is the problem of production inefficiency. This is so as production efficiency is directly related to increase in production. Efficiency is concerned with the relative performance of the processes used in transferring given inputs to outputs.

Yam can be grown in nearly all tropical countries provided water is not a limiting factor. In Nigeria it is grown within the coastal region up to latitude 12^0N and corresponds to the rainforest, wood savanna and southern savanna belt. This is the region where the annual rainfall exceeds 800mm in amount and 4months in duration (Ike and Inoni, 2006).

The main objective of the study was to determine the impact of rural credit on production efficiency of yam farmers in Isuikwuato Local Government Area of Abia State, Nigeria. However, the specific objectives were:

- To describe the socio-economic characteristics of borrowers and non-borrowers among yam farmers.
- To determine the relative technical efficiency among users of rural credit.

METHODOLOGY
The Data
The data used in this study were primary data collected through cost-route approach by means of structured questionnaire from a sample of one hundred and twenty yam farmers in Isuikwuato Local Government Area of Abia State. A purposive sampling of ten yam producing villages was selected from the area. (Acha, Ozara, Ezere, Ahaba, Ovim, Ndundu, Akpukpa, Nvurunvu, Isunabo, and Achara).

A list of yam farmers who obtained credit from the two main banks in the area (Access Bank, PLC and Uturu Community Bank PLC) during the 2012 farming season were obtained from the banks, and corporative societies. Six credit users were randomly selected from the ten villages giving a total of sixty yam credit users. Six non-credit users were also randomly selected from the ten villages, giving a total of sixty non-credit users.

Data Analysis

The addictive multiplicative dummy variable approach was used to determine technical efficiency of the yam farmers.

The production function is implicitly specified as follows:

$Y=f(X_1, X_2, X_3, X_4, X_5, D, X_1D, X_2D, X_3D, X_4D, X_5D, ei)$ …….. (1)

Explicitly, the log linear Cobb-Douglas functional form is:

$LnY = LnA_0 + B_0D + A_1LnX_1 + B_1DLnX_1 + A_2LnX_2 + B_2DLnX_2 + A_3LnX_3 + B_3DLnX_3 + A_4LnX_4 + B_4DLnX_4 + A_5LnX_5 + B_5DLnX_5 + ei$ ………. (2)

Where in equation (1) and (2):

Ln = the natural logarithm

Y = Value of all output (₦)

A_0 = the intercept or constant term

B_0 = co-efficient of the intercept shift dummy or neutral technical efficiency parameter.

D = dummy variable which takes the value of unity for credit users and zero otherwise.

X_1D, X_2D, X_3D, X_4D, X_5D are the slope shift dummies for:

X_1 = Labour input (manday)

X_2 = Farm size (Hectare)

X_3 = Value of fertilizer used (₦)

X_4 = Value of other production inputs like seeds, cost of agrochemicals, planting materials (₦).

X_5 = Value of capital services used with the production period such as farm machinery, implements and tools

e_i = Error term

RESULTS AND DISCUSSION

1. Socio-economic characteristics of Respondents

a. Age of farmers:

For the non-credit users, 28% of the farmers were of the 26-35years age bracket, 8% were between 56 and 65 years old. For the credit-users, 42% were of the 36-45years age bracket and 3% were between 66 and 75years old.

b. Educational Level

For the non-credit users, 87% had formal education and 13% had no formal education. For the credit-users, 83% had formal education but 17% had no formal education.

c. Household Size.

For the non-credit users, 77% had a household size of 5-8, 3% had a household size of 11-15. In the credit-users, 78% had a household size of 5-8 and 3% had a household size of 11-15.

d. Years of Experience in Yam Farming

For the non-credit users, 27% had 5-15 years of experience in yam production while 8% had over 50years of experience in yam production. For the credit–users, 42% had 5-15years experience while 3% had over 50years experience in yam production.

e. Farm Size.

For non-credit user, 68% of the farmers had farm size of 0.1-1 hectare and 32% had farm size of 1.1-2 hectares. For credit users, 53% had farm size of 1.1-2 hectares and 13% had farm size of 3.1-4 hectares.

From the Table1, the intercept dummy for the two groups of farmers was not significant this implies that the two groups of farmers were equally technically efficient in yam production.

However, the slope shift dummy for labour was statistically significant at 1 percent indicating that the credit users and the non-credit users were factor biased or non-neutral in their production function. The slope shift dummy for labour was positive, which shows a higher level of use intensity for labour by the credit users.

The result indicated that the Linear form fitted the data for credit users with 66% of the total variation in the value of output accounted for by the explanatory variables. The value of output was significantly influenced by the labour, farm size and other production inputs at 5% probability level. This implies that one additional unit of labour will reduce the value of output by N326.50. White one hectare increase in farm size will increase the value of yam production by N55,781.24 and one Additional unit of other productive input will lead to #1,229.00 increase in the value of output of yam. The value of fertilizer used and the depreciated capital input were not significant.

The result of the estimated function for non-credit users in Table2 indicates that the double log production function was the best fit and explains 55% of the variation in yam output in the study area.

The coefficients of labour and other inputs were positive and statistically significant at 5% Level. However, the coefficient of fertilizer was negative but statistically significant at 5% Level this implies that a unit increase in labour will increase the value of output of yam by N512.00; a unit increase in other production inputs will increase production of yam by N470.00

CONCLUSION

The main objective of this study was to determine the impact of rural credit on the production efficiency of yam farmers in Isuikwuato local government area of Abia state, Nigeria.28% of the non-credit user farmers were of the credit user farmers were of the 26-35 years age bracket while 42% of the credit-users were between 36 and 45 years old. 87% of the non –credit user farmers had formal education, but 83% of the credit users had formal education .77% of the non –credit user farmers had a family size of 5-8 27% of non –credit users farmers had 5-15 years of experience in yam production. 68% of the non –credit users had a farm size of 0.1-1 hectare, while 53% of the credit users had farm size of 1.1-2 hectares.

Cobb –Douglas functional form was chosen as the lead equation for technical efficiency because it had a higher R^2 of 63%. Farm size (X_2), value of fertilized (X_3), value of other inputs (X_4) and dummy for labour (X_1D) were statistically significant at 5 percent level.

Table 1: Estimating the Technical Efficiency for Yam Farmers

Variable	Linear	Exponential	Double log	Semi log
Constant	8899.88 (0.89)	-462208.3 (-0.66)	6.35 (3.89)	10.47 (43.61)
X_1(labour Monday)	-326.50 (0.31)	-25246.88 (-0.44)	-0.12 (-0.91)	-3.77 (-1.50)
X_2(farm size ha)	55781.24(0.82)	52064.68(-0.44)	-554(2.59) **	-546(3.33) **
X_3(Value of fertilizer	-1.095(0.06)	-12086.49(-1.85)	-4.38(-2.89) **	-1.11(-0.25)
X_4(Other input)	1.23(0.32)	44392.18(0.68)	0.46(3.0) **	1.62(1.75)
X_5(Depreciated Assets	2.29(0.07)	28220(0.46)	0.12(0.86)	4.01(0.48)
D	-9003.82(-0.07)	1220.21(0.01)	0.26(0.99)	0.50(1.63)
X_1D	-1260.02(1.11)	1122.83(2.09)	3.32(2.66) **	6.46(2.37) **
X_2D	-15379.54(-0.09)	-386.07(0.01)	-0.19(0.84)	-0.39(-0.01)
X_3D	-6.52(-0.33)	-0.17(-0.11)	-1.29(-0.37)	-1.32(1.37)
X_4D	-0.94(-0.22)	-0.17(-0.11)	-1.29(-0.37)	-1.32(1.37)
X_5D	14.92(0.35)	6.51(0.18)	5.71(0.07)	5.76(0.56)
R^2	0.291	0.311	0.633	0.597
F-ratio	4.01	4.44	16.91	14.58

Source: Field Survey

NB: t-values are in bracket.***= Statistically Significant at 1% level,**= Statistically significant at 5% level and

* =Statistically significant at 10% level.

Table 2: Estimated Model for Non-Credit Users in Yam Production

Variable	Linear	Exponential	Double Log	Semi-Log
Constant	-103.95(-0.001)	10.97(43.39)***	4.57(2.89)**	-1214542(1.60)
X_1(Labour)	933.53(1.50)	2.69(1.94)	0.51(2.39)**	153925.73(1.50)
X_2 (farm size)	40401.70(56)	0.15(0.96)	-3.44(-0.12)	2364.35(0.02)
X_3 Fertilizer	-7.614(-0.86)	-1.17(-0.60)	-4.86(-2.51)**	-16411.00(-1.77)*
X_4 other inputs	285(18)	2.97(0.82)	0.47(2.74)**	69866.26(0.85)
X_5 Depreciated Assets	17.21(0.49)	9.77(1.25)	4.08(0.25)	9048.54(0.12)
R^2	0.21	0.47	0.55	0.22
F-ratio	2.83***	9.72***	13.29***	3.12**

Source: Field Survey

NB: t-values are in bracket, ***=Statistically Significant at 1% level, ** = Statistically Significant at 5% level, * = Statistically Significant at 10% level.

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ECONOMIC ANALYSIS OF COCOA REHABILITATION TECHNIQUES IN ONDO STATE, NIGERIA

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ABSTRACT
Rehabilitation is any method or activity that can improve the performance of existing trees. Rehabilitation of cocoa trees involves pruning and other activities, removing all diseased and pest-infected pods, dead and diseased branches, mistletoes, chupons, controlling weeds and disease, and pest control. This study describes socio-economic characteristics of the respondents and also to identify various operations and cost involved in carried out cocoa rehabilitation techniques. The study was carried out ldanre local Government Area (LGAs) of Ondo state. Primary data were used through the use of well structured questionnaire. Multi-stage systematic sampling techniques were used to select three villages from ldanre local Government Area .Descriptive statistics were the analytical tools used for the analysis of the study data which includes frequency and percentages distribution. A total of 53 respondents were enumerated during the study .The result from study area shows that majority of the respondents spent average ₦8000 on labour for clearing their farm while 32.1% of the respondent spent average of ₦3000 on labour per hectares for removal of mistletoes. However, 64.2% spent average of ₦5000 per hectare to procure fungicides while (83%) of the respondent spent average of ₦5000 to procure fertilizer that is used for cocoa production. Majority (73.6%) of respondent has knowledge about cocoa rehabilitation techniques. Finally, the major problem encountered by respondent was high price of input with (62.2%). Farmers should always be encourage to carried out rehabilitation techniques in all cocoa producing states which will bring existing trees into better production .
Keywords: cocoa, rehabilitation, cost, techniques, descriptive

INTRODUCTION

The centrality of agriculture to the development of developing economics is now beyond dispute. A vast body of knowledge has assigned a phenomenal role to agriculture in the early stages of industrialization in west and central Africa, agriculture has continued to play a dominant role in the provision of food, raw materials for industries, employment for the majority and foreign earning ,which are used in financing development activities particularly the permanent crops .Permanent crop otherwise known as perennial tree crops are long term crops that occupy the field planted for a long period of time and largely harvested every year and do not have to be replanted for several years after each harvest. ln the last 40 years ,permanent crops ,notably cocoa ,coffee, oil palm and rubber, have dominated the export agriculture (Nkamleu, Nyemeck and Gockowski,2010). Rehabilitation entails factors such as planting materials, cultural practices (weeding and pest control), plant propagation management and the economics of rehabilitation.

There are many defined and undefined factors that affect cocoa production rehabilitation in Nigeria and adequate and concise attention is not to be given to these factors. Cocoa farmers in Nigeria are not going out of cocoa production due to its less profitability and productivity. Many factors that affect cocoa production rehabilitation includes high cost of venturing into vegetative propagation and multiplication of cocoa, lack of technical know-how or illiteracy on the part of the farmer, insensitivity of government to agriculture and cocoa production, use of unselected seedlings or less improved seedlings for planting and no adequate or proper management of cocoa trees. These factors among others contribute to the less productivity and profitability of cocoa production in Nigeria.

Rehabilitation is any method or activity that can bring existing trees into better production. Rehabilitation of cocoa trees involves pruning of cocoa and shade trees, removing all diseased and pest-infected pods, dead and diseased branches, mistletoes, chupons, controlling weeds and disease, and pest control. Rehabilitation may also involve cleaning out all unwanted materials from the cocoa farm and adding fertilizer or organic matter to renew soil nutrients in order to improve the production of old cocoa trees.

Objectives

i. identify various operations and cost involved in carried out cocoa rehabilitation technique In the study area and;

ii. identify the problem which cocoa farmers are facing in the study area**.**

METHODOLOGY

The study was carried out in ldanre, Ondo state, Nigeria. The state is situated in the south western geo-political zone of Nigeria. Ondo State has a vast area of arable land, which is predominantly known for agricultural activities which is the main of economic livelihood (Adegeye, 2003).The inhabitants of Ondo State grow a wide variety of tree crops which produce fruit ,leaves ,timber and other useful products. Ondo State is the main of cocoa producing area of the country, at present. It supplies more than 65 percent of Nigeria's cocoa exports. Other producing states in Nigeria are Ekiti, Oyo, Ogun, Osun, Edo, Kogi, Kwara, Taraba, Imo, and Cross River State . Idanre is a Local Government Area in Ondo State, Nigeria. Its headquarters are in the town of Owena. It has an area of 1,914 km² and a population of 129,024 at the 2006 census. Idanre local government was created in 1991 from old Idanre/ Ifedore Local Government. It has landmarks of about 428km and shares boundaries with Ile-Oluji / Okeigbo, Ondo East, Odigbo, Akure South/ North and Edo-State.The primary data were carried out through the use of well-structured questionnaires, which were administered at the farm level among the cocoa farmers in the study area.A multi-stage systematic sampling technique was followed to draw the study sample of 53 respondents.

RESULTS AND DISCUSSION

Results presented in Table 2 shows the cost spent on labour for the following operations. It can be deduced from the study that 86.8% of the respondent spent average of ₦8000 on labour used in clearing their land while majority (77.4%) of the respondent spent average of ₦3000 on labour used in fertilizer application for their farm operations .Furthermore, chemical used for farm operations by the respondents show that 45.3% of the respondents spent average of ₦3000 on labour been chemical used on their farm while 26.4% spent ₦2000 on labour for pruning of unwanted branches which cost ranges between ₦2300, ₦2400, ₦2500, ₦2700, ₦3000, ₦3500. It can also be deduced from study that 32.1% of the respondent spent ₦3000 on labour per hectare for removal of mistletoes while 79.2% of the respondent spent average of ₦3000 on labour for insecticides application.

However, 64.2% of the respondents spent average of ₦5000 per hectare in procuring fungicides while 66.0% of the respondents spent ₦2300 in procuring herbicides. The result from finding shows that 47.2% of the respondents spent ₦1500 been cost used in procuring cutlass. Majority (79.2%) of respondent spent ₦1000 to procure harvesting hook while 49.1% of the respondents spent average of ₦15000 to procure knapsack sprayer and 83.0% of the respondents spent average of ₦5000 to procure fertilizer that is used for cocoa production.

Table 3 shows rehabilitation techniques and problem faced by respondent in the study area. It can be deduced from the study that 64.2% of the respondents weed their farm two times throughout the farm season while 20.8% weed their farm three times. Majorly (73.6%) of the respondents have knowledge about the cocoa rehabilitation techniques and 22.7% of the respondents does not have knowledge about rehabilitation techniques.

However, 49.1% of the respondents replant their cocoa while 39.6% of the respondents used coppicing as their rehabilitation techniques while 11.3% of the respondents also used budding on generated chupons. Majority of the respondents have problems of mistletoes in reducing cocoa yields in study area while 3.8% of the respondents have the problem of moss in reducing cocoa yield, 1.9% have problems of reducing cocoa yields through rodents and climber. Table 2 shows that 62.2% of the respondents have problems in obtaining farm inputs while 43.4% does not have problems in obtaining farm inputs.

Table 2 shows problem encountered by respondents in the study area, Majority (62.2%) of the respondents have problem with high price of farm inputs while 11.3% of the respondents have problem for both scarcity and high price and unavailability of farm inputs while 15.1% the respondent have problem with Untimeliness supply of farm inputs. Table 2 also shows that majority (96.2%) of the respondents used plantain as shade crop for cocoa production while 3.8% of the respondents used banana as shade crop for cocoa; which means respondents used plantain as crop shade in the study area. Finally, 62.3% of the respondents have problem with illegal felling of trees on farm while 37.1% does not have problems with trees felling.

CONCLUSION AND RECOMMENDATIONS

Based on the result of this research, the following policy measures which will assist cocoa farmers in Ondo State are recommended tha farmers should always be encourage to carried out rehabilitation techniques in all cocoa producing states which will bring existing trees into better production and government should reduce the high cost of input especially the chemicals which are used to control weed, disease and pest.

Table 1: Cost Spend on Labour for the Following Operations.

Clearing Cost(₦)	**Frequency**	**Percentages**
7000	1	1.9
7500	5	9.4
7800	1	1.9
8000	46	86.8
Fertilizer Application Cost (₦)		
2500	11	20.8
2700	1	1.9
3000	41	77.4
Pruning Cost(₦)		
2000	14	26.4
2300	1	1.9
2400	4	7.5
2500	10	18.9
2700	7	13.2
3000	14	26.4
3500	3	5.7
Mistletoes removal Cost(₦)		
2000	12	22.6
2300	11	20.8
2400	3	5.7
2500	6	11.3
2700	3	5.7
3000	17	32.1
3500	1	1.9
Expenditure		
Insecticide Cost (₦)		
3000	42	79.2
3200	11	20.8
Fungicides Cost(₦)		
3000	2	3.8
5000	34	64.2
5200	1	1.9
5400	16	30.2
Herbicides Cost(₦)		
2300	35	66.0
2400	16	30.2
2500	2	3.8
Harvesting Hook(Cost ₦)		
1000	42	79.2
1200	10	18.9
1500	1	1.9
Knapsack Sprayer (Cost ₦)		
14500	1	1.9
15000	26	49.1
15400	7	13.1
15500	15	28.2
16000	3	5.7
17000	1	1.9
Fertilizer (Cost ₦)		
5000	44	83.0
5500	2	3.8
6000	7	13.2

Table 3: Rehabilitation Techniques and Problem Facing by Cocoa Farmers

How frequently do you weed your farm	**Frequency**	**Percentage**
Not at all	2	3.8
Once	6	11.3
Two times	34	64.2
Three times	11	20.8
Do you know about cocoa rehabilitation techniques		
Yes	39	73.6
No	12	22.7
If yes, which type,		
Coppicing	21	39.6
Replanting	26	49.1
Budding/grafting on generated chupons	3	5.65
Planting on cocoa plantation.	3	5.65
What problems do you consider most serious in reducing yield		
Mistletoes	49	92.5
Moss	2	3.8
Climbers	1	1.9
Rodent	1	1.9
Do you have problem in obtaining input.		
Yes	30	62.2
No	23	43.4
What are the problems encountered		
High price	33	62.2
Unavailability	6	11.3
Scarcity and high price	6	11.3
Untimeliness supply farm input	8	15.1
Type of shade crop used for your cocoa		
Plantain	51	96.2
Banana	2	3.8
Forest trees	0	0
Do you have illegal feeling		
Yes	33	62.3
No	20	37.7

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APPLICATION OF THE LOGIT MODEL TO DECISION ON FARMERS' ADOPTION OF IMPROVED CASSAVA VARIETIES IN AKWA IBOM STATE, NIGERIA

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ABSTRACT
The study aimed at estimating and explaining the parameters of the adoption process of the disease-resistant new improved cassava varieties, by farmers in AkwaIbom State. The main purpose for the development of the varieties is to increase the yield of cassava, which is a famine-reserve crop and rural staple food in Nigeria. Like any other innovation, improved cassava varieties must endure a phase of dissemination. Innovators and policy makers need knowledge of the expected rate of adoption. In this study, a conceptual framework was developed for the decision to adopt or not to adopt and econometric analyses of the diffusion process are presented, using Logistic regression model. To increase the rate of adoption in the study area, emphasis should be on the availability of the improved cassava stems to the farmers.
Keywords: Cassava, farmers, adoption, decision, logit model, Akwa Ibom.

INTRODUCTION
There has been much discussion on the need to increase productivity and sustainability in agriculture through adoption of modern agricultural production technologies (Adesina and Baidu, 1995; Akudugu*et al.*, 2012; Chilot*et al.*, 1996; Polson and Spencer, 1992; Nkonya*etal.*, 1997; Beshir*et al.*, 2012 etc). Increasing agricultural productivity is critical to meet expected rising demand and, as such, it is imperative to investigate the factors that influence farmers' decisions on modern technology adoption (Challa, 2013). Agricultural technologies include all kinds of improved techniques and practices which affect the growth of agricultural output (Jain *et al.*,2009). In the opinion of Loevinsohn *et al.*, (2013), the most common areas of technology development and promotion for crops include new varieties and management regimes; soil as well as soil fertility management; weed and pest management; irrigation and water management. By virtue of improved input/output relationships, new technology tend to raise output and reduces the average cost of production, which in turn, results in substantial gains in income (Challa, 2013). In fact, adoption of improved technologies is believed to be a major factor in the success of the green revolution experienced by Asian countries (Ravallion and Chen, 2004; Kasirye, 2010). On the other hand, non-adopters can hardly maintain their marginal livelihood with socio-economic stagnation, leading to deprivation (Jain *et al.*, 2009).
Quite a large number of studies have investigated the influence of various socio-economic, cultural and political factors on the willingness of farmers to use new technologies (Strauss *et al.*, 1991; Polson and Spencer, 1992; Adesina and Zinnah, 1993; Akudugu et al., 2012).
In many of the adoption behavior studies, the dependent variable is constrained to lie between 0 and 1 and the models used were exponential functions while univariate and multivariate logit and probit models, including their modified forms have been used extensively to study the adoption behavior of farmers and consumers. Shekya and Flinn (1985) have recommended probit model for functional forms with limited dependent variables that are continuous between 0 and 1 and logit models for discrete dependent variables.In this study, the responses recorded are discreet (mutually exclusive and exhaustive) and therefore, a univariatelogit model was developed to analyze the adoption behavior of farmers to improved cassava varieties. The logit model, which is based on cumulative logistic probability functions, is computationally easier to use than other types of models and it also has the advantage to predict the probability of farmers adopting the technology.

Methodology
Study Area
The study area was Akwa Ibom State and it has 6 agricultural zones namely Oron, Abak, Ikot Ekpene, Etinan, Eket and Uyo which have very high potential for agriculture. A total of 120 farmers were selected, using a multi-stage random sampling technique across the zones.

Logit model: The logit model was used and it assumes that the underlying stimulus (Ii) is a random variable which predicts the probability of "improved cassava varieties" adoption:

$$Pi = \frac{e^{Ii}}{I+e^{Ii}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Conceptually, the behavioural model used to examine factors including "new cassava varieties" adoption is given by:

$Y_{i\,=\,g}(Li)$……………………………………………………………………………….(2)

I_i=$bo + \Sigma_{bj} X_{ji}$…………………………………………………………………….(3)

WhereY_i is the observed response for thei^{th} observation ($i.e,$ the binary variable, Y_i = 1 for an adopter, Y_i = 0 for non-adopter). $I_i$is an underlying stimulus index for the i^{th}observation. (Generally, there is a critical threshold $\{I_i^*\}$ for each farmer, if $I_i < I_i^*$, the farmer is observed to be non-adopter and if$I_i \geq I_i^*$, the farmer is observed to be adopter); g is the functional relationship between the field observation (Y_i) and the stimulus index (I_i) which determines the probability of the "improved cassava varieties" adoption).

$I = 1, 2, \ldots\ldots\ldots, m$ are observationson variables for the adoption model; m is the sample size; X_{ji} is the j^{th}explanatory variables for thei^{th} observation and $j = 1, 2, 3, \ldots\ldots\ldots, n; bj$ is an unknown parameter; $j = 0, 1, 2, \ldots\ldots\ldots, n,$ where n is the total number of the explanatory variables.

Empirical model specification: The data in which the empirical model is based were drawn from a sample size of one hundred and twenty smallholder farmers in AkwaIbom State, using a multi-stage random sampling technique. Structured questionnaire was used to solicit information from the respondents. The dependent variable is measured by dichotomous variable: farmers who used the technology or still using the technology were categorized as adopters while those not using were non-adopters. The definitions and measurement of variables as well as sample characteristics are presented in Table 1. The variables included in the logit model are: age, educational level, farming experience, access to improved varieties, access to credit, farm distance, frequency of extension contact with farmers, and $ei,$ the random disturbance.

Past studies have shown that the age of the farmers is related to adoption decision. Younger farmers have been found to be knowledgeable about new practices and at the same time, willing to take risk (Polson and Spencer, 1992; Bultena and Hoiberg, 1983; Gould *et al.*, 1989; Challa and Tilahun, 2014).Following the earlier empirical findings, the maintained hypothesis is that age is negatively related to adoption. Years of experience ($i.e.$when the farmer had his own farm) are distinguished from farming experience. The latter is not relevant for empirical model since most farmers judged their total experience as starting from the first day that they started going out with their parents to farm. What is important is the experience since the farmer became a decision maker on his own field (Mueller and Jansen, 1988). Farm size represented by farm area has been shown to be positively related to adoption decision (Akinola, 1987; Norris and Batie, 1987), therefore, it is hypothesized that the sign is positive. Contact with extension agents is expected to be positively related based on the innovation-diffusion theory. Such contact, that is, exposing farmers to information can stimulate adoption (Polson and Spencer, 1992; Voh, 1982; Kebede*et al.*, 1990). Years of experience in farming are related to the ability of the farmer to obtain; process and use information relevant to farming. A positive relationship is hypothesized between this variable and the probability of new improved varieties of cassava stems adoption.

RESULTS AND DISCUSSION

Empirical result: A summary of the socio-economic characteristics of the sampled respondents in the study area reveals that actual mean estimates obtained for variables did not show much variation (Table 2). Most of the farmers were still within the productive age. Majority (71.4 percent) in the area are young and energetic male farmers with high literacy levels. Access to the new cassava varieties was found to be 44 percent. The study further revealed that farmers usually look upon the extension agents to provide information and farm inputs. About 75 percent established that extension agents within their locality were the primary source of information on the improved cassava varieties but since there was scarcity of the improved cassava cuttings, adoption sometimes become difficult. This may have affected adoption rate in the study area.

Rate of adoption: The rate of adoption is the relative speed with which members of a social system adopt an innovation. It is measured as the number of individuals who adopt a new technology within a specified period. In measuring the rate of adoption of the improved cassava varieties, the proportion of farm land (proxy) related to cassava planting to the proportion of cassava cuttings received from the extension agents was used as criteria. The rate of adoption for the state was found to be 38.5 percent.

Logit regression analysis, using shazam software package shows that most of the coefficients are not consistent with hypothesized relationships and their tests of significance help to indicate their importance in explaining adoption decisions of the farmers. The parameter estimates for the model was evaluated at 5% level of significance. Logit estimates for the survey location (Table 3) revealed that apart from age, years of farming experience and farm size were found not statistically significant in explaining improved cassava variety adoption; education, contact with extension agents, access to cassava stems (cuttings) and distance to farm were statistically significant at 5% level. The positive sign and significance of the extension contact variable implies that extension is an important factor that will promote farmers' adoption of improved cassava varieties in the study area.

The study revealed that the main source of technology is through extension personnel. The non-availability could be attributed to non-accessibility in terms of quantity and time. Farm size though not statistically significant has a negative correlation with adoption. This sign is contrary to a priori expectation and implies that an inverse relationship exist between the farm size and adoption. The result further confirmed that increase in farm size might not after all lead to adoption of the technology. This result is consistent with findings from India and Bangladesh (Ahmed, 1981; Onyewaku and Mbuba, 1991). Farmers' age and education (though significant) were found to be negatively and positively related to adoption behavior respectively. These two parameters are consistent with our a priori expectation. The implication of these findings is that a younger farmer with better education has the tendency to take risk and adopt the technology.

The empirical model can be used to draw economic implication for the new improved cassava varieties improvement strategies in the state. The estimated model was used to predict probability of the improved cassava variety adoption:

I_i = -0.178 – 0.298 +2.627 – 0.679 – 3.395 – 1.054 + 0.624 – 1.75

The probability that a farmer will adopt the technology is given by:

$$P_i = [\frac{e^{-1.75}}{1+e^{-1.75}}] = 0.78$$

or 78 percent. The result shows that there is 78 percent chances that a farmer would adopt the improved cassava varieties, all other things being equal.

CONCLUSION

This paper showed that education, contact with extension agents, access to improved cassava varieties are significant variables that influence farmers' improved cassava variety adoption and use decisions. The results demonstrated further that for the technology to be successful, government and research institutes in charge of improved cassava variety distribution must ensure cassava cuttings availability in the right quantity and appropriate time. This provides a justification for government policies aimed at providing adequate infrastructure and institutional arrangements that will enhance the procurement and distribution of the improved cassava varieties. Technical guidance in the form of extension training will also enhance adoption of the technology.

Table 1: Definition of variables in the empirical model

Dependent variable	
Yi	Farmer adoption decision which takes the value of 1 if he is adopting and 0, otherwise.
Independent variable	
Age (X_1)	Age of the farmers, measured in years
Education (X_2)	Farmers' education level: 1 if he is able to read and 0, otherwise.
Farm size (X_3)	Farm size represented by farm area, measured in hectare.
Experience (X_4)	Farmers' farming experience, measured in years.
Extension (X_5)	Contact with extension agents, measured by the frequency of contact or participation at cooperative meetings
Farm distance (X_6)	Distance between homesteads to farm, measured in kilometer.
Access to improved cassava stems (X_7)	Access to cassava stems is measured in kilometer

Table 2: Descriptive Statistics of some variables used in the empirical model

Variable	Mean value	Standard deviation
Proportion		
Age	43.00	11.15
Education	0.84	0.35
Farm size	0.72	1.44
Extension	1.76	1.93
Farming experience	1.89	3.42
Farm distance	3.65	0.34
Access to cassava stems	0.76	0.33

Source: Data analysis, 2015

Table3: Estimated results for farmer adoption model

Variable	Parameter Estimate	Asymptotic Standard error	t-ratio
Intercept	-5.642	1.422	
Age	-0.178	0.059	0.234
Education	0.624	7.602	2.722*
Farm size	-0.298	0.272	0.426
Extension	2.627	0.726	3.956*
Farming experience	-0.679	0.282	0.664
Farm distance	3.453	2.657	1.654
Access to cassava stems	-1.054	0.426	2.088*

*Parameter estimate significant at 5%; Source: Field survey, 2015
Total number of cases = 120 -2loglikelihood = 38.540
Cases correctly predicted = 93.33% Chi square Statistics = 68.350

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DETERMINATION OF FARM HOLDING CAPACITY OF GROUNDNUT FARMERS IN KANO STATE, NIGERIA

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ABSTRACT
A survey was conducted to investigate the socio-economic characteristics, farm holding capacity and groundnut digging operations employed by groundnut farmers in some selected Local Government Areas of Kano State Nigeria. A multi-stage random sampling technique was used to select 72 respondents for the study and the data was analyzed by the use of descriptive statistics. The results revealed that, majority (62.5%) were above 40 years while 26.40% of them were of the age bracket of 36-40 years constituting about 94.4% of the respondents. The result of this study showed that 93.1% of the respondents were married and about 40.3% have household size of 6-10 persons, 27.8% of them have household size of 11-15 people, 48.60% have no formal education while 51.4% have acquired one form of formal education or the other. The result further showed that, 88.9% were predominantly farmers having farming as their primary occupation and majority (52.80%) of them had farming experience above 20 years. 94.4% of the respondent were small scale groundnut farmers with groundnut farmland between 0.1-5.99 hectares and a mean of 2.2 hectares. Majority (90.3%) of the respondents use animal traction in their farming operations, 88.9% of them used cattle as draught animal in the study area. Most (93.1%) used hired labour, 98.6% of them dig their groundnut manually and 100% of the respondents pay for groundnut digging operation. It was recommended that, government agencies and NGOs should assist groundnut farmers in the study area in sourcing small scale groundnut digger to increase their productivity and link farmers with financial institutions where they can assess soft loan.
Keywords: Farming holding, capacity, Groundnut, Nigeria, Kano State

INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is one of the world's most popular leguminous crops cultivated throughout the tropical and subtropical area where annual precipitation is within the range of 1000-1200 mm for optimum growth of crop. The crop is grown in nearly 100 countries and the most leading producers of groundnut are China, India, Nigeria, U.S.A, Senegal, Indonesia and Sudan (Garba *et al*, 2002). The total world output of the crop in 2012 was 40.1 million metric tons out of which Nigeria accounted for 3.1 million metric tons (USDA, 2012). Groundnut has high economic and nutritional potentials and is an important cash crop for peasant farmers in poor tropical countries (Garba *et al*, 2002). In Africa, groundnut production has been estimated at about 4.6 million tons with Senegal, Nigeria, Zaire and Sudan being the largest producers and an annual estimation placed Nigerian production of unshelled nut at about 2.6 million metric tons from a land area of approximately 2.5million hectares (Attanda and Adinoyi, 2016). Beside, providing food for man and livestock, groundnut can be an important source of much of the needed foreign exchange for the country (Ashley, 1993). In Nigeria, groundnut is produced in almost all the northern states. The leading producing states include Niger, Kano, Sokoto, Kastina, Kaduna, Adamawa, Yobe, Plateau, Borno, Taraba, Gombe and Nassaraw (Attanda and Adinoyi 2016). Despite its importance, the crop is still not sufficient due to some problem which hinders its productivity, this problem is attributed to rapid urbanization, fragmented farm lands, pod loss during harvesting, low per capital income, poor storage, inadequate transportation and marketing facilities as well as non-challent attitude to agriculture among others Gulati (2000). Kuye *et al*, (2004) further noted that, small operators in Nigerian agricultural sector face pure competition both at production and marketing stages.

The objectives of the study were to:

i. Determine the socio-economic characteristics of the respondents
ii. To ascertain the holding capacity of groundnut farmers in the study area and
iii. To identify the digging operations employed by groundnut farmers in the study area

METHODOLOGY

Study Area

Kano State is located in North-Western Nigeria with Coordinates: 11°30′N and 8°30′8.5°E, the State has been a commercial and agricultural state, which is known for the production of groundnut. It has more than 18,684 square kilometers (7,214 sq mi) of cultivable land and is the most extensively irrigated state in the country. It has 44 local government areas in 3 senatorial districts Adinoyi (2016).

Data Collection

A multi-stage random sampling technique was employed to select respondents for the study. In stage one, all the three senatorial districts was considered for the study, in stage two, two local government areas were randomly selected from each senatorial district, the local government areas selected were Gezawa and Dawakin Kudu from Kano central, Dambata and Tofa in Kano north as well as Bebeji and Ajingi in Kano south. In stage three, twelve farmers were randomly selected from each local government area. In all, a total number of seventy two (72) farmers were used for the study. The Data collected was analyzed using a simple descriptive statistic.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of the Respondents

The results obtained from the study as depicted in Table 1 reveals that, majority (62.5%) were above 40 years while 26.40% of them were of the age bracket of 36-40 years. Also, male farmers dominated groundnut production constituting about 94.4% of the respondents. This reveals that, more men were engaged in groundnut farming than women due to its economic and commercial value to provide income for the up-keep of the family, this is in line with the study of Girei *et al*, (2013) which showed that, in Africa, when a crop is perceived as commercial, men are more likely to take over from women. Also, the result of this study shows that 93.1% of the respondents were married. This implies that married people are more involved in farming activities in the study area than the single and other categories. This implies that being married tends to provide family labour for groundnut production and less money is spent on hired labour. The study also reveals that, 40.3% of the respondents have household size of 6-10 persons, while 27.8% of the farmers are of household size of 11-15 people. The result also shows that 48.60% of the respondents have no formal education while 51.4% have acquired one form of formal education or the other which is a vital component in technology adoption in agricultural mechanization. The result further shows that, 88.9% are predominantly farmers having farming as their primary occupation while, 20.80% had petty trading as their secondary occupation. Majority (52.80%) of them had farming experience above 20 years.

Table 2: shows that the majority (30.6%) of the farmer had up to 11 years of groundnut farming experience while the remaining 69.40% had groundnut farming experience of 12 years and above. The research also revealed that 61.1% of the respondents are small to medium scale farmers having 0.1-5.99 and 6.0-9.99 hectare of farm land respectively. It was discovered from the result that 94.4% of the respondents interviewed were farming groundnut at small scale level with groundnut farm land of between 0.1-5.99 hectares and a mean of 2.2 hectares and this agrees with the findings of Lowder *et al*, (2015). Majority (23.6%) of the groundnut farmers in the study area had groundnut yield between 10-20 bags per year. It was found out that 25.0% of the farmers spent between ₦5, 000 to ₦9, 000 (five thousand to nine thousand Naira) per year per hectare on groundnut digging operation.

The result in Table 3 revealed that, majority of the respondents (90.3%) use animal traction in their farming operations. About 88.9% of them used cattle as draught animal in the study area while majority (90.30%) of the farmers used draught animal for ridging, 66.70% used their drought animal for weeding operation, and 68.1% for transportation. Most of the respondents (93.1%) used hired labour in farming operation. The result revealed that 98.6% of the respondents dig their groundnut manually using hoe while 100% of the respondents pay for their groundnut digging operation. This result is in line with the finding of Paul *et al*, (2013) states that digging and lifting operations or harvesting, are among the most time and labor-intensive operations associated with groundnut production. When plants are ready for harvest, rural smallholders traditionally dig their crop using a hoe to sever the tap root and lift the groundnut plant by hand. 97.2% of the smallholders surveyed reported harvesting their crop using this method which takes one or two weeks for both husband and wife to complete lifting an acre of groundnut farm.

CONCLUSION AND RECOMMENDATIONS

The results of the study showed that majority of the respondents fall within the active age, most of them were found to be small holder farmers and manually dig their groundnut using hoe. They also employ the use of draught animals (Cow) in carrying out ridging, weeding and transportation operations.

Based on the outcome of the study, it is therefore recommended that government agencies and NGO's should assist groundnut farmers in the study area in getting small scale groundnut harvesting machine like animal drawn groundnut digger since they used animal traction in some of their farm operations, a simple animal draw groundnut digger would be suitable for small groundnut farm holders because it would require minimum investment in acquiring the machinery, and this require less problem of repair and maintenance with technical known how and this will eventually lead to reduction in cost, maximize time and increase productivity of groundnut farmers. Also, since majority of the respondents in the study area are small scale groundnut farmers, it will be worthwhile to link them with financial institutions where they can assess soft loan to boost their production.

Table1: Socio-Economic Characteristics of the Respondents

Variable	Frequency (n = 72)	Percentage (%)
Age (Years)		
20-25	02	02.80
26-30	02	02.80
31-35	04	05.60
36-40	19	26.40
Above 40	45	62.5
Sex		
Male	68	94.40
Female	04	05.60
Marital status		
Married	67	93.10
Single	02	02.80
Divorce	01	01.40
Widow	02	02.80
Household size		
1-5	07	09.70
6-10	29	40.30
11-15	20	27.80
16-20	10	13.90
Above 20	06	08.30
Educational level		
No formal education (Qur'anic education)	35	48.60
Adult education	06	08.30
Primary education	10	13.90
Secondary education	11	15.30
Tertiary education	10	13.90
Primary occupation		
Farming	64	88.90
Civil service	07	09.70
Trading	01	01.40
Secondary occupation		
Artisan	13	18.10
Petty trading	15	20.80
Civil servant	09	12.50
Provision of agric services	04	05.60
Driving	01	01.40
Farming	05	06.90
Processing	02	02.80
None	23	31.90
Years of farming Experience		
1-5 years	03	04.20
6-10 years	13	18.10
11-15 years	09	12.50
16-20 years	09	12.50
Above 20 years	38	52.80

Source: Field Survey, 2015

Table 2: Groundnut Production in the Study Area

Variables	Frequency (n)	Percentage (%)
Years of groundnut farming experience (Years)		
3-11	22	30.60
12-20	19	26.40
21-29	12	16.70
30-38	11	15.3
39-47	08	11.10
Total farm size cultivated (Ha.)		
0.1-5.99 (Small scale)	44	61.10
6.0-9.99 (Medium scale)	18	25.00
10 and Above (Large scale)	10	13.90
Yield (Bags)		
<10	09	12.50
10-20	17	23.60
21-30	14	19.40
31-40	10	13.90
41-50	10	13.90
>50	12	16.70
Cost of digging groundnut (₦)		
1,000-4,900	09	12.50
5,000-9,000	18	25.00
10,000-14,000	15	20.80
15,000-19,000	09	12.50
20,000-24,000	07	09.70
25,000 and above	14	19.40

Source: Field Survey, (2015)

Table 3: Animals Traction and Groundnut Digging Operation

Variables	Frequency (n)	Percentage (%)
Use of animal traction in the farm		
Use of animal traction	65	90.30
Not use of animal traction	7	09.70
Total	**72**	**100**
Type of Animal Used		
Cattle	64	88.90
Camel	01	01.50
Total	**72**	**100**
Operations where animal traction are used		
Ridging	67	93.80
Harvesting	02	0.00
Weeding	48	66.70
Transportation	49	68.1
Total	**72**	**100**
Hired Labour		
Use of hired labour	67	93.10
Use of family labour	05	06.90
Total	**72**	**100**
Method of Groundnut Digging		
Use of manual hoe	71	98.60
Use of bare hand (Uprooting)	01	01.40
Total	**72**	**100**
Payment of labour for Digging Groundnut		
Yes	72	100.00
No	0	0.0
Total	**72**	**100**

Source: Field Survey, 2015

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FACTORS INFLUENCING INCOME GENERATING ACTIVITIES BY RURAL WOMEN IN OGO-OLUWA LOCAL GOVERNMENT, OYO STATE, NIGERIA

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ABSTRACT
The study examined the factors influencing income generating activities by rural women in Ogo-Oluwa Local Government Area of Oyo State. A well structured questionnaire was used to obtain relevant information from respondents. a total of 90 respondents constitute the sample size, which were selected through simple random sampling technique. The study revealed that 68.9% of the respondents were within the age range of 30-49 years.71.1% had one form of education or the other, 69% of the respondents are married and 41.1had 4-6household size. The major occupation of the respondents is farming with 56.7% had 5-20 years of experience in their income generating activities. The study also revealed multiple responses of various factors influencing their choice of income generating activities such as past experience (90%) personal interest (83.3%) and capital (60%) are of great magnitude. It is therefore recommended that compulsory and free education, capital, and capacity building should be provided for rural women in the study area by different levels of government and non-governmental organization to improve on their income generating activities and quality of food to the household.
Keywords; Factors, income, activities, rural women

INTRODUCTION

Women have moved from traditional roles of being housewives and providing labour on their husband's farm only, to also own farm of their own (FAO, 2011). Most of the activities which women engaged in their livelihood strategies are not defined as 'economically active employment in national account systems, yet are crucial to the wellbeing of household members (FAO, 2010). Much of women work is also under valued because it is typically under remunerated and often confined to the domestic or household realm such as caring for children, the elderly and the ill, collecting water and fuel for cooking and heat, and maintaining households and preparing food are the responsibilities which are mostly taken up by women and girls (Fontana, 2010).

Women comprise 50 per cent of the world's total population, perform two-third of the world's work hours, receive 10 per cent of world's income and own less than one per cent of total assets (Elkhalil, 2014). Women are 70% of the world's poor and 70% of agricultural labor in developing countries. Women provide between 60 and 80 per cent of the food for household consumption (World Bank, 2014). Women's contribution to agricultural production varies from country to country, crop to crop and task to task (Marilee, 2012). On the basis of available evidence and statistics, the role of women in agricultural production in Nigeria cannot be trivialized. They perform crucial roles in the domestic and economic life of the society. Rural and national development can hardly be achieved with the neglect of this important and substantial segment of the society (Kishor, 2012).

There has been an increased concern for developing the skills of women. Many factors can contribute to the socio-economic development of women such as land, technology, credit, and employment, etc. in their choice of income generating activities. Of these various factors, access to credit constitutes the crucial input for their ability to earn an income, leading to an increase in their status and autonomy (Rajasekhar, 2010). Therefore, the objective of the study is to determine factors influencing income generating activities of rural women in Ogo-Oluwa Local Government Area of Oyo State.

METHODOLOGY

The study was carried out in Ogo-Oluwa Local Government Area of Oyo State. The simple random sampling technique was used in selecting respondents. The data for this study was obtained from primary source. Questionnaire was the main instrument for data collection. It was however complimented with interview schedule. The questionnaire comprises of demographic characteristics (age, marital status, educational level, household size, etc,) and the factors that influence their choice of income generating activities (gender differential, past experience, capital, etc,). The study covered the whole of Ogo-Oluwa Local Government. A total of 90 household respondents were selected. Data generated for this study were analysed using descriptive statistics such as frequency distribution, percentage, mean.

RESULTS AND DISCUSSION

The results in table 1 show the age grouping of the respondents. Most of the women farmers (68.9%) falls between the age 30-49 years thus could be regarded as middle age ,while 4.4.% fall between 60-69. It shows that more than half of the respondents (69 %) are married while 1 % is divorced. This implies that most rural women have additional responsibilities to carry out (FAO, 2011). The greater proportion of the household size is between 4-6 (41.1%). This can be attributed to increase in awareness and sensitization of rural people of benefits of family planning by government agencies (like primary health care centres and extension agent). Table also indicates that majority (71.1%) has one form of education or the other while only 28.9% of the respondents did not have any form of education. It shows that most of the respondents (55.5%) are farmers while about 44.5 % of the respondents engaged in non-farming activities, this is consistent with Marilee (2012) who revealed that women's contribution to agricultural production varies from country to country, crop to crop and task to task.

Table 2 shows the factors influencing respondents in their choice of income generating activities. It shows that the major influencing factors are the past experience (90%) in their chosen activities, personal interest (83.3%) and availability of initial capital (60%). It is followed by inherited (37.8%), taste of people in their areas (24.4%), demand of the people and gender differential (23.3%), their husband decision (18.9%), socio-cultural factor (10%) and educational status (7.8%). This result is also in line with Rajasekhar (2010) who revealed that many factors can contribute to the socio-economic development of women such as land, technology, credit, and employment, past experience, etc, in their choice of income generating activities.

CONCLUSION

Based on the findings of this study, it can be concluded that rural women play a significant role in agricultural activities through their income generating activities to ensure household food security which cover both agricultural and non-agricultural activities in addition to their domestic responsibilities. Majority of the rural women engaged in farming activities as their primary occupation while they engaged in non-agricultural activities to complement their income. It is therefore recommended that compulsory and free education, capital, and capacity building should be provided for rural women in the study area by different levels of government and non-governmental organization to improve on their income generating activities and quality of food to the household.

Table 1: Distribution of the respondents according to their socio-economic status

Variables	Frequency	Percentage
Age (years)		
21-29	8	8.9
30-39	32	35.6
40-49	30	33.3
50-59	16	17.8
60-69	4	4.4
Total	**90**	**100**
Marital status		
Single	8	8.2
Married	69	77.2
Divorced	1	1.1
Separated	3	3.3
Widowed	9	10.3
Total	**90**	**100**
Educational Level		
No formal education	26	28.9
Primary Education	42	46.6
Secondary education	18	20
Tertiary education	4	4.5
Total	**90**	**100**
Household size		
1-3	29	32.2
4-6	37	41.1
7-9	24	26.7
Total	**90**	**100**
Years of experience		
5-12	36	39.9
13-20	18	19.9
21-28	13	14.4
29-36	8	8.8
37-44	9	9.9
45-52	6	6.9
Total	**90**	**100**
Occupation		
Farming	49	54.4
Crop processing	1	1.1
Trading	20	22.2
Food vendor	5	5.6
Hawking	1	1.1
Sewing	6	6.7
Casual labour	2	2.2
Hired labour	2	2.2
Civil servant	4	4.4
Total	**90**	**100**

Source: Field Survey, 2011.

Table 2: Distribution of respondents according to the factors influencing their choice of income generating activities.

Factors	Frequency	Percentage
Past experience	81	90
Personal interest	75	83.3
Capital availability	54	60
Inherited	34	37.8
Taste of people	22	24.4
Demand of people	21	23.3
Gender differential	21	23.3
Husband's decision	17	18.9
Socio-cultural	9	10.0
Educational status	7	7.8

***Multiple Response**
Source: Field Survey, 2011.

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ANALYSIS OF AGRICULTURAL CREDIT ON FARMERS PRODUCTIVITY IN UYO LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

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ABSTRACT
The study was conducted in Akwa Ibom State, Nigeria to determine the effects of agricultural credit on farmers productivity in the study area. Multistage random sampling technique was used in the study. Primary data was collected through a well-structured questionnaire and analyzed with OLS multiple regression model. The result of the study indicated that out of the nine (9) variables fitted in the model, seven (7) were significant. The significant variables included level of education, credit source, experience, farm size, amount approved, interest and household size as the major factors affecting the productivity of farmers. The coefficient of multiple determinations for the lead equation R^2 was 0.82, was highly significant at 1% probability level, indicating that 82%of the variation in farmers productivity (income) were significantly explained by the variables investigated in the study. F – ratio value of 42.48 is statistically significant at 1%. This implies goodness of fit in the model. The study indicates that farmers would benefit more from farm credit if policies are made to improve availability of more credit and accessible financial institutions.

Keywords: credit, productivity, agricultural credit, Akwa Ibom

INTRODUCTION

Agriculture is a major contributor to Nigeria's Gross Domestic products (GDP) and small – scale farmers play a dominants role in this contribution (Rabji *et al*, 2009) but their productivity and growth are hindered by limited access to credit facilities (Odoemenem *et al*, 2010). There seem to be general consensus that the provision of credit to farmers and other agricultural related business will improve the agricultural sector of the Nigerian economy as agricultural credit is expected to play a critical role in agricultural development (Duong and Izumida, 2002). It was in recognition of the downward trend that was observed in agricultural productivity that the federal Government of Nigeria at various periods put in place credit policies and established credit institutions and schemes that could facilitate the flow of agricultural credit to farmers (Adegeye *et al.*, 1985). Among such schemes are; the Nigeria Agricultural and co – operative and Rural Development Bank (now known as the Nigerian Agricultural co – operative and Rural Development Bank) established in November 1972, the establishment of rural branches of rural branches of commercial banks throughout the country following a mandatory federal Government Policy direction in 1976. Agricultural credit enhances productivity and promotes standard of living by breaking vicious cycle of poverty of small scale farmer. Adegeye *et al* (1985) described agricultural credit as the process of obtaining control over the use of money, goods and services in the present in exchange for a promise to repay at a future date. Olaitan (2006) noted that countries witnessing declining agricultural production at the same time it is faced with an increasing population. Iheancho *et al* (2006) suggested that the lack of finance to the agriculture sector has caused a decline in agriculture production and agribusiness. According to the CBN (2007), about 65 percent of Nigerian's economically active population lacks access to formal financial service, hence the continuous effects by government to address the issue. The situation raises the need for an enquiry into the performance of the credit finance provided, that is the effects it has on creating access to finance, increasing productivity and ultimately delivering on intended objectives.

METHODOLOGY

Study Area

The research was conducted in Uyo Local Government Area of Akwa Ibom State,Nigeria. Akwa Ibom is a state in Nigeria named after the Qua – Iboe River. It is located in the coastal south – southern part of the country, lying between latitudes 4^0321 and 5^0331 north and longitudes 7^0251 and 8^0251 East. The state is bordered on the east by Cross River State, on the west by Rivers State and Abia State, on the south by the Atlantic Ocean and the southern most top of cross River State. It has a population of about 3.9 million people, though comparatively small in land mass, it is rich in a couple of mineral resources such as; crude oil, natural gas, limestone, gold, salt, coal, silver, to mention but just a few.

Sampling Technique

Multistage random sampling technique was adopted in the study. First stage was the purposive selection of Uyo Local Government Area because of predominance of farmers in the area. Second stage was the random selection of five communities' out of the nineteen communities, which are Oku, Anna, Offot, Uyo Itam and Ikono Uyo. In

the last stage, twenty farmers each were selected from the five communities each by random sampling to make a total of one hundred farmers (sample size).
Primary source of data were collected through the use of a well-structured questionnaire. Data were analyzed with the use of descriptive statistics like tables and frequencies and multiple regression analysis method was used to determine the effect of credit utilization on farmers output and income and the model specification is stated below.

Y = Income(₦)
X_1 = Age (years)
X_2 = Education (years spent in school)
X_3 = Credit source (formal = 1, informal = 0)
X_4 = Farming experience (years)
X_5 = farm size (hectares)
X_6 = Amount of credit received (₦)
X_7 = Interest charge (yes = 1, No = 0)
X_8 = household size (numbers)
X_9 = grace period (yes = 1, No = 0)
U = Error terms

RESULTS AND DISCUSSION

The result from Table 1 shows the determinants of income. The double log functional form was chosen as the lead equation for the study. This is due to its R^2 value, number of significant variables, significance of F- ratio and conformity to apriori expectations. From the double-log functional form, out of the nine (9) variables fitted in the model, seven (7) were significant. The significant variables included level of education, credit source, experience, farm size, amount received, interest and household size.
Farm size, amount received and interest were statistically significant at 1% and positively related to the dependent variable (income). This implies that as this variables increase, the income of the farmers also increases.
Experience was significant at 10% and directly related to the dependent variable (income). This implies that as the farmers grow older in farming, their income tend to increase.
Education, credit source and household size were statistically significant at 5%, 10% and 10% respectively and are inversely related to the dependent variables (income). This implies that as those variables increases, the dependent variable (income) reduces though this against a priori expectation. The coefficient of multiple determination for the lead equation R^2 was 0.82 was highly significant at 1% probability level, indicating that 82%of the variation in farmers productivity (income) were significantly explained by the variables investigated in the study. This therefore means that 18% of the variation was lost due to error or variable not accounted for.
F – ratio value of 42.48 is statistically significant at 1%. This implies goodness of fit in the model.

CONCLUSION AND RECOMMENDATIONS

The study indicates that farmers would benefit more from farm credit if policies are made. To improve upon the existing condition; availability of more and accessible financial institutions, release of loans, literacy programmes as such would enhance their socio-economic status.

Table 1: Regression Analysis of the effects of credit utilization on Income

Variables	Linear	Exponential	Double-log +	Semi-log
Constant	144575.1	11.23	8.26	-90491.7
	(1.47)	(20.54)***	(5.71)***	(-0.27)
Age($X_{1)}$	-0.19	-0.16	0.04	0.06
	(-2.50)**	(-1.98)*	(0.57)	(0.71)
Education(X_2)	0.13	0.07	-0.16	0.01
	(1.87)*	(0.96)	(-2.23)**	(0.08)
Credit source(X_3)	-0.03	0.00	-0.13	(0.18)
	(-0.32)	(0.05)	(-2.00)*	(-2.26)
Experience(X_4)	0.27	0.22	0.13	0.06
	(3.67)***	(2.95)***	(2.06)*	(0.84)
Farm size(X_5)	0.79	0.74	0.20	0.25
	(11.15)***	(9.97)***	(3.40)***	(3.43)***
Amount received(X_6)	-0.05	-0.05	0.85	0.75
	(-0.75)	(-0.83)	(15.62)***	(11.24)***
Interest (X_7)	-0.17	-0.01	0.20	0.23
	(-2.57)***	(-0.09)	(3.36)***	(3.22)***
Household size(X_8)	-0.03	-0.34	o.08	-0.21
	(-0.50)	(-2.85)***	(-1.76)*	(-3.57)***
Grace Period(X_9)	-0.04	0.01	0.02	-0.02
	(-0.64)	(0.09)	(0.41)	(-0.29)
R^2	0.72	0.69	0.82	0.72
R^{-2}	0.69	0.66	0.80	0.69
F-value	(25.08)***	(22.19)***	(42.48)***	(25.32)

Source: Field Survey, 2014.N/B values in parenthesis are T- values,*** = 1% significant level,** = 5% significant level,* = 10 % significant level,+ = lead equation

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DETERMINANTS OF LABOUR SUPPLY AND OUTPUT OF CASSAVA FARMERS IN EBONYI STATE, NIGERIA

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ABSTRACT

This study was carried out in Afikpo North L.G.A of Ebonyi State. The major aim was to examine the factors responsible for labour supply and productivity among cassava farmers in the study area. Farm level and relevant household variables were used for the data analysis. The findings show a relatively aging population of predominantly men. The Cobb Douglas function for labour supply factors showed a 67.3% variation in labour supply as a result of supply related variables included in the model. Variables household size and wages were all significant and positively related to labour supply at 5% and 1% respectively while farm size and farm income were significant at 1% and 5% respectively but negatively related to labour supply. Similarly, 77% variation in the cassava output was explained by the changes in the independent variables included in the model. The result showed that farm size was positively related to cassava output at 1% level of significance. Farming experience showed a 1% positive significance level implying that farmers would get more output from their cassava farms as they got more experience. Based on the findings of this research, it was recommended that Government at all levels should empower rural cassava farmers through the provision of farm loans, adequate supply of improved farm inputs (seeds and fertilizers) that are early-maturing and disease-resistant. Farmers on their own should form cooperatives which would make access to loans very easy and convenient and as such, lending institutions should be willing to assist rural farmers meet their food production target by ensuring timely disbursement of loans and at affordable interest rates too.

Keywords: Labour supply, output, determinants, cassava

INTRODUCTION

Cassava (*Manihot esculenta crantz*) belongs to the family *Euphorbiacaea*, and originated in Latin America and it is now cultivated in all parts of the world. In Africa, about 600 million people are dependent on cassava for food (International Fund for Agricultural Development (IFAD) 2013). Nigeria is the largest producer of cassava in the world with a population figure of 52.4mt and it is one of the world's most important food crops with an annual output of over 34 million tonnes of tuberous roots (Asogwa *et al*. 2013). Nigeria's production accounts for 19% of the world output and 34% of Africa's output, it also plays a principal role in the nation's food economy (Agwu *et al.,* 2007). Cassava is the chief source of dietary food energy for the majority of the people living in the lowland tropics and much of the sub- humid tropics of west and central African (Tsegia *et al*., 2002; Cited by Echebiri and Edaba, 2008). At present, a wide range of traditional cassava forms (such as garri, fufu, starch, lafun, abacha etc) are produced for human consumption (Kormawa *et al.*, 2003). Cassava products are used in various forms for human consumption, livestock feed and manufacturing of industrial products (Ene, 1992).

According to Nweke *et al.* (2002), eighty percent (80%) of Nigerians in the rural areas eat a cassava meal at least once a day and hence it plays a major role in the country's food security. As a crop whose by-products have a wide array of uses, cassava is the most important food crop for Nigeria by production quantity next to yam, which is the most important food crop by value (FAOSTAT, 2012).

Despite an increase in production in recent times, cassava production has suffered a considerable shortage in labour supply even with adequate provision of other production inputs. Agricultural production especially in the tropics and sub-saharan Africa is essentially manual and labour intensive, involving the use of rudimentary equipment-mainly simple tools and equipment such as hoes and cutlasses. Government at the national, state and LGA levels, have attempted to ease the labour constraint and stimulate expansion of farms through tractor hiring services but the tractors are either inaccessible to the poor who need them most or in a state of disrepair. According to the World Bank report (2009), labour productivity in Nigeria is persistently low.

Studies of the labour supply have concentrated on the developed countries. Also, most of these studies emphasized the determinants of the size of the labour supply and the pattern of labour participation placing emphasis on the personnel, gender, household and labour market characteristics, and some relevant demographic factors such as fertility, urbanization and migration. Similarly, use of work oxen is difficult because of tsetse fly infestation and the nature of the soil. Considerably, efforts in terms of family and hired labour are needed to clear land, prepare it for planting. Family labour which is mostly used as hired labour is expensive because of migration of able body young men and women to the cities in search of other higher paid and attractive jobs or education, leaving an aging farm labour force.

Moreover, mechanization of farming activities such as land clearing and preparation will be difficult in the cassava producing area because of heavy rainfall and the dominance of trees and shrubs. This study therefore is an attempt to examine the labour supply condition of cassava producers in Afikpo, Ebonyi state.

METHODOLOGY

Study Area

This work was carried out in Afikpo North L.G.A of Ebonyi State. The L.G.A is situated in the southern part of the state, bounded to the North by Akpoha, west by Okposi L.G.A, south by Ubeyi L.G.A and east by Abbi in Cross River state. The study areas span an area approximately 164 square kilometers (164 sq. km). Afikpo North is hilly and lies in trough of a syncline of undulating sandstone. The inhabitants are mainly peasant farmers. Data used for this work was collected with the aid of questionnaires from the study area. Such data included the socio-economic characteristics of the cassava farmers, their labour supply data, farm size and other farm related variables.

Data Analysis and Model Specification

The data collected for this study were analyzed with the use of simple descriptive tools like frequencies tables and percentages. Other econometric tools like Cobb Douglas function, multiple regression were also used.

The Cobb-Douglas stochastic production frontier function is explicitly specified as:

$Ln\ Y = \beta_0 + \beta_1 In\ X_2 + \beta_2 In\ X_2 + \beta_3 In\ X_3 + \beta_4 In\ X_4 + v_1 - \mu_1$

Where

Y= Total Labour Supply (Man days); X_1=Household size; X_2= Farm size (Hectares);X_3= Wages (₦); X_4= Farm Income (₦)

The multiple regression model is implicitly stated as;

$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + U$

Where

Y= Total cassava output (measured in naira); X_1=Farm size (Hectares); X_2=Farming Experience (Years); X_3=Fertilizer input (₦); X_4 = Distance to farm site (Km); X_5 = Number of Extension visits/year; X_6=Credit value (₦); X_7=Household size; B_0=Intercept; $b_{1-}b_8$ = Coefficients of the estimated parameters; U=Stochastic error term

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Cassava Farmers

The result shows that 75% of the respondents were males and 25% females implying that cassava farming households predominantly carried out by males with moderate house sizes of 4 to 6 persons. Result further shows that land acquired by inheritance accounted for about 50% of all the land used for farming in the study area. This indicates that the traditional ownership of land was still in vogue as the farmers would have refused to sell their land on the grounds of native beliefs. This kind of land tenure system stems from the kinship practice still observed in most communities of the south-eastern part of Nigeria.

Factors Affecting Labour Supply to Cassava Farmers in the Study Area

The result of factors affecting labour supply to the cassava farmers are presented in Table 1. Four explanatory variables were included and regressed against the data for labour supply measured by the total man days of labour during the farming season. The R^2 value of 67.3% means that 67.3% variation in labour supply was accounted for by changes in the independent variables included in the model.

Household size positively affected labour supply to cassava farmers at 5% level of significance in the study area. It implies that households will give out labour to those in need of it provided that the household is large enough such that the loss of a labourer would not reduce the required labour needed to carryout farm operations in the household owned farms. The findings of this work also showed that wages positively affected labour supply at 1%. This means that households would release more labour to the market provided that buyers paid reasonable amount of wages. These wages in-turn would increase household income. This is obtainable only when the wages received for a labourer given out is more than the cost of hiring a labourer to do the same task. This assumption holds for imperfect labour markets with some elements of wage discrimination.

Farm income had a negative relationship with labour supply to cassava farmers in the study area at 5% level of significance. This implies that as farm income increased, households were reluctant to supply labour. This is may be so since the income from farm was enough to meet other necessary family consumption needs. It could also be that the household labour force increased farm output at an optimal level such that a loss in one labourer will lead to a larger marginal decline in output.

Determinants of farm output of cassava farmers

The multiple regression was used to analyze the determinants of cassava farmers' productivity in the study area. The lead (linear) equation was chosen based on the number of significant explanatory variables, value of R^2 and the signs of the coefficients as they conform to *a priori* expectation. The results are presented in Table 2.

The result showed that 77% of variation in cassava output was explained by the variables included in the model. Farm size was positively related to cassava output at 1% level of significance. This conforms to *a priori* expectation and simply means that as farm size increased, cassava output increased as well. It is worthy to note that farm size is the major determinant of farm output because farmers in the rural areas are not yet receptive to modern technologies due to low income. Such technology that encourages land use intensification would definitely increase farm output even with limited farm size but this is not the case in the study area where farmers depended solely on crude implements and output only increased with land area.
Farming experience showed a 1% positive significant relationship with cassava output. This implies that farmers would get more output from their cassava farms as they got more experience. This result is in concordance with economic theory. Experience is an important variable which enables farmers to make certain innovative and market driven decisions such as adoption of modern farm practices and use of improved inputs. Experienced farmers are also able to overcome certain production challenges and farm intricacies, thus, losses through ignorance and adoption or continuous utilization of obsolete practices are avoided.
Fertilizer usage influenced cassava output positively at 5% level of significance. This indicates that cassava output will increase with an increase in fertilizer application. This statement meets *a priori* expectation. The coefficient of fertilizer at 0.3 means that for every 1kg increase in fertilizer application, farm output will increase by 0.3. It is therefore obvious that increasing farm output would require that farmers increase fertilizer usage. However, it should stated that excessive use of fertilizer on farmlands can damage the soil fertility by destroying the soil living organisms responsible for soil aeration and other desirable soil qualities. Application also should be dependent on the type of cassava, soil nutrient requirement and under the best and most suitable application technique.
The distance farmers travelled to their farms from their homes had a negative toll on cassava productivity at 10% significance. The implication of this is that as farmers located their farms farther away from their residential areas, farm output decreased. The reason for this decline may stem from the number of household members willing to trek long distances for the purpose of farming. It may also be as a result of loss of strength through walking. In such cases, the farmers get tired and may either become completely worn-out to do any meaningful farm work and thus reduce efficiency as a result of drudgery and fatigue.
A 10% significant positive relationship existed between the number of extension visits witnessed by cassava farmers and their output. This means that farm output will increase with the frequency of extension visits. During extension visits, farmers are informed of current farm management practices, new and available technologies, better farm decisions and others. Household size had an unexpected negative relationship with cassava output at 10% meaning that farm output will decrease as household size increases. This finding does not corroborate *a priori* expectation and may have arisen from the fact that many of the farming households had a large dependency ratio, thus limiting the available labour for increased output.

CONCLUSION AND RECOMMENDATIONS

The determinants of labour supply, utilization and farm productivity as studied by this work showed that both farmers' socio-economic characteristics and other economic and land tenure-related variables had strong influences on the labour market of cassava farmers as well as their productivity level in the study area. The study also revealed that labour supply was highly inelastic, i.e. an increase in wage rate increased labour supply by a large margin. This is because of the relative availability of labour in the study area. Based on the findings of the study, farmers are encouraged to expand their productive capacity to make food abundant in supply as to meet the ever-growing demand for food in the study area; community Labour unions should ensure a uniform wage rate for different categories of labourers. Government at all levels should on their own part empower rural cassava farmers through the provision of farm loans, adequate supply of improved farm inputs (seeds and fertilizers) that are early-maturing and disease-resistant. Farmers on their own should form cooperatives which would make access to loans very easy and convenient and as such, lending institutions should be willing to assist rural farmers meet their food production target by ensuring timely disbursement of loans and at affordable interest rates too.

Table 1: Factors Affecting Labour Supply of Cassava Farmers in the Study Area

Variable	Coefficients	t-values
Constant	1.854	9.675***
Household size	0.123	2.432**
Farm size (Hectares)	0.934	-3.654***
Wages (₦)	1.201	3.072***
Farm Income (₦)	2.761	-2.887**
Adjusted R	.000	0.576
R^2	.000	0.673
F-ratio	.000	7.889***

Source: Field Survey Data, 2016. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 2: Regression estimates of cassava farmers' output in Ebonyi state

Variable	Linear (+)	Exponential	Semi-Log	Double Log
Constant	.864	.000	.000	.000
	(14.041)***	(-6.493)***	(12.283)***	(6.584)***
X_1 (Farm Size, Ha.)	.929	.809	.193	.887
	(3.190)***	(.245)	(1.820)*	(2.145)**
X_2 (Farming experience, Yrs.)	.337	.160	.728	.811
	(2.970)**	(-1.961)*	(-.350)	(.242)
X_3 (Fertilizer inputs, Kg)	.300	.000	.000	.000
	(2.756)**	(.717)	(14.778)***	(1.035)
X_4 (Distance to farm, Km)	-.059	008	.410	.032
	(-1.930)*	(2.765)**	(-.831)	(1.341)
X_5 (Extension visits)	.974	.647	.911	.014
	(1.733)*	(.465)	(.122)	(2.710)***
X_6 (Credit value, ₦)	.209	076	.060	·152
	(1.271)	(2.121)**	(1.924)*	(1.123)
X_7 (Household size)	.074	.746	.848	.172
	(-1.826)*	(-.328)	(.193)	(-3.119)***
R^2	0.773	0.564	0.500	0.549
Adj. R^2	0.869	0.614	0.584	0.560
F Ratio	32.928***	17.222***	14.188***	23.366***

Source: Field Survey Data, 2016.

*** Significant at 1%, ** Significant at 5%, * Significant at 10%. The figures in parenthesis are t-ratios.

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COST-BENEFIT ANALYSIS OF WEED CONTROL METHODS ON COWPEA PRODUCTION

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ABSTRACT
This study is aimed at evaluating the cost-benefit analysis of selected weed control methods in cowpea production in research farm of the National Centre for Agricultural Mechanization (NCAM), Ilorin, in the 2014 and 2015 planting seasons. Five treatments, included weeding with rotary cultivator (mounted on a tractor), hoe-weeding at 3 and 6 weeks after planting (WAP), pre-emergence herbicide application (Galex at 5litres/ha), post-emergence herbicide application of fusilade (2 litres/ha) followed by scepter (1 litre/ha) and a no-weeding check. All the treatments were laid out in a randomized complete block design with four replications. Cowpea yield was best under pre-emergence weed control at 490.0kg/ha and 605.5 kg/ha while no weeding control had the poorest yield between 313.8 and 338.9 kg/ha in both years (2014 and 2015). Also the highest profit (₦137,400:00 and ₦184,160:00) was obtained under the pre-emergence weed control while the lowest profit (₦94,140:00 and ₦108,448:00)was obtained in No-weeding control plot in both years. The highest cost benefit ratio (CBR) of 26.1 in 2014 and 30.5 in 2015 were recorded with rotary cultivator plot followed by pre-emergence with CBR of 15.3 and 20.1 while the lowest CBR of 3.9 and 4.3 respectively were recorded for hand weeding in both years.
Keywords: Cowpea, Cost-benefit analysis, Treatments, NCAM

INTRODUCTION

Recent statistics shows that about 7.56 million tons of cowpea were produced annually on about 12.76 million hectares of land (IITA, 2013). The need to provide food in the right quantity, quality and at affordable costs remains a priority in most of the developing countries, where the bulk of agricultural production is largely in the hands of peasant farmers. Constraints faced by this category of farmers include the use of poor plant genetic materials and inadequate protection practices (Williams, 2006).

Weeds are a permanent constraint to crop productivity in agriculture and they are plants which compete for nutrient, space and light and they exert lots of harmful effects by reducing the quality as well as quantity of crops if the weed population is left uncontrolled (KavalinusKaite and Bobinas, 2006). Because weeds interfere with mankind's efficient use of the natural environments that have been disturbed, weed control is basic to the use of those environments for food, fiber, shelter and recreation. Weed control reefers to those actions that seek to restrict the spread of weeds and destroy or reduce their population in a given location (Akobundu, 1987). Weed control is a required input in most crop production ventures.

Weed management is the ability to manipulate weeds so that they do not seriously interfere with mankind's efficient use of their environment. In relation to agricultural activities weed management refers to how weeds are manipulated so that they do not interfere with the growth, development and economic yield of crops and animals. The major components of weed management are preventive weed control, cultural control, biological control and chemical weed control.

Cowpea (Vigna unguiculata L.) sown in summer season is infested by a number of weed species that competes with the crop right from germination to harvest, affecting the crop yield adversely (Yadav *et al*, 1998). Therefore in order to enhance crop yield and its effects on soil fertility, control of weeds during peak periods is very important. Weed density, type of weeds, their persistence and crop management practices determine the magnitude of yield loss. Yield loss in cowpea due to weeds was 12.7-60.0 % (Li *et al*, 2004). There is no single method to controlling weeds of all forms; different kinds of social, economic and environmental factors influence the choice of control method to be used. Although conventional methods like hand weeding and herbicide application are effective in weed control but they are uneconomical due to higher cost of labour and hazardous effects to the environment (Cheema *et al*., 2003). Also in general, herbicides are effective only against some weed species, but results in serious infestation of other weeds. The suggestion that integrated weed management can be useful to provide better weed control measures should further be assessed. In view of these, a study was designed to evaluate different weed control methods under rain-fed cowpea production.

The objective of this study was therefore to analyze the cost-benefit of several weed control techniques on the performance of cowpea.

MATERIALS AND METHODS

Field experiment was carried out at the Research farm of the National Centre for Agricultural Mechanization, Ilorin, located on Longitude 4°30' East and latitude 8°26' North, in the 2014 and 2015 planting seasons. Land preparation was done using conventional tillage of ploughing followed by harrowing after about one week

interval. Field was thereafter demarcated into plots. Planting of cowpea seeds was done by hand with a spacing of 75cm x 15cm and 2 seeds per hole. The cowpea variety planted was Ife brown. Five treatments which included weeding with rotary cultivator (mounted on a tractor), hoe-weeding at 3 and 6 weeks after planting (WAP), pre-emergence herbicide application (Galex at 5litres/ha), post-emergence herbicide application of fusilade (2 litres/ha) followed by scepter (1 litre/ha) and a no-weeding check. The treatments were laid out in a randomized complete block design with four replications.
Weed cover scores of the plots were obtained after hoe weeding and when all the weed control methods have been applied to the treatments on the field. Crop vigour score was obtained 8WAP, when all weeding techniques on the treatments had been completed. At maturity 20 plants per plot were taken randomly to study the effects of the weed control methods on plant height, number of pods per plant, number of seeds per plant and weight of 1000 seeds. Grain yield in kg per hectare was also measured. The results were subjected to analysis of variance and means separated using the least significant difference method.

RESULTS AND DISCUSSION

The tables below showed the yield difference per hectare recorded by the different treatments account for the variation observed in value of output/ha (total revenue) in both years. The value of Total Revenue (TR) for different weed control methods varies from rotary cultivator to no weeding control with pre-emergence weed control having the highest revenue of ₦137,400 and ₦184,160 for year 2014 and 2015 respectively followed by post-emergence weed control, rotary cultivator, hand weeding and no-weeding (₦110,310 - ₦158,702, ₦108,830 - ₦148,250, ₦98,150 - ₦140,656 and ₦94,140 - ₦108,448). This conformed with that of Chikoye *et al.* 2005 and Omovbude and Udensi, 2013 who noted that chemical control is a better alternative to manual weeding because it is cheaper, faster and gives better weed control. The highest cost benefit ratio (CBR) of 26.1 in 2014 and 30.5 in 2015 were recorded with rotary cultivator plot followed by pre-emergence with CBR of 15.3 and 20.1 while the lowest CBR of 3.9 and 4.3 respectively were recorded for hand weeding in both years.

CONCLUSION

Cowpea productivity was enhanced through application of herbicides by reducing weed infestation. This interplay in the net revenue recorded in the seasons in the study area.

Table 1: Cost and Benefit Analysis of Weed Control Method in cowpea production in 2014 cropping season

S/N	Treatments	Plant Height (Cm)	Weed Cover Score	Weight of 1000 seed	Crop Vigour Score	Herbicide Cost/Ha	Cost of Treatment Application	Total cost	Grain Yeild (Kg/ha)	Selling Price (Kg/ha)	Revenue (N/ha)	Net Revenue Profit (N/ha)	CBR
1.	Rotary Cultivator	53.0	1.90	141.7	3.90	-	4,330	4,330	377.2	300	113,160	108,830	26.1
2.	Hand Weeding	60.9	0.60	139.9	4.50	-	34,000	34,000	440.5	300	132,150	98,150	3.9
3.	Pre-emergence herbicide (Galex)	60.4	1.30	129.1	4.10	8,000	1,600	9,600	490.0	300	147,000	137,400	15.3
4.	Post-emergence (fusillade fb Scepter)	56.6	1.30	119.2	3.30	7,250	1,600	8,850	397.2	300	119,160	110,310	13.5
5.	No weeding Control	64.4	3.5	133.7	3.5	-	-	-	313.8	300	94,140	94,140	
	Mean	**59.1**	**1.72**	**132.7**	**3.86**				**447.7**				
	LSD (0.05)	**NS**	**0.93**	**NS**	**6.58**				**92.4**				

Table 2: Cost and Benefit Analysis of Weed Control Method in cowpea production in 2015 cropping season

S/N	Treatments	Plant Height (Cm)	Weed Cover Score	Weight of 1000 seed	Crop Vigour Score	Herbicide Cost/Ha	Cost of Treatment Application	Total cost	Grain Yield (Kg/ha)	Selling Price (Kg/ha)	Revenue (N/ha)	Net Revenue Profit (N/ha)	CBR
1.	Rotary Cultivator	68.3	0.90	159.9	3.10	-	5,030	5,030	479	320	153,280	148,250	30.5
2.	Hand Weeding	71.1	0.60	170.6	4.0	-	42,000	42,000	570.8	320	182,656	140,656	4.3
3.	Pre-emergence herbicide (Galex)	75.6	1.90	157.9	4.60	8,000	2,400	9,600	605.5	320	193,760	184,160	20.1
4.	Post-emergence (fusillade fb Scepter)	67.4	2.30	156.5	3.50	7,250	2,400	8,850	523.6	320	167,552	158,702	18.9
5.	No weeding Control	68.8	4.60	155.1	2.80	-	-	-	338.9	320	108,448	108,448	
	Mean	**70.2**	**2.06**	**160.0**	**3.60**				**987.7**				
	LSD (0.05)	**NS**	**0.60**	**NS**	**0.36**				**204.5**				

Weed score ratings: 5= extremely weedy plot
0= virtually no weed.
Crop vigour ratings: 5= Very healthy plants
LSD (0.05) - least significant difference at 95% probability level.
N.S. – not significant.

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ASSESSMENT OF PARTICIPATION IN RURAL DEVELOPMENT PROJECTS IN UMUAHIA SOUTH LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA: A CASE OF FADAMA III PROJECT

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ABSTRACT

The study assessed the participation in rural development projects in Umuahia South Local Government Area of Abia State: the Fadama III project experience. Personal characteristics of the respondents were described, level of participation ascertained and factors influencing their participation in the project were determined. A multi-stage simple random sampling technique was adopted to select respondents for the study. Frequencies, percentages and regression analysis were used to analyze data collected. About 37.78 percent of the respondents were in the ages of 38 and 47 years, while majority of them were female. There were more married respondents with household size of 2 and 6 members representing 58.89 percent and 63.33 percent respectively. Secondary education was observed as their level of formal education with informal form of occupation representing 35.56 percent and 57.78 percent respectively. Respondents' level of participation was rated low. Personal characteristic like age, sex, martial status, household size were highly significant at 1 percent and level of formal education was also significant at 5 percent and positively related to their participation except occupation. The hypothesis of significant relationship was accepted. It was recommended, for proper education and awareness to be created on the benefits and sustainability of the project, before the beneficiaries are allowed to assess the grant and hence implement/execute the project.

Key words: Participation, Rural development project, Fadama III project.

INTRODUCTION

In Nigeria, implementation of rural development projects has been impeded as observed by the centre-down approach in which the rural people were not involved in project conception, planning and monitoring which often led to failure and abandonment of many valuable projects. Of recent, infrastructural approach to development remains a vital instrument to reach and assist poor communities in the developing countries (UN, 2005). Development interventions in the past have tended to focus on resource and knowledge transfer to beneficiary communities through the stale centre-down approach (Creighton, 2005). Having realized the weakness of this approach, it has paved way for the adoption of the 'bottom-up' approach to development. Since the 1970's, there have been deliberate government efforts towards mobilizing the people for rural development. The integrated rural development, river basin development authorities, community development and institutional strategies constitute integral parts of concerted efforts geared towards socioeconomic transformation at the grass-roots.

However, inspite of the clamour for 'bottom-up' approach to rural development, project beneficiaries are still being deprived of participating in the identification, planning, implementation, monitoring, and evaluation of projects that are meant to improve their welfare (Akpomunie, 2010). Even when an element of 'participation' is built into projects, it is often largely in terms of local investment of labour and not necessarily participating in decision-making. Beneficiary communities are only informed after plans have been made and this is done through formal meetings where the officers justify their plans but modification is not considered (Thwala, 2010).

The World Bank is one of the main institutional players of development projects in developing countries. Over the years, the World Bank has been involved in various identifiable key projects in Nigeria. Fadama development project is one of the those key projects of World Bank aimed at sustainably increasing the living standard of rural poor farmers, the vulnerable in the society and the physically challenged. It is an agricultural-based development project targeted at the rural communities to able them improve their living standard. Fadama project came into Nigeria in 1992, but Abia State keyed into this project in 2008.

Despite great expectations and hope that Fadama project will sustainably put food on the tables of benefiting communities and the Local Government Area, the impact of the project is not that visible and yet to be felt, hence the study. Specifically, personal characteristics of the beneficiaries were described, level of participation assessed and personal characteristics influencing participation in the project was determined. Hypothesis of significant relationship between personal characteristics and participation in the project was also tested.

METHODOLOGY

The study area was Umuahia South Local Government Area of Abia State. All the Fadama Community Associations (FCAs) in the area formed population for the study. A multi-stage simple random sampling technique was used to select respondents for the study. At first stage, three (3) FCAs were drawn from all the FCAs in the study area. At second stage, three (3) Fadama Users group (FUG) were drawn from the FCAs selected at the stage one. At third stage, ten (10) members were drawn each from the FUGs selected at stage two. Those selected formed respondents for the study. Data for the study was collected with the aid of questionnaire and interview of respondents. Percentages, frequencies and regression analysis were used to analyze data collected. The concept of participation was achieved through Chapin social participation scale of 1939. The participation components were weighted as follows:

Attendance to meeting -1, committee membership -2, financial contribution -3 and office holding -4. In this study, level of participation was measured based on the degree of involvement specified as follows: score 0 for non participation, score 1-5 for low level of participation and score 6-10 for high level of participation.

RESULTS AND DISCUSSION

Result from Table 1 showed that about 37.78 percent were in the ages of 38 and 47 years with majority (56.67%) been female. About 58.89 were married while household size ranged between 2 and 6 members representing 63.33%. Secondary education was observed to be their level of formal education while informal occupation was their means of livelihood representing 35.5% and 57.78% respectively.

From Table 2, it was observed that there was low level of participation from the respondents sampled. This was attributed to poor awareness and education of the beneficiaries by the facilitators of the project before they were allowed to access the grant. The low level of participation reflects the lack of total acceptance of the project, hence the non-sustainability of the project in the study area.

The coefficients of sex, age, household size and marital status were highly significant but at 1% and positively related to respondents participation in the project while level of formal education was significant at 5% and positively related to participation. This result is in agreement with earlier result of Udoka 2007 who found that coefficients of age, sex and household size were key factors in determining participation in development projects. Occupation was not significant and hence not discussed. The hypothesis of positive relationship between personal characteristics and participation was accepted.

CONCLUSION

It was concluded that majority of the respondents were adult with ages between 38 and 47years while more female participated in the project. There were more married respondents while their household size ranged between 2 and 6 members. Secondary education was their level of formal education while informal occupation was the means of livelihood of the respondents. It was also concluded that there was low level of participation in the project leading to non-sustainability of the project and its attendant effect. Personal characteristics play an important role in influencing respondents' participation excepting occupation. There was positive relationship between participation in the project and personal characteristics of the respondents. It was recommended to sufficiently educate the beneficiaries on the benefits and workings of the project before they are allowed access the grant, this will ensure sustainability and full participation in the project.

Table 1: Distribution of respondents according to personal characteristics

Variables	Frequency	Percentage (%)
18-27	8	8.89
28-37	12	13.33
38-47	34	37.78
48-57	26	28.89
58 and above	10	11.11
Sex		
Male	39	43.33
Female	57	56.67
Martial Status		
Single	11	12.22
Married	53	58.89
Divorced	0	0
Widowed	26	28.89
Household Size		
2-6	57	63.33
7-11	25	27.78
12 and above	8	8.89
Level of Formal Education		
No formal education	9	10.00
Primary education	26	28.89
Secondary education	32	35.56
OND/NCE	11	12.22
HND	10	11.11
Bachelors Degree	2	2.22
Higher Degrees	0	0
Occupation		
Formal	38	42.22
Informal	52	57.78

Source: Field Survey, 2015.

Table 2: Distribution of respondents based on level of participation in the project.

Participation Category	Frequency	Percentage (%)
High (6-10)	33	36.67
Low (1-5)	42	46.67
Non (0)	15	16.67

Source: Field Survey, 2015.

Table 3: Regression analysis to determine relationship between personal characteristics and participation in the project

Variables	Coefficients	Standard error	t-values
Intercept	-1.7866	0.1039	-7.5505
Age (x_1)	0.0175	9.0038	4.6077***
Sex (x_2)	0.3065	0.0550	4.7006***
Martial status (x_3)	0.1835	0.0782	2.4614***
Household size (x_4)	0.0562	0.1042	3.6638***
Level of formal education (x_5)	0.0024	0.0209	9.1163**
Occupation (x_6)	0.3017	0.0708	4.8002

Source: Field Survey, 2015.
Note: *** Significant at 1%, ****** significant at 5%.

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COST AND RETURNS ANALYSIS OF CASSAVA-BASED MIX CROPPING SYSTEM IN ABIA STATE, NIGERIA

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ABSTRACT
The study was carried out in Abia State, Nigeria to estimate the cost and returns to cassava based mix cropping system. The multi-stage stratified random sampling technique was used in selecting a sample of 100 respondents from the area. Data were collected using a well-structured questionnaire. The data collected was analyzed using descriptive statistics and farm budget technique. The result of the analysis show that the net returns to cassava/yam/maize/melon crop mixture was N142, 667.28, while the returns per naira invested by the farmer were ₦0.48k. The cassava varieties cultivated are TME 419, TMS 30572, TMS 30555, TMS 4(2) 1425, TMS 98/002, NR 8083, NR 8082, NR 84292, NR 8212, Nwaibibi, 98/0581 and yellow root cassava. The study recommended the practice of mixed cropping as a food security strategy and income generating venture.
Keywords: Net Returns, Cassava-based, mix cropping

INTRODUCTION

Cassava is one of the world's most important food crops, with annual global production at approximately 276 million metric tons (MT) in 2013. According to Nteranya and Adiel (2015), supported by Obasi *et al*, (2015), The top producing countries globally in 2013 were: Nigeria (accounting for 19% of the total), Thailand (11%), Indonesia (9%), Brazil (8%) and Democratic Republic of Congo (6%). It is a major source of dietary food energy for the entire populace living in the lowland tropics and much of the sub-humid tropics of West and Central Africa (Echebiri and Edaba, 2008).

Nigeria is currently the largest cassava producer in the world with estimated annual production of about 40 million metric tonnes. About 90% of this is however, consumed as food. Presently, cassava is primarily produced for food especially in the form of *gari*, *lafun* and *fufu* with little or no use in the agribusiness sector as an industrial raw material. But the crop can be processed into several secondary products of industrial market value. These products include chips, pellets, flour, adhesives, alcohol, and starch, which are vital raw materials in the livestock, feed, alcohol/ethanol, textile, confectionery, food and soft drinks industries. They are also tradable in the international market. Cassava (*Manihot esculentum*) is a very important staple root crop in Nigeria.

Although Nigeria is the world's largest producer of cassava, production is largely by small scale illiterate and conservative farmers who cultivate the soil with rudimentary implements. The demand for cassava in developing countries is estimated to grow at 2% annually for food and 1.6% per year for feed, while total production is projected to reach 16.8million tons by 2020 based on current production rate (Mailumo *et al*., 2012). In addition, improvements in the cropping system will also boost productivity as well as enhance the net returns from the enterprise. Fakoyode *et al*., (2008), observed that though cassava when cultivated as the sole crop result in high output, the greatest disadvantage of sole cropping is that in instances of pest and disease outbreaks, the farmer usually loses a significant part of his crop and sometimes loses all.

In South East of Nigeria, there are essentially two types of cropping patterns involving cassava-based (cassava, maize, melon) and yam-based (yam, cassava, maize and melon). Other crops that may be found in this crop association are Okra, groundnut, cocoyam, pepper, cucumba, and garden egg. The main reason for these crop combinations in the farmer's field is that it is used as a food security initiative in most communities. The key to increasing agricultural output in most developing countries is improving the productivity of farmers, which cannot be achieved without markets that would effectively bind the increasingly specialized activities of thousands of widely dispersed producers into an integrated national economy. Thus, an efficient and responsive cropping system is an indispensable component of the development process (Egbetokun and Omonona, 2012). This study therefore estimated the cost and returns of cropping systems involving cassava in the study area.

METHODOLOGY

The study was conducted in Abia State of Nigeria. The state lies within approximately latitude $4^0 40`$ and $6^0 14`$ North and longitude $7^0 10`$ and 8^0 east and covers a land areas of about 5,243.7sq km which is approximately 5.8% of the total land area of Nigeria. Abia state is characterized by three agricultural zones; name Aba south, Umuahia and Ohafia areas. The main crops grown in the area include cassava, cocoyam, yam, maize, melon, okra and vegetables. A multi – stage random sampling technique was employed in the selection of the respondents for the study. The existing three agricultural zones in the state namely Abia south, Umuahia and Ohafia were used. Also, a random selection of two local government areas from each agricultural zone was done. In the third stage, ten communities were randomly selected from each of the local government areas earlier selected; then a village was randomly selected from each of the communities. Lastly, four farmers were randomly selected from each of the four selected villages. This gave a sample size of 100 respondents.

Data were collected using structured questionnaire. The variables on which data were collected include the production practices of farmers, cultivars of cassava planted in the area, size of farm land cultivated, quantity of inputs used, labour availability, revenue derived from non-farm sources, prices of inputs used and outputs produced, quantity of output produced, and expenditure on farm inputs used. The prices of inputs used and outputs produced were based on the prevailing market prices in the study area during the 2015 cropping season. The prices are as specified: land rent at N1,196.72 per plot; labour wage rate at N1,500 per man-day; cassava cuttings at N500 per bundle; fertilizer at N96 per kilogram (or N4,800 per 50 kg bag); capital at N1.00 ; output price at N12.50 per kilogram (Obasi *et al*, 2015). The period of the research covered the 2015 cropping season. Data were analyzed using descriptive statistical tools, gross margin analysis and net returns model. The estimates are stated below:

$GM = TR - TVC$

$\pi = GM - TFC$

Where,

GM = Gross margin

Π = Profit

TVC = Total variable cost

TFC = Total fixed cost

TR = Total revenue

The net return model is specified as:

$NR = TR\text{-}TC$

$NR = \sum_{j}^{n} = 1\ TVP_i - \{TVC_j + TFC_i\}$

$\sum_{j}^{n} = 1\ P_jQ_j - \sum_{j}^{m} = 1\ \{\sum_{k=1}^{z} P_kX_k + \sum_{l=1}^{z} P_lF_l\}$

Where:

TVP = Total Value of Production

FC = Fixed Cost

j = jth respondent

n = number of respondents

Pj = Price of jth respondent's output

Qj = Output of jth respondent

Pk = Price of the Kth variable input

Xk = Variable inputs

m = number of variable inputs

PL = Price of the Lth fixed input

FL = Fixed input

z = number of fixed inputs

Straight line method was used to depreciate the capital input. The model is specified as follows:

D = (P – S) N...

Where

D = Annual depreciation

P = Purchase Price

S = Salvage or scrap value

N = Economic life span of asset

The revenue generated through the sale of cassava stems, roots and other crop mixtures was estimated, and the difference between the revenue generated and the cost incurred was also calculated.

RESULTS AND DISCUSSION

Net Returns to Cassava Cropping Systems (Cassava/Yam/Maize/Melon Cropping Systms)

The income and expenditure analysis for cassava/yam/maize/melon; cassava/yam/maize/okra and cassava/yam/maize/vegetables mix cropping. The net farm income was N144, 876.58. The return per naira invested was N0.48k. This result indicates that cassava/yam/maize/melon mix cropping has both the highest net return per naira invested. The cropping system is therefore ranked first among all the cropping systems practiced by farmers.

The income and expenditure analysis for cassava/yam/maize/melon shows total revenue of N480, 000 and a total cost of production of N357, 912.16. The total variable cost and total fixed cost were N111, 844. 73 and N35, 939.69 respectively. The total variable cost on farm inputs are; planting materials (N52,744.73 or 21%) and fertilizer (N43,200 or 16%), land preparation (N36,000 or 17%) and weeding (N12,000 or 10%) respectively. The return per naira invested was N1.48 The result suggests that the mix cropping is profitable.

CONCLUSION

The result of this study suggests policies aimed at promoting cassava based cropping systems by providing cassava farmers with necessary inputs especially fertilizers, good road transportation network. However, farmers should be encouraged by extension workers to form associations that would enable them pull their resources together, raise loans and purchase the needed facilities so as to tap the potentials inherent in cassava enterprise. Conclusion is that the mixtures are profitable and farmers are encouraged to practice it for food security and income.

Table 1: Income and expenditure analysis for Cassava/Yam/Maize/Melon crop mixture

Item	Quantity	Unit Price (N)	Value (N)/ha
Cassava tubers	15 tonnes	12,500	187,500
Cassava cuttings	105 bundles	500	52500
Other crops			180,000
Total revenue			420,000
Expenditures			
Variable cost			
Planting materials			52,744.73
Fertilizer	9 bags of 50kg	4,800	43,200
Cost of Labour			
Bush clearing	12 man days	1,500	18,000
Land Preparation	20 man days	1,800	36,000
Planting	16 man days	1,500	24,000
Weeding	8 man days	1,500	12,000
Fertilizer application	20 man days	1,500	30,000
Staking	11 man days	1,500	16,500
Harvesting	15 man days	1,500	22,500
Total cost of labour			**159,000**
Total Variable Cost			111,844.73
Gross Margin			308,155.27
Fixed cost			
Annual land rent			29,580.56
Depreciation on capital			6,359.13
Total fixed cost			35,939.69
Total Cost (TFC + TVC)			269,973.42
Net Farm Income (TR – TC)			144,876.58
Return per Naira invested			**₦0.48k**

Source: Field data, 2015

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IMPACT OF THE MENACE OF FULANI HERDSMEN ON CASSAVA PRODUCTION IN ABIA STATE, NIGERIA

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ABSTRACT
The study assessed the impact of menace of Fulani herdsmen on cassava production in Abia State, Nigeria. Multi-stage purposive sampling technique was used to select five Local Government Areas (Ohafia, Umuahia North, Umunneochi, Ikwuano and Bende L.G.As) and one community from each of the selected LGAs with twenty respondents drawn. This gave a sample of one hundred respondents. Data and information were elicited from the respondents using structured questionnaire sets. Descriptive statistics were employed in the analysis of data and the results show the activities of Fulani herdsmen had moderate impact on their economy (3.13) through the destruction of crops and reduction in crop yield as well as their environment (3.36) through environmental pollution, fertilization of the farm, land degradation and erosion. The study concluded by recommending that federal and state governments should discreetly implement the grazing reserve policy and also takes necessary actions to curb the menace of the Fulani-herdsmen in the area.
Keywords: Herdmen, Fulani, menace, cassava production

INTRODUCTION

Cattle rearing by Fulani-herdsmen have contributed to the economy of the South-East and the country at large. The place of Fulani herdsmen is inevitably important as they have sustained the production and sales of meat in markets across the country. Despite their undisputable importance to the country's economy, recently their activities in the South-East and the country as a whole threaten the life and existence of those living within their areas of grazing, especially in the rural areas. There is virtually no community in the South-East where you will not find the Fulani herdsmen but the most disturbing to people especially farmers is the way they kill, maim and allow their cattle to destroy farm crops wherever they set their feet. According to Nkwopara et al., (2015), the activities of these herdsmen in some communities in Abia State have become a source of major concern to the people. This is as a result of the repeated destruction of crops and farmlands in rural communities in the state. The most annoying aspect is that the herdsmen challenge them when they are confronted.

Haro and Dayo (2005) opined that one of the major causes of the conflict is that most times the Fulani herdsmen lead their herds into the farms during growing season while these cattle eat or trample on the crops thereby destroying the farm. Tonah (2006) asserted that the reasons for the increasing farmer-herder conflicts include the southward movement of pastoral herds into the humid and sub-humid zones, coupled with the successful control of the menace posed by disease, the extensive availability of veterinary medicine and expansion of farming activities into areas that served as pasture land before now. Other sources of conflict according to Gbehe (2009) are the pursuit of access to a variety of limited resources which includes grasslands, water for animals, rival claims to land, and so on.

METHODOLOGY

The study area was carried out in Abia state, Nigeria. Multi-stage purposive sampling technique was used to select five L.G.As (Ohafia, Umuahia North, Umunneochi, Ikwuano and Bende L.G.As) and one community from each of the selected LGAs. The LGAs selected were the ones that have experienced destruction by Fulani herdsmen. Twenty respondents were randomly selected from each of the selected communities giving a total of 100 respondents.

A well structured questionnaire was used to elicit information from the respondents. Data collected were analyzed using descriptive statistic like percentages, means and a 5-point Likert scale rating.

RESULTS AND DISCUSSION

Table 1 revealed that the respondents perceived that the activities of Fulani herdsmen had moderate impact on their economy (3.13) through the destruction of crops and reduction in crop yield as well as their environment (3.36) through environmental pollution, fertilization of the farm, land degradation and erosion. Furthermore, it had high impact on their social lives (4.21) through conflict, obstruction of traffic, loss of lives and destruction of property.

Results in Table 2 showed that respondents' perceived that the menace of Fulani herdsmen in the study area has reduced the amount invested into cassava production (3.35) for fear of losing their investments as well discouraged farmers from going to the farm for cassava cultivation (3.20).

Table 3 indicated that the major problems associated with tackling the conflict between Fulani herdsmen and farmers in the study area are governments' inability to implement the grazing reserve policy (3.27), inability of security personnel to take adequate actions (4.42), increased rate of unemployment (3.25), high rate of poverty (3.50) and illiteracy (3.01).

CONCLUSION

The activities of Fulani-herdsmen in the Abia state and South-east in general is a major obstruction to the development of agriculture and the nation's economy. Therefore the study recommends federal and state governments should discreetly implement the grazing reserve policy and also take necessary actions to curb the menace of the Fulani-herdsmen in the area.

Table 1: Respondents' Perceived Impact of Fulani-Herdsmen/Farmers Conflict on Cassava Farmers in Abia state

Impact Item	SD	D	U	A	SA	Total	Mean	Rank
A. Economic Impact								
1. Destruction of Crops	5 (5)	19 (38)	47 (141)	25 (100)	4 (20)	304	3.04	Moderate
2. Reduction in crop yield	5 (5)	20 (40)	32 (96)	35 (140)	8 (40)	321	3.21	Moderate
							3.13	**Moderate**
B. Environmental Impact								
1. Environmental pollution	0 (0)	10 (20)	19 (57)	41 (164)	30 (150)	391	3.91	High
2. Fertilization of the farm	20 (20)	31 (62)	30 (90)	15 (60)	4 (20)	250	2.50	Moderate
3. Land degradation	0 (0)	5 (10)	20 (60)	56 (224)	19 (95)	389	3.89	High
4. Erosion	2 (2)	20 (40)	51 (153)	17 (68)	10 (50)	313	3.13	Moderate
							3.36	**Moderate**
C. Social Impact								
1. Conflict	0 (0)	1 (2)	0 (0)	59 (236)	40 (200)	438	4.38	High
2. Obstruction of traffic	0 (0)	0 (0)	10 (30)	20 (80)	70 (350)	460	4.60	High
3. Loss of lives	1 (1)	20 (40)	15 (45)	34 (136)	30 (150)	372	3.72	Moderate
4. Destruction of property	0 (0)	0 (0)	10 (30)	60 (240)	30 (150)	420	4.20	High
							4.21	**High**

Key: Low impact – 1.00 – 2.33
Moderate impact – 2.34 – 3.66
High impact – 3.67 – 5.00

Table 2: Respondents' Perceived Impact of Fulani-Herdsmen/Farmers Conflict on Cassava Production in Abia state

Item	SD	D	U	A	SA	Total	Mean
1. Reduced land area allocated to cassava production	10 (10)	20 (40)	44 (132)	20 (80)	6 (30)	292	2.92
2. Reduced the amount invested into cassava production	3 (3)	18 (36)	30 (90)	39 (156)	10 (50)	335	3.35
3. Discouraged farmers from going to the farm for cassava cultivation	5 (5)	20 (40)	35 (105)	30 (120)	10 (50)	320	3.20
4. Reluctance to adopt new technologies in cassava production	6 (6)	28 (56)	42 (126)	20 (80)	4 (20)	288	2.88
Mean score							**3.00**

Table 3: Respondents' perception of the problems associated with tackling the conflict between Fulani herdsmen and farmers

Problem	To a very great extent	To a great extent	To some extent	To a little extent	None at all	Total	Mean
1. Inability of the Government to implement the grazing reserve policy	15 (75)	25 (100)	36 (108)	20 (40)	4 (4)	327	3.27
2. Climate change	8 (40)	15 (60)	30 (90)	25 (50)	22 (22)	262	2.62
3. Inability of the security personnel to take adequate actions	55 (275)	32 (128)	13 (39)	0 (0)	0 (0)	442	4.42
4. Encroachment of crop cultivation into grazing lands as a result of increase in population	10 (50)	10 (40)	37 (111)	27 (54)	16 (16)	271	2.71
5. Increased rate of cattle rustling	0 (0)	0 (0)	15 (45)	20 (40)	65 (65)	150	1.50
6. Increased rate of unemployment	28 (140)	20 (80)	12 (36)	29 (58)	11 (11)	325	3.25
7. High rate of poverty	30 (150)	25 (100)	15 (45)	25 (50)	5 (5)	350	3.50
8. Illiteracy	10 (50)	18 (72)	40 (120)	27 (54)	5 (5)	301	3.01
Mean score							**3.00**

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EFFECT OF MICROCREDIT ON POVERTY REDUCTION AMONG RURAL NON-FARM HOUSEHOLDS IN NORTHEAST, NIGERIA

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ABSTRACT

This study assessed the effect of microcredit on poverty reduction among rural non-farm households in North-East, Nigeria. Multi-stage random and purposive sampling techniques were employed to select 200 non-farm households who constituted the sample size. Primary data used for the study were sourced with the aid of structured questionnaire which was administered to the respondents. Data collected were analysed using both descriptive and inferential statistics. The result showed that non-farm households accessed credit from both formal and informal credit sources, however, bulk of micro-credit was obtained from informal/unorganized sector. The study observed that out of the mean of ₦366,180 applied for by nonfarm households, ₦265,815 representing 72.6% was disbursed to them. Prior to acquisition of microcredit, the rural households earned a mean annual income of ₦254,580, however, a year after microcredit acquisition, it rose by 29.4% (₦106,025.04) to ₦360,605.04. Moreso, the findings indicated 38.0% of nonfarm households were poor. The poverty depth of 0.30 and poverty severity of 0.26 was obtained for the households. The regression analysis on the effect of microcredit on the income of the non-farm households revealed that the coefficient of income was positive and statistically significant at 1% probability. The effect of microcredit on the poverty profile of non-farm households revealed that microcredit exerts negative influence on poverty status of non-farm households in the study area. The study recommends: the establishment of robust rural credit scheme in rural areas; and institution of policy framework that will enable poor rural households without appropriate collateral to access funds for farm and non-farm activities.

Keywords: Microcredit, Poverty Reduction, Rural Nonfarm Households, Northeast Nigeria.

INTRODUCTION

Nigeria occupies a total land mass of 923,766 square kilometers and has over 74 million hectares of arable land. She has a projected population of 162.47 million in 2011 and active workforce of 56.6% (15 – 64 years of age) (Mimiko, 2011); yet Nigeria is among the 25 poorest countries in the world with up to 70% of her population being poor (UNDP, 2000). This level of poverty in the country is attributed to inadequate economic productivity and growth. In the quest to overcome poverty rural households engage in economic diversification activities such as nonfarm activities. Diversification is a sure way of reducing the risk of income variances while improving household income (Fuller, 1990).

Capital resource such as finance is one of the principal factors of production. In support of this, Ezike (1999) contended that finance is the sixth sense that makes other senses to function effectively. Access to finance is a crucial motivation for agricultural and non-agricultural productivity. Non-farm enterprises in rural areas require unhindered access to credit to boost their economic activities. This is predicated on the fact that credit serves as the engine that drives other factors of production to attain higher level of growth. The birth of microfinance of which micro-credit is a subset component represents a flexible structures and systems by which a wide range of financial and enterprise development services are offered to micro-entrepreneurs in an affordable and convenient manner. Thus, microcredit is one of the mantras of contemporary development initiatives all over the world.

The introduction of microcredit in Nigeria was based on the failure of the top-bottom formal financial institutions to address the credit needs of the rural poor households, thereby constraining the processes of investing for livelihood enhancement among the rural entrepreneurs. This credit gap created by formal financial institutions to give credit to rural entrepreneurs is filled by the micro-finance institutions. Despite the existence of several microcredit institutions such as microfinance, cooperative societies, Bank of Agriculture, money lenders etc, Northeast, Nigeria is still regarded as the zone with the highest rate of poverty in Nigeria (NBS, 2012). It is against this backdrop that this study assessed the effect of microcredit on poverty reduction among rural nonfarm households in Northeast, Nigeria. To achieve this, the following specific objectives were set out: analyse the sources and utilization of micro-credit by the rural non-farm households; determine the effect of micro-credit on the income of non-farm households in the area; and determine the effect of micro-credit on the poverty profile of rural non-farm households in the study area. The study also tested the hypothesis that microcredit has no significant effect on poverty profile of the rural nonfarm households.

METHODOLOGY

This study was carried out in Northeast, Nigeria. North East Geo-political zone is made up of six (6) states, namely: Adamawa, Taraba, Bauchi, Gombe, Borno and Yobe. It has a population of 18,984,299 million people and a land mass of 274,548.1 km^3. The study employed multistage random and purposive sampling techniques in the selection of 200 rural nonfarm households. The first stage involved the purposive selection of four (4) States out of the six States in the North East zones. This was informed by the need to select only those states with relative peace because of activities of Boko Haram in this zone. In the second stage, five local government areas were randomly selected from each of the four states, to give a total of twenty (20) LGAs. In the third stage, two wards from each local government area were randomly selected to give a total of forty (40) wards. In each of the wards, five (5) were selected purposively, thus, a total of two hundred (200) rural non-farm households were sampled for the study. Data for the study were collected using interviewers schedule based on structured questionnaire. Descriptive statistics was used to analyze objectives (i) and (ii) while objective (ii) was further subjected to FGT index analysis, and objective (iii) was achieved using simple regression. Finally, objective (iv) was achieved with the aid of logit regression. F-test, Z-test was used to test the hypotheses.

Model Specification

The Foster, Greer and Thorbecke (FGT) Index

The Foster, Greer and Thorbecke (FGT) index was used to determine the threshold which was used to categorize the level of poverty among non-farm households in the study area. The FGT index was computed with the aid of this formula stated below:

$$P\alpha = \frac{1}{n}\sum_{i=1}^{H}\left(\frac{Z-Y}{Z}\right)^{\alpha} \text{ .... (i)}$$

Where: Z = poverty line
N = total Sample
H = the number of poor (below poverty line).
Y = average household monthly *per capita* expenditure
α = poverty index which takes value of 0, 1 and 2

Simple Regression Model

The simple regression model used to determine the effect of micro-credit on the income of non-farm households in the study area is explicitly stated as:

i. Model for nonfarm households:

$Y = \alpha + \beta X + et$ ………………………………. (ii)

Where:
Y = Amount of microcredit acquired by the nonfarm households (naira)
X = Income of nonfarm households (naira)
α = Constant/ intercept
β = Coefficient
et = Stochastic error term

RESULTS AND DISCUSSION

Sources and Utilization of Micro-Credit by Rural Non-farm Households

Basically, credit can be secured either from formal or informal sources. The result of the analysis is presented in Table 1. The result in Table 1 shows that rural non-farm households accessed micro-credit in the study area from both formal and informal credit sources. However, the bulk of micro-credit obtained by the respondents was higher from informal/unorganized sector. The inform sources of microcredit accessed by the non-farm were money lender (63.0%), rotatory club (isusu/adasu) (62.5%) and friends and relatives (44.0%). On the formal credit source, the most available sources for nonfarm households include: cooperative society (38.5%) and commercial bank (23.0%). This is an indication that the rural non-farm households depend more on informal credit sector for microcredit procurement and this have serious implication for their investment level, considering the exorbitant interest rate inherent in the informal credit institution. However, the high access to informal credit may be attributed to the ease with which clients approach the credit principals. This is in consonant with the findings of Mohieldin and Write (2000), who identified the major sources of informal credit for rural households to into family, friends, money lenders and savings from and off-farm income. Similar report has been credited to Akinbode, Salami and Ojo (2014).

From the result in Table 2, it was observed that although 37.5% of the non-farm household applied for above N300,000, most (45.0%) of them obtained between ₦150,001 – ₦300,000. More so, the mean amount applied was ₦366,100 out of which about 72.6% representing N265,815 was disbursed to them. Overall, the level of access to micro-credit in terms of amount disbursed to the rural non-farm households in the study area is general low, considering the current economic reality in the country. This finding is in line with that of Okonkwo (2010), who argued that demand for microcredit by rural households is hardly met. This is mostly due to their poor state and the fear of high loan default.

The result in Table 3 shows that nonfarm households utilized the acquired credit for investment in various economic non-farm activities. It was observed that the rural households utilized the acquired microcredit to start-up and expand their petty trade (69.0%), procurement of mini equipment and tools for artisanal works (mason, carpentry, mechanics, black smith) (54.5%), procurement of raw materials for manufacturing firms (46.0%) and non-farm labour (43.5%). This suggests that rural households used acquired credit to invest in economic ventures as against the popular opinion that such credit is diverted for family and personal purposes.

Determination of Household's Poverty Status

The relative poverty index (RPI) approach was used for determination of poverty status of non-farm households in the study area. The RPI was computed as 2/3 of the monthly mean *per capita* expenditure. Based on the mean *per capita* expenditures of ₦18,375.4 for non-farm households, the RPI was determined to be ₦12,250.3. Consequently, any household with monthly expenditure below the poverty line (i.e. ₦12,250.3) were classified as poor while those with expenditures of (₦12,250.3 and above) were classified as non-poor. Expenditure is known to play a very important role in the poverty level of household because it reflects the true level of actual income. Hence, expenditure is more preferable to income since incidental inflows like remittances and gifts, which do not occur regularly, are part of household income. The result of the analysis is presented in Table 4.

The result in Table 4 shows the FGT poverty indices among the surveyed rural nonfarm households. The poverty indicators were consistently high among the rural households. For example, the head count ratio value of 0.38 was recorded among the nonfarm households in the study area. This implies that about 40% of rural nonfarm households were poor (i.e living below the World Bank minimum per capita daily expenditure of $1.25 (₦400.00)). On the poverty depth, 0.30 was recorded among the rural nonfarm households, suggesting that an average household requires to mobilize up to 30% of $1.25 (₦400.00) per day for each household member to be able to escape poverty. The poverty severity shows 0.26, indicating the seriousness of poverty in the study area; because the closer this value is to one (1), the more serious the poverty in the area. The high proportion of poor households in the study area calls for urgent poverty policy intervention programmes for poverty alleviation in the area. This may not be unconnected with fact that poverty is largely a rural phenomenon (Pinstrup-Anderson, Lorch, and Rose, 2001).

Effect of Microcredit on the Income of Rural Non-Farm Households

Simple regression analysis was also used to determine the effect of microcredit obtained by the non-farm households on their income in the study area. The summary of the findings is presented in Table 6.

The regression result in Table 5 shows that the coefficient of determination (R^2) was 0.954 or 95.4%, indicating that 95.4% of total change observed in the income of non-farm households was attributable to variation on the amount of microcredit obtained by the non-farm household. The very high value of F-ratio (4122.951) and the low value of standard error of the estimate (22.823636) signify the goodness of fit of the model. The Durbin-Watson value was 2.010 indicates absence of autocorrelation in the model. The overall model was statistically significant ($P < 0.05$), implying that microcredit exerts significant influence on the income of non-farm households in the study area. The coefficient of income of the non-farm households was positively signed and statistically significant at 1%. This implies that procurement of microcredit will enhance income generation of the non-farm households. Additionally, acquisition of micro-credit caused 41.3% effects on income of the non-farm households in the study area. The very high level of significance at 1% level, suggests that microcredit is an important predictor of income generation among non-farm households in the study area.

Effect of Microcredit on Poverty Profile of Non-Farm Households in the Study Area

The result of the logit regression analysis is presented in Table 6. From the result in Table 7, it was observed that the coefficient of microcredit obtained was negatively signed as well as statistically insignificant. This means that increase in supply of microcredit can lead to decrease in poverty profile among non-farm households by 0.004 and vice versa. The overall logit model was moderately adequate as indicated by the values of Pearson Goodness-of-Fit (34.295) and the 2 Log likelihood (251.813). However, the overall model was statistically insignificant ($P > 1.000$); implying that microcredit does not exerts positive influence on poverty profile of the non-farm households in the study area. This may be explained by the small size of credit available to the non-farm households in the area.

Test of Hypothesis

The null hypothesis which stated that the microcredit has no significant effect on poverty profile of the rural nonfarm households was tested using the values of Cox & Snell R^2 (0.019) and Nagelkerke (0.026) as presented in Table 6 above. These values indicated that microcredit has poor effect on poverty profile of the nonfarm households in the study area. Consequently, the null hypothesis was accepted that the microcredit has no significant effect on poverty profile of the nonfarm households in the study area.

CONCLUSION

The study concludes that microcredit acquisition significantly contributed to the income generation of rural nonfarm households. This implies that microcredit is a veritable tool for enhancing income generation among nonfarm households in rural communities of Nigeria. However, the study found that microcredit exerts negative influence on poverty status of rural non-farm households in the study area. This apparently was due to the meagre size and volume of credit supplied to the households, which was majorly between ₦50,001 – ₦150,000. This range of credit is grossly inadequate to impact meaningfully on the poverty profile of rural households in the study area. Based on this the study recommends the establishment of robust rural credit scheme in rural areas; and institution of policy framework that will enable poor rural households without appropriate collateral to access funds for farm and non-farm activities.

Table 1: Distribution of Farm and Non-Farm Households According to Sources of Micro-Credit Accessed in the Study Area

Sources of microcredit	Variable description	Non-Farm households	
		Freq. (n=200)*	Percentage
Formal	Commercial bank	46	23.0
	Bank of Agric.	6	3.0
	Cooperative society	77	38.5
Informal	Money lender	126	63.0
	Relatives & friends	88	44.0
	Rotatory club (Isusu/Adasu)	125	62.5

Source: Field Survey, 2015
*Multiple responses recorded

Table 2: Distribution of the Non-Farm Households According to Amount of Loan Applied and Amount Obtained

Items	Credit range (₦)	Non-Farm households	
		Freq. (n=200)	Percentage
Amount applied	30,000- 100,000	18	9.0
	100,001-200,000	47	23.5
	200,001-300,000	60	30.0
	Above 300,000	75	37.5
Mean (₦)		**366,100**	
Amount obtained	5000- 50,000	15	7.5
	50,001-150,000	37	18.5
	150,001-300,000	90	45.0
	Above 300,000	58	29.0
Mean (₦)		**265,813**	**72.6%**

Source: Field Survey, 2015.

Table 3: Distribution of the Rural Nonfarm Households According to Areas of Utilization of Microcredit

Activities	Freq (n=200)*	Percentage
Starting up and expanding petty trade	138	69.0
Procurement of raw materials	92	46.0
Investment in service industry (motor cycle, motor vehicle, rental facilities)	64	32.0
Equipment and tools for artisanal works (mason, carpentry, mechanics, black smith)	109	54.5
Labour used	87	43.5

Source: Field Survey, 2015
*Multiple responses recorded.

Table 4: Incidence, Depth and Severity of Poverty among Rural Non-Farm Households in the Study Area

FGT index	Non-farm households (n=200)
Incidence of poverty (P_0)	0.38
Depth of poverty (P_1)	0.29
Severity of poverty (P_2)	0.26

Source: Compute from Field Surveyed Data, 2015

Table 5: Effect of Microcredit on the Income of Non-Farm Households in the Study Area

Variables	**Coefficient**	**Standard Error**	**t-value**	**Sig.**
Constant	269619.727	140.159	1923.668	*
Income of non-farm households	0.413	0.000	64.210	*
R	0.977			
R^2	0.954			
Adj. R^2	0.954			
Std. error est.	22.823636			
F-ratio	4122.951			

Source: SPSS Analysed Field Data, 2015
* indicate significance at 1%.

Table 6: Effect of Microcredit on Poverty Profile of Non-Farm Households in the Study Area

Variable	Coefficient (B)	Std Error	Z	Sig.
Constant	-5.414	2.460	-2.201	**
Microcredit obtained (₦)	-0.004	0.000	-0.000	NS
Pearson Chi-square	34.295			NS
2 Log likelihood	264.587			
Cox & Snell R^2	0.019			
Nagelkerke R^2	0.026			

Source: SPSS Analysed Field Survey, 2015.

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SOCIO-ECONOMIC FACTORS AFFECTING AGRICULTURAL TECHNOLOGIES ADOPTION AMONG FARMERS IN ABAKALIKI LOCAL GOVERNMENT AREA OF EBONYI STATE, NIGERIA

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ABSTRACT
The study analyzed the socio-economic factors affecting agricultural technology adoption among farmers in Abakaliki Local Government Area of Ebonyi state. Multistage random sampling technique was used to select a total of 120 respondents and primary data which was used for the study were collected through the use of structured questionnaire. Objective I was realized using descriptive statistics while objective ii was actualized with the aid of multiple regression analysis. The result of the analysis showed that majority (65%) of farmers were male, 65% of the respondents were married with an average household size of 9 persons and a mean age of 46 years. Most of the respondents (84.2%) had a formal education with a mean farming experience of 17 years and also with a mean annual farm income of ₦185, 000.00. Also, the study showed that the socio-economic characteristics of the farmers have significant influence on technologies adoption as was shown by the coefficients of multiple determinations (R^2) of the socio-economic variables which was 0.748. Based on the findings, the study recommended that farmers should be encouraged to engage into full time farming and improvement in their productive base in order enhance the adoption of agricultural technologies in the area.
Keywords: Socio-economic, Agricultural Technologies, Adoption, Farmers

INTRODUCTION
The importance of technology to agricultural development especially in less developed countries is widely recognized. This is predicated on the observed impact of technology and its potential and actual contributions to development of agriculture. In developing countries like Nigeria where the greater proportion of its population lives in the rural areas, agricultural technologies can provide a potential means of increasing production, rise in income as well as the standard of living of farmers (Ani, 2002). Kassapu (1999) defined agricultural technology as the application of knowledge to the solution of practical problems to meet the basic needs of mankind in their daily life in terms of energy, food, housing, health, clothing, transportation.
According to Agwu (2004), there are number of factors that influence the extent of adoption of agricultural technologies such as characteristics or attributes of technology, the adopters or clientele, which is the object of change agent and the socio- economic, biological and physical environment in which the technology take place. Among these factors the socio-economic attributes of farmers have great influence on adoption of appropriate technologies needed for optimum farm outputs and productivities. For instance, socio-economic factors determine the number of technological package to be adopted at a particular time irrespective of other influencing factors. Thus, annual farm income, total annual income, farm size and educational status were positively related to adoption while age and household size had inverse relationship with technologies adoption (Mbam, 2016). Also, the personal characteristics of the farmers such as age, sex, experience and educational status have strong influence on the level of technologies adopted by farmers in order to enhance farm outputs and productivities. For example, the willingness to adopt a technology may change with age and experience (CIMMYT 1993). Thus, as older farmers may be less willing to invest in technologies that only pay off in the longer term (Feder and Umali 1993), younger farmers who may be more educated or be more open to trying out new technologies often modify their perceptions of the riskiness of new technologies over time as they acquire more information on new improved technologies (Marra et al 2003).
Although a number of studies have been conducted across the globe on agricultural technology adoption, there seems to be dearth of knowledge on the socio-economic factors that affect agricultural technologies adoption, especially among farmers in the study area. In a bid to proffer solution to the above problem, the study described the socio-economic characteristics of the farmers and as well as analyzed the effects of the socio-economic characteristics of the farmers on the levels of adoption of agricultural technologies in the area.

METHODOLOGY
The study area was Abakaliki, Local Government Area (L.G.A) which has seven (8) autonomous communities with its headquarters at Nkaliki. The L.G.A. covers a mass area of 106km^2 and total population of 285,758 people (NPC, 2006). Geographically, the area lies within longitude 80^{0}E and latitude 40^0 N and South west and north east trade wind that prevail in the area. The annual rainfall of the area ranged between 1500-2000 mm and the temperature ranged between 23.9ºc to 25.7ºc per annum. The area is bounded in the north, west and south by

Ebonyi, Ezza south and Ezza north L.G.As respectively and in the east by Obubra L.G.A of Cross River state. The inhabitants of the area are predominantly farmers and as such engaged in crop, livestock and fish production. Multistage random sampling technique was used in selecting the respondents for the study and primary data collected through the use of well structured questionnaires were analyzed using descriptive and inferential statistics. Objective i was realized using descriptive statistics while objective ii was actualized using multiple regression analysis.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The result of the analysis (Table 1) showed that majority (87.2%) of the respondents was between 31-60 years of age with a mean age of 46 years. This implied that the majority of the farmers were within their productive and active age of farming and this is within the age defined as economic active age (30-60) (FAO, 2000). Also, the result showed that most (65%) of the respondents were male indicating that more males were into farming in the area. This finding is in line with Madugu and Bzugu (2012) who opined that for agricultural sector of the economy to be in its optimum level, there must be preponderate of male in farming. Equally, the result showed there was active participation of married people in agricultural activities as was indicated by the majority (65%) of the respondents that were married. This is justified as Agbom (2012) reported that more married farmers were involved in adoption of agricultural technology in Oyi Local Government Area of Anambra state. The household size of the respondents with mean household size of 9 persons implied that the farmers had chances of getting family labor for use in their farm and this would have increased the size of land cultivated. The study showed that majority (84.2%) of the farmers had acquired various levels of education. This justified the importance education in the adoption of agricultural technologies and this in consonance with the findings of Feder and Umali (1993) that adoption of new technologies was positively correlated with the farmer's level of education. Again, it was found that the average farming experience of the farmers was 17 years implying that the farmers have acquired reasonable years of experience as a result of farming activities in the area and this favored adoption of innovations. This is in consonance with the findings of Marra *et al*. (2003) that in addition to schooling, farmers will also benefit from the skills to use the technologies that may be acquired through long time experiences.

Furthermore, the result showed that majority (51.7%) of the respondents had a mean annual farm income of N185, 000.00 which is an indication that the farmers earned little or low income from farming activities. This corroborated Mbam (2016) who found that income level is an important factor in determining farmers' decision to adopt agricultural technologies. The study also showed that majority (72.5%) of the respondents was into full-time farming and with a mean farm size of 5 hectares. This implied that the respondents were small to medium holder farmers and this may have affected the adoption of agricultural technologies in the area thus, justifying the report by Gabre-Madhin *et al.*, (2001) that large commercial farmers adopted new high-yielding maize varieties more rapidly than small-holder farmers.

Effects of the Socio-economic Characteristics of the Farmers on the Level of Adoption of Agricultural Technologies

A multiple regression analysis was used to determine the effect of the socio-economic characteristics of the farmers on the level of adoption of agricultural technologies (Table 3). The result showed that the coefficient of multiple determinations (R^2) was 0.748 or 74.8%, signifying that 74.8% of total variation observed was explained by the explanatory variables i.e. socio economic characteristics (x_1-x_9) included in the model. Specifically, the coefficient of age (x_1) was statistically significant and positively related to the adoption level of agricultural technologies. This implies that the older a farmer is, the more receptive he will be to adoption of agricultural technologies. This conformed to findings of Onumadu and Osahon (2014) that the age was one of the socio-economic determinants of adoption of improved rice technology. The coefficient of marital status (x_3) was positive and statistically significant indicating that marital status will bring about increase in adoption level of agricultural technologies. This conforms to the *a priori* expectation as married couples are constantly engaged in economic activities such as farming in order to meet-up with their family needs (Baumüller, 2012).

The coefficient of household size (x_4) was statistically significant but negatively related to the adoption level of agricultural technologies implying that a decrease in household size will lead to increase in the adoption of agricultural technologies thus conforming to the a priori expectation. The coefficient of educational level (x_5) was statistically significant and positively related to the adoption levels, implying that the more educated a farmer is, the higher his level of technologies adoption. Farming experience (x_7) was positive and statistically significant, implying that years of experience influence positively the adoption of technologies. This corroborated Alarima, Adamu , Masunaga and Wakatsuki (2012) who found that years of experience influenced the adoption of new rice technologies. The coefficient of the farm size (x_9) was statistically significant and positively related to technologies adoption level. This implies that the higher the farm size, the higher the number of technological package a farmer will adopt and this was justifiable as (Mbam, 2015) found that farmers with large farm size have comparative advantage than those with smaller farm size as it concerns the adoption of technologies.

CONCLUSION AND RECOMMENDATIONS

The study found that socio-economic characteristics of the farmers such as age, marital status, household size, educational status, farming experience and farm size affect significantly the adoption of technologies needed for enhanced farms' outputs and productivities. Based on the findings, the study recommended that farmers should encouraged to engage into full time farming in order enhance the adoption of agricultural technologies. Also, farmers' productive base should be improved in order to increase the adoption of more agricultural technologies in the area.

Table 1: Distribution of the Respondents According to Socio-economic Characteristics

Variables	Description	Frequency (n=120)	Percentage	$\bar{x}$
Age (years)	21-30	1	8	46
	31-40	38	31.7	
	41-50	55	43.8	
	51-60	14	11.7	
	60 and above	10	8.3	
Gender	Male	78	65.0	
	Female	42	35.0	
Marital status	Single	30	25.0	
	Married	78	65.0	
	Widowed	12	10.0	
Household size	1-4	19	15.8	9
	5-8	36	30.0	
	9-12	42	35.0	
	13-16	18	15.0	
	17 & above	5	4.2	
Educational status	No formal education	19	15.8	
	F.S.L.C.	29	24.2	
	S.S.C.E	44	36.7	
	OND/NCE	15	12.5	
	B.Sc/Postgraduate	7	5.8	
Farming experience	6-10	18	15.0	17
	11-15	50	41.7	
	16-20	37	30.8	
	21 & above	15	12.5	
Annual farm income	≤ 50,000	19	15.8	185,000
	50,001-100,000	26	21.7	
	100,001-150,000	36	30.0	
	150,001-200,000	21	17.5	
	200,001-250,000	12	10.0	
	300,001-350,000	6	5.0	
Farm size	≤1-2	18	15	5
	3-5	60	50	
	6-8	42	35	
Farming status	Full-time	87	72.5	
	Part-time	33	27.5	

Table 2: Effects of Socio-economic Characteristics of Farmers on the Adoption Level of Agricultural Technologies in the Area

Variables	Coefficient	Standard error	t-value	Significance
Constant	-2.641	0.687	-3.846	*
Age (x_1)	0.033	0.011	3.060	*
Gender (x_2)	-0.145	0.140	1.036	NS
Marital status (x_3)	0.630	0.127	4.958	*
Household size (x_4)	-0.038	0.014	-2.648	*
Educational level (x_5)	0.204	0.014	14.702	*
Farming status (x_6)	-0.047	0.120	-0.391	NS
Farming experience (x_7)	0.044	0.016	2.711	*
Annual farm income (x_8)	4.005E-7	0.000	0.748	NS
Farm size (x_9)	0.117	0.042	2.805	*
R^2	0.748			
D.W	1.772			
F-statistics	36.316			
Standard error	0.57378			

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SOCIO-ECONOMIC FACTORS INFLUENCING FOOD CONSUMPTION EXPENDITURE OF HOUSEHOLDS IN UYO METROPOLIS OF AKWA IBOM NIGERIA

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ABSTRACT

Household food consumption pattern in Nigeria is a growing challenge as reflected in the rise in the general price level. The impact of this hardship in the current dispensation in the country may not be equally felt by all socio-economic groups. This is because the wherewithal for meeting essential food requirements may vary from one income group to the other. This, therefore, calls for the need to examine the extent of the variation in consumption expenditure among income groups. This study examined food consumption expenditure in Uyo Metropolis, Akwa Ibom State, Nigeria using data collected from 179 households through stratified sampling. Findings revealed that majority of the respondents were wage earners. Food expenditure was found to be highest in self employed/wage earners households while per caput food expenditure was highest in the self employed households. The self employed households were found to earn the highest monthly income. Educationally, household heads who have attended university or its equivalent spent the highest amount (N41,075.71) on food. About 68% of the households in the study were found to be low income households. Income, household size and households' level of education were found to have great influence on household food consumption expenditure.

INTRODUCTION

Food consumption is a topical issue in Nigeria, not only because it is related to poverty and food security, but because it is highly correlated with living standards and household resources. Essentially, the demand for food depends on population and the dietary habit per capita and daily calorie intake of the people. If this is particularly biting in a developing country where food expenditures account for a relatively large share of household income, it is more excruciating in Nigeria as a mono-culture economy where massive oil wealth of the 1970s led to the neglect of the entire agricultural sector. This worsened the problem of food shortages and Government's responded with massive importation of food products to meet domestic demand. Imports increased from ₦756.5 million in 1970 to ₦12, 839.6 million in 1981. This high import bills, not only aggravated the food crises, it exacted on the foreign reserves of the country (Ayantoye, 2009).

To solve the fundamental problems of food shortages and consumption, government embarked on multi-dimensional policies, programmes and projects spurred-on by large incomes from oil exports.

In spite of all these efforts, statistics and reports point to insufficient food supply for the teeming Nigerian population. According to Kormawa (1999), per capita growth of production of major foods in Nigeria has not been sufficient to satisfy the demands of an increasing population. This has created a gulf between national food supply and demand. The wide food supply–demand gap is compounded by high inflation rate. This, according to CBN, (2012) has manifested as increases in prices of food, beverages, housing, water, electricity, and transport among others. Though, it is said that the rural Nigerian communities still adhered to traditional food habits that are related to socio-economic status, production, distribution, utilization and household size (Okeke, 1996), the high inflation rate has direct negative consequence on the food purchase ability of the populace (Mohammad and Omotosho, 2010).

Empirical studies on food consumption expenditure and pattern abound (Cunningham, Cuningham and Saigo, 2005; and Obayelu, Okoruwa and Oni, 2009). However, it is the work by Olarinde and Kuponinyi (2005) that reported on the dynamic (ever changing) household food consumption patterns in Nigeria with its attendance effect on expenditure. Uyo as the state capital and a commercial nerve city in Akwa Ibom State could not be an exception. However, in spite of these changes, and the growth of Uyo as a State Capital, there has not been any recent empirical study to assess what factors influence food consumption expenditure in the area. The present study is intended to bridge this information and knowledge gap. Specifically, it intends to examine the influence of socio-economic characteristics on household food consumption expenditure in Uyo metropolis

METHODOLOGY

The Study Area: The study was conducted in Uyo Metropolis, Akwa Ibom State. Uyo is the capital of Akwa Ibom State. It is located on latitude 05º3ʺN and longitude 07º57ʺE. It is bordered on the south by Ekpe Atai and Nsit Ibom Local Government Areas, on the West by Abak Local Government, on the North by Ikono and Itu Local Government Areas and on the East by Uruan Local Government Area respectively. It has an estimated population of 309,573 (National Population Commission, NPC, 2006). It is a commercial nerve centre of the entire

Akwa Ibom State. Inhabitants of Uyo Metropolis are workers in public and private institutions and firms. Others are engaged in trading, craft making and transportation business.
Stratified sampling method was employed in the study. The study area was stratified into cells based on features/characteristics usually associated with low, medium and high density settlements. Due to non-availability of sampling frame, selection of compounds from which households were chosen was done through "random-walk" method. One household was selected in each compound for detailed study. A total of 60 respondents were selected from high, medium and low income earners areas of Uyo metropolis respectively. This gave a total sample size of one hundred and eighty (180). Out of 180 households, 179 supplied complete data that were used in the analysis while the remaining one (1) was discarded because of incomplete information.

Methods of Data Analysis: To analyze the socio-economic characteristics of the households and how they affect consumption expenditure in Uyo metropolis, descriptive statistics namely mean and percentages were used.

RESULTS AND DISCUSSION

Household (Hh) Socio-economic Characteristics and Food Expenditure

Table1 presents sampled households classified by occupation of the household head. The result reveals that 42.78 percent were wage earners, 32.78 percent were both wage earners and self-employed and 24.44 percent were household heads that were only self-employed. The wage earners group was made up of public servants, civil servants, professionals, Bankers, company workers as well as administrators. The self-employed households had the least average household size of 5 persons while the wage earning households had an average household size of 6 persons. The result also reveal that the self-employed and wage earning households spend the highest on food of ₦48,747.54 (27.11%) per month while their per caput food expenditure amounted to ₦6,673.09. Moreover, the wage earning households spend the least amount on food as well as the per caput food expenditure per month. In view of this, the self-employed households had the highest amount of income and the per caput income that accrues to the household which was ₦187,954.55 and ₦31,807.69 respectively.
Household size characteristic assessed in this study area was noted to vary directly with both income and expenditure. The Table shows that average household size of 4 persons had 46.93% of the household's sampled persons while only 2.23% have average household size of 17 persons. The results reveal a tendency towards small family size in the study area. This is in line with Obayelu, Okoruwa, and Oni, (2009) study of urban households in Kogi and Kwara State as well as Usharani and Reddy (2004) in Hyderabad, India. The current trend can be attributed to awareness created by government and such non state actors like Society for Family Health in controlling birth rate. Another reason could be high rate of inflation in the State. This may have made keeping and maintaining large family size rather hard and difficult. Average household size in the study area was six (6) persons.
Table 3, presents the educational level of household Heads. The result shows that percentage food expenditure decreases as income per household increases with the level of education attainment. This may not be unconnected with adoption of family planning measures by the learned. The result conforms to the *apriori* expectation. This correlation is reflected in the income per household, per caput income as well as the per caput food expenditure. The finding is similar to those of Yeong-Sheng (2012) in Malaysia.
Table 4 present the average monthly income by income group. The result shows that an observable pattern in the result is that, the higher the household income, the larger the size of the household, and also the food expenditure per household as well as the income per caput. Finally, the result reveals that the low income household spend 51.74 percent of their income on food, the middle income households allocate 26.19 percent of their disposable income on food whereas, the high income household allotted only 13.69 percent of their disposable income on food. This is in line with Umoh (1994) and Yeong-Sheng (2012) in Malaysia.

CONCLUSION AND RECOMMENDATION

This study examined food consumption expenditure in households in Uyo Metropolis, Akwa Ibom State, Nigeria. It was found that almost a half of the respondents were wage earners. Food expenditure was found to be highest in self-employed/wage earners households while per caput food expenditure was highest in the self-employed households. The self-employed households were found to earn the highest monthly income. Educationally, household heads who have attended university or its equivalent spent the highest amount (N41,075.71) on food followed by those with NCE and ND while those who have only primary education spent the least amount (N19,609.49) on food per month. Only 68% of the households in the study were found to be low income households. Income, household size and households' level of education were found to have serious influence on household food consumption expenditure. This also shows that large incomes have the tendency of households to consume good quality food items and procure other basic necessities in life.
In order to improve income in Uyo Metropolis, employment should be provided for the labour force so that unemployment can be relatively reduced. Qualitative education and apprenticeship training of the population should be embarked upon by government and developmental agencies in order to enhance the employment of the

generality of the masses. Also, the current minimum wage rate should be increased. To substantially improve the quality of life in the metropolis, there must be a concerted effort to get those who are not educated to be educated to a higher level. This is because; the likelihood of securing a higher paid job tends to increase with the level of educational attainment. It also increases the tendency of the population to adopt new practices that can lead to a rise in income generation.

Table 1: Distribution of Households Heads by Occupation and Food Expenses per month

Occupation	Percentage of total Household	Average Household Size	Food expenditure per Household (₦)	Monthly per caput food expenses (₦)	Monthly Income per Household (₦)	Monthly per caput income (₦)
Self employed	24.44	5.00	40,300.79 (21.44%)	6,820.13	187,954.55	31,807.69
Wage earners	42.78	6.00	38,939.26 (26.19%)	6,434.17	148,643.63	24,610.92
Self employed/ wage earners	32.78	7.00	48,747.54 (27.11%)	6,673.09	179,784.87	26,859.97
All groups	**100.00**	**6.00**	**47,457.04**	**6,567.77**	**147,537**	**22,825.52**

Source: Field survey, 2014

Table 2: Distribution of Households Size and Food Expenditure per month

Hh Size	Percent of total Hh	Average Hh size	Monthly Food expenditure per Hh (₦)	Monthly Per caput food expenses (₦)	Monthly Income per Hh (₦)	Monthly Per caput income (₦)
1 – 5	46.93	4.00	35,333.68 (30.17%)	8,421.28	117,126.19	26,977.59
6 – 10	41.89	7.00	46,349.94 (23.99%)	6,480.90	193,159.57	27,559.11
11 – 15	8.95	13.00	67,423.13 (53.23%)	5,137.11	126,662.50	9,559.24
Over 15	2.23	17.00	18,927.75 (113.76%)	1.455.98	16,638.53	1,279.89
All groups	**100.00**	**6.00**	**47, 457.04**	**6, 567.77**	**147, 537**	**22, 825.52**

Source: Field survey, 2014

Table 3: Distribution of Households (Hh) by Educational Level of Household Head

Educational Level of Hh	% of total Hh Head	Mean Hh size	Monthly food expenditure per	Monthly per caput food	Monthly Income per Hh	Monthly per caput
Primary sch.	1.68	8.00	19,609.49 (70.03%)	2,557.76	28,000.00	3,652.17
Up to Sec. School	15.64	7.00	28,971.43 (43.25%)	4,181.44	66,991.27	9,668.84
NCE &ND,.	18.44	5.00	32,884.24 (43.69%)	6, 576.85	75,271.22	1,5054.24
University &Polytechnic	64.24	7.00	41,075.71 (21.51%)	7,282.20	191,003.63	28,342.47
All groups	**)0.00**	**6.00**	**47,457.04**	**6,567.77**	**47,537.00**	**22,825.52**

Source: Field survey, 2014

Table 4: Distribution of Household by Income Group per month

Income group (₦)	Percent of total Hh Head	Average Hh size	Monthly Food expenditure per Hh (₦)	Monthly Per caput food expenses (₦)	Monthly Income per Hh (₦)	Monthly Per caput income (₦)
Low (< 147,537)	68.71	5.00	36,896.02 (51.74%)	6,793.73	71,309.76	13,130.39
Middle (147,537-274,000)	22.35	6.00	50,141.85 (26.19%)	7,963.71	191,442.30	30,405.54
High (> 274,000)	8.94	11.00	58,857.76 (13.69%)	9,350.71	429,968.30	39,088.03
All groups	**100.00**	**6.00**	**47,457.04**	**6,567.77**	**147,537.00**	**22,825.52**

Source: Field survey, 2014

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A REVIEW OF PRODUCTION AND MARKETING OF YAM IN NIGERIA

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ABSTRACT
Yam, a tropical crop in the genus Dioscorea*, has as many as 600 species out of which six are economically important staple species. In Nigeria, in many yam-producing areas, it is said that "yam is food and food is yam". However, the economic production of yam in Nigeria is substantially short and cannot meet the growing demand at its present level of use. Yam is grown on free draining, sandy and fertile soil, after clearing the first fallow. Land is prepared in the form of mound or ridge or heap of 1 metre (3 ft 3 in) height. The yams recommended for such soil conditions in Nigeria are white yam or white guinea yam (Discorea rotundata) and water yam or yellow yam (Discorea alata). Planting is done by seed yam or cut setts from ware tubers. Its cultivation is very profitable despite high costs of production and price fluctuations in the markets . An average profit per yam seed, average harvest and storage in Nigeria, was calculated at over US$13, 000 per hectare harvested .Households demand for yam consumption is very high in Sub-Saharan Africa. Nutritionally, yam is a major staple food consumption, providing food for millions of people in the West Africa. It is eaten in different forms such as fufu , boiled, fried and roasted . This root and tuber place in the diet of smallholder farmers cannot be ignored. It contributes over 200 dietary calories per capita per day for over 150 million people in West Africa. Yam tubers are sold on cash and carry basis and prices based on perceived size and quality of tubers. There is normally no grading system in place and a lack of formal contacts and arrangements between farmers and traders. From district markets yam tubers are transported to major urban centres such as Lagos for sale at larger urban markets. This review indicates that lack of finance, inadequate modern farm inputs, storage and processing, and high cost of labour, appeared to be the major constraints to yam production in Nigeria. In order to improve yam production, the government of Nigeria should provide a conducive environment and invest heavily in yam cultivation by providing farm tools to small holder farmers at subsidized rates.*
Keywords: Yam, Economics, Production, Nigeria.

INTRODUCTION

Yam is in the class of roots and tubers that is a staple of the Nigerian and West African diet, which provides some 200 calories of energy per capita daily. In Nigeria, in many yam-producing areas, it is said that "yam is food and food is yam". However, the production of yam in Nigeria is substantially short and cannot meet the growing demand at its present level of use. It also has an important social status in gatherings and religious functions, which is assessed by the size of yam holdings one possesses.(Ayannwuyi *et al.*,2007).According to the Food and Agricultural Organization report, in 1985, Nigeria produced 18.3 million tonnes of yam from 1.5 million hectares, representing 73.8 percent of total yam production in Africa.(Aidoo, 2009).According to 2008 figures, yam production in Nigeria has nearly doubled since 1985, with Nigeria producing 35.017 million metric tonnes with value equivalent of US$5.654 billion (Babaleye,2003). In perspective, the world's second and third largest producers of yams, Côte d'Ivoire and Ghana, only produced 6.9 and 4.8 million tonnes of yams in 2008 respectively. According to the International Institute of Tropical Agriculture, Nigeria accounted for about 70 percent of the world production amounting to 17 million tonnes from land area 2,837,000 hectares under yam cultivation.(Asante *et al*.,2007). Yam, a tropical crop in the genus *Dioscorea*, has as many as 600 species out of which six are economically important staple species. These are: *Dioscorea rotundata* (white guinea yam), *Dioscorea alata* (yellow yam), *Dioscorea bulbifera* (aerial yam), *Dioscorea esculant* (Chinese yam) and *Dioscorea dumetorum* (trifoliate yam). Out of these, *Dioscorea rotundata* (white yam) and *Dioscorea alata* (water yam) are the most common species in Nigeria. Yams are grown in the coastal region in rain forests, wood savanna and southern savanna habitats (Grunert *et al*., 2005).

The major producers of yam in Nigeria are Niger State, Abia State, Nassarawa State and Benue State. The problems of yam marketers include poor storage facilities, poor marketing strategy, and problem of income and culture of the people. As the campaign for household food security gains momentum all over the world, and some extreme hunger and poverty must be eradicated by year 2015, yams are some of the food crops whose production has got to be emphasized. Yams, being an important food crop for at least 60 million people in West Africa, it is therefore necessary to lower its production cost and scale up its production through an efficient use of its production resources (Babaleye, 2005). It is thus important that the profitability of its production be assessed. It is obvious that there is a potential for the increase in its production and much can be done to derive foreign exchange from its export. In spite of this, little or no study has been conducted to assess the profitability of yam production among small scale farmers. The objective of this review is to analyse the status of production and marketing of yam in Nigeria.

Cultivation Practises

Yam is grown on free draining, sandy and fertile soil, after clearing the first fallow. Land is prepared in the form of mound or ridge or heap of 1 metre (3 ft 3 in) height. The yams recommended for such soil conditions in Nigeria are white yam or white guinea yam *(Discorea rotundata)* and water yam or yellow yam *(Discorea alata)*. Planting is done by seed yam or cut setts from ware tubers. One day before planting, the tubers have to be subjected to treatment with wood ash or a fungicide (thiabendazole) to prevent damage to the soils. The setts are planted at an interval of 15–20 centimetres (5.9–7.9 in) with the cut face facing up. Mulching is essential during October–November with dry grass or plant debris weighed down with balls of mud. Dosage of fertilizer application, as essential, is decided after chemical analysis of the soil samples. Manual weeding by hoeing is done three or four times depending on the rate of weed growth. Two Stakes, each of 2 metres (6 ft 7 in) height are used for staking the plants to vine over it; one for two plants with the other used for bracing with the adjacent stakes. Sorghum stovers are also used for this purpose in the savannah land. Pest and disease control is addressed by cultural control and chemical methods; the pests which affect the plant are nematodes suchas root knot *Meloidogyne* spp. and yam nematode *(Scutellonema bradys)*, and insects such as yam shoot beetle, yam tuber beetle and crickets. Weeding of the field is essential and maintaining a 2–3 metres (6 ft 7 in–9 ft 10 in) weed free border around the field is to be ensured. Disease resistant [cultivars] are normally recommended for use. Harvesting is done before the vines become dry and soil becomes dry and hard. Generally, a yield of 10–15 tonnes per ha for white yam and 16–25 tonnes for water yam are obtained by following prescribed management practices. The harvested yams are stored by tying them with ropes. They have a shelf life of about 5 months. Warehouses where they are stored should be made rodent proof with a metal base and wire netting. Rotten buds and sprouted buds should be removed. Although it is grown widely in Nigeria, the area where it is grown most is the Benue State (land area of 802,295 km^2) one of the states in Benue valley of Nigeria where the labour-intensive practices are still the norm and the land holdings are small. In this state especially among Tiv people, the size of the yam farm or the tonnage of yams produced becomes the social status of that farmer. Because of high level of yam production in the State of Benue, Benue State is crowned as the Nigerian Bread Basket. Yams are planted on mounds rather than flat slopes depending on the hydromorphic nature of the soils which are generally of loose soil suitable to grow roots and tuber crops.(Bolinks *et al*.,2005While yam production issues have been stressed on agronomical practices, a research study carried out on the economic efficiency of this crop grown in this region with small farm holdings, which is labour-intensive, reveals that land, labour and material (fertilizers and chemicals), credit and extension services inputs have a significant bearing on the yield of yam in the region.

Socioeconomic Importance of Yam Production

Yams are among major cash and most consumed food crops West African countries (GTZ, 1999) like Nigeria (Babaleye, 2003; National Bureau of Statistics, 2012). Its cultivation is very profitable despite high costs of production and price fluctuations in the markets (IITA, 2013; Izekor and lumese, 2010). An average profit per yam seed, aer harvest and storage in Nigeria was calculated at over US$13, 000 per hectare harvested (IITA, 2013). Households demand for yam consumption is very high in Sub-Saharan Africa. Nutritionally, yam is a major staple food consumption, providing food for millions of people in the West Africa. It is eaten in diff erent forms such as fufu (the so-called poundo yam and Amala in Nigeria), boiled, fried and roasted (Aidoo, 2009; IITA, 2009). This root and tuber place in the diet of smallholder farmers cannot be ignored. It contributes over 200 dietary calories per capita per day for over 150 million people in West Africa (Babaleye, 2003). Yams have over 21% dietary fi bre and are rich in carbohydrates, vitamin C, potassium, manganese and other essential minerals (IITA, 2009). Many yam belt areas in Nigeria continuously proclaimed "yam is food and food is yam" (Maikasuwa and Ala, 2013). Some family rural dwellers, where yams are grown, eat it all day round. Arguably, yams are the only available food especially during the harvesting season. However, the primary research carried by LSMS-ISA (Living Standards Measurement Study- Integrated Surveys on Agriculture) in Nigeria showed that the consumption patterns of yams differ from the poor and rich people.

Relatively, richer households were found to be consuming more yams, but selling less harvested than poorer households. Poorer households consumed fewer yams, arguably because they heavily depended on yam for income than their richer counterparts who have other sources of earning (National Bureau of Statistics, 2012). Yam plays signifi cant roles in the social-cultural activities in Sub-Saharan Africa such as Nigeria and Ghana. For instance, some households used it during marriage and fertility ceremonies. More so, the festival takes place yearly to celebrate its harvest,and other social ceremonies (IITA, 2013; Izekor and Olumese, 2010; Bamire and Amujoyegbe, 2005; Aidoo, 2009). In Nigeria just like in many sub-Saharan African countries, agriculture is the largest employer of labour.

Yam Marketing in Nigeria

Yam tubers are sold on cash and carry basis and prices based on perceived size and quality of tubers. There is normally no grading system in place and a lack of formal contacts and arrangements between farmers and traders. From district markets yam tubers are transported to major urban centres such as Lagos for sale at larger urban markets. There are a number of different types of trader involved in the purchase and sale of yam tubers. Rural assemblers and local wholesalers (also known as shed owners in some states) purchase yam from local farmers to sell on to individual consumers but principally to larger urban traders (wholesalers) who visit district markets. The local wholesalers serve as collection centres for farmers. Buying agents normally facilitate sales from farmers to larger wholesalers and charge a commissioning fee to local wholesalers (Grunert *et al* ,2005). Local wholesalers sell on behalf of the farmers and also receive a service charge from bulk buyers (urban wholesalers). In some cases this fee is in the order of N200.00 to N300.00 per 100 tubers transacted. The larger-scale urban wholesalers often travel to origin to organise purchase of yam, perhaps travelling weekly or more frequently. Nigeria is the world's largest yam producer, contributing approximately two thirds of the global production. In Nigeria, there is a high demand for yam in terms of consumption (Bamire *et al*,2005). Yam is however, prepared in various ways such as boiled, roasted, fried or mashed as done with mashed potatoes or processed into powder for puddings or for other meals. The back of the yam is also used as feed for livestock; therefore all parts of it are useful. 'Yam tubers however, consist of about 21% dietary fiber and are rich incarbohydrates, vitamin c and essential minerals and are also low in fat' (IITA, 2012).It provides a reference point for improvements in services and the business environment. It is a vehicle for pro-poor initiatives and for linking small businesses with the market. Value chains reside at the core of high-impact and sustainable initiatives focused on improving productivity, competitiveness, and entrepreneurship, (Bolinks *et al* 2005).

CONCLUSION

Yam products have some socioeconomic importance in Nigeria. For instance, some households used it during marriage and fertility ceremonies. They also celebrate its harvest and used it for other social ceremonies. Yams are among the most major cash and food crops in the country. Lack of finance, inadequate modern farm inputs, storage and processing, and high cost of labour, appeared to be the major constraints to yam production in Nigeria. In order to improve yam production, the government of Nigeria should provide a conducive environment and invest heavily in yam cultivation by providing farm tools to smallholder farmers at subsidized rates. In addition, the government should provide more loans to farmers at zero or low-interest rate. Yam processing industries should be created for sustainable cultivation and higher productivity. Possibly, this will go a long way in accelerating yam products for the betterment of smallholder farmers and traders, thus partly ensuring food security in the country.

Table 1: Annual yam production in the world and Nigeria, (1961-2012)

Yams element	Area	1961	1980	1990	2000	2010	2012
Area harvested(Ha,1,000)	World	1,151	1,362	2,247	4,032	4,942	5,037
Production(MT million)	World	8.32	12.1	21.76	39.55	53.60	58.75
Production(MT million)	Nigeria	3.50	5.25	13.62	26.21	34.16	38.00
Production (% of the world)	Nigeria	42	44	63	66	64	65
Yield(Hg/Ha)(thousand)	World	72.35	88.16	96.90	98.09	108.47	116.65
Yield(Hg/Ha)(thousand)	Nigeria	77.78	105.35	106.77	98.98	119.07	131.03

Source: FAOSTAT, 2014

Table 2: Selling Prices at Agyaragu and Dedere Yam Markets in Nasarawa

Wholesaler Sells at N/Tuber	Marketing costs	Balance as profit	Tuber size and season
170	N37.5	N32.5	Small – off-season/ Medium – peak season
335	N47	N88	Medium – off-season / Large – peak season
500	N67	N133	Large-0ff-season

Source: YIFSWA

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DETERMINANTS OF LOAN REPAYMENT PERFORMANCE OF SMALL-SCALE CASSAVA FARMERS IN IMO STATE, NIGERIA: TOBIT MODEL APPROACH

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ABSTRACT
The study aimed at examining determinants of loan repayment among cassava farmers in Imo State. It adopted simple random sampling technique in the selection of 152 cassava farmers as respondents. Data were generated by use of questionnaire. Data were analyzed using descriptive statistics and Tobit model. The study results showed that educational attainment, experience in loan use, household size and net farm income significantly influenced loan repayment performance of cassava farmers. The study recommended that financing institutions should take the afore-mentioned determinants seriously in their lending business.
Keywords: Determinants; Loan; Performance; Tobit model

INTRODUCTION
Agricultural lending involves giving out credit in cash or kind to farmers for the purpose of farm production (Abott & Makeham, 1979; Ojiakor &Ogbukwa, 2012). The principles of economics and finance have shown that by using other people's funds along with his own, an investor is most likely to improve his business significantly than if he had to depend solely on his equity (Lot, 1998; Pandey, 2010). As this rule applies to commerce, so also does it apply to agriculture in developed and developing countries of the world.
Cassava (*Manihot esculenta*) is one of the most important crops in Nigeria, playing dominant role in rural economy especially in the southeastern agro-ecological zone and is increasingly gaining importance in other parts of Nigeria. Nigeria is currently the largest producer of cassava in the world with an annual output estimate of 45 million metric tonnes and global share of 19 percent (Philips, Taylor, Sanni & Akoroda, 2004). The crop supplies about 70 percent of the daily calorie intake of well over 50 million Nigerians (Ugwu, 1996). About 80 percent of Nigerians who reside in the rural areas eat cassava meal at least once a day; and when compared to rice and maize, cassava has carbohydrate content which is about 40 percent higher than rice and 25 percent more than maize (Nyerovwo, 2004; Muhammed-Lawal, Omotesho & Oyedemi, 2013). It also generates about 25 percent cash income of all food crops grown in the country (Eze & Nwibo, 2014 ; Nweke, 1994). The high demand for cassava today is largely due to the increasing industrial scale use of its products. In addition to providing food for the populace, its export is a major earner of foreign exchange for the country
The major problems facing these agricultural credit programmes irrespective of the institution channel are low credit recovery rates and patronage. For instance, between 1978 and 1990, the cumulative number and value of loans guaranteed by Agricultural Credit Guarantee Scheme Fund (ACGSF) stood at 122,246 valued at N765.4 million, while the total number and value of loans fully repaid by all categories of borrowers stood at 34,744 and valued at N179.68 million representing only 23.5% of the total loan value (Olagunji & Ajiboye, 2010). Osakwe and Ojo (1986) also reported that large rate of default has been the perennial problem of most government organized and supported agricultural credit schemes in Nigeria. Similarly, Olabode and Oladebe (2008) maintained that most of the defaults arose from poor management procedure, loan diversion and unwillingness to repay loans. However, many studies have focused on indispensability of credit in agricultural transformation. However, there is paucity of information on effects of socio-economic factors on repayment performance of these farmers in the study area using Tobit model. It is this gap this study sought to fill.

Study Objectives
The objectives of this study were to:

(i) examine their sources of loan; and

(ii) estimate effects and sizes of socio-economic factors on loan repayment performance of the recipients.

Study Hypothesis:
H$_O$: Socio-economic characteristics of cassava farmers do not significantly affect their loan repayment performance in the study area.

MATERIALS AND METHODS
The area of study is Imo State of Nigeria. Imo State lies between longitude 63°5'E and7°28'E and latitude 5°10'N and 5°57'N (Ministry of Lands Owerri, 1992). The state has land area of 5,289.49km^2 and estimated population of 3,934,899 (NPC, 2006). Imo State has an estimated farming family's population of 303,333 (Imo ADP, 2000). The state is bounded on the east by Abia State, on the south and south-west by River State, on the west and north-west by River Niger over which lies Delta State and on the north by Anambra State and Enugu State (Imo State of Nigeria Diary, 2010).

Multi-stage sampling technique was employed in the selection of respondents for the study. First, two local government areas were selected from each of the three agricultural zones in the state. The local government areas are Ihitte Uboma and Isiala Mbano, Ideato North and Orsu, Oguta and Ohaji/Egbema for Okigwe, Orlu and Owerri agricultural zones respectively. Second stage was the identification of the registered small scale cassava farmers in the six local government areas who take loans from Bank of Agriculture with the help of field officers of the bank which were 245 in number using simple random sampling while adopting Yemane (1967) fomular in the determination of sample size from the population. The fomular is given as:

$$n = \frac{N}{1 + N(\mathrm{e})^2}$$

Where: n= sample size
N= population size
e= tolerable error level (here 5%)

From the foregoing therefore you will obtain the following:

$$n = \frac{N}{1 + N(e)^2} = \frac{245}{1 + 245(.05)^2} = 152$$

Based on the above calculation the above total sample size was 152.

Data Analysis

Objective i and ii were analyzed using descriptive statistics while objective iii was analyzed with Tobit model. The Tobit (censored) regression model is a model whose dependent variable can be censored from left (below) or right (above). In this case all variables above the censored point are seen by the model as real values but below are seen as zero. The standard Tobit model is given as:

$$Y^* = x_i\beta + \varepsilon_i = 1\ldots, N$$

Where: y^* = unobserved latent dependent variable; y_i = observed dependent variable, β = the vector of coefficients, and ε_i = error term, assumed to be independently and normally distributed, i.e., $\varepsilon_i \sim N\ (\mathrm{O},\ \sigma^2)$ and x_i denotes the (K x1) vector of exogenous and fully observed regressors.

The model specification is as follows:

REP= f(AGE, GDR, EDL, EXP, HHS, OCP, NFY, FMS, INT) + μ

where:

REP= the percentage of loan repaid by the farmer within the period of study censored from below at 65% .

AGE= age of the respondent in years;
EDL= number of years spent in educational pursuit by the respondent;
GDR= gender of the respondent which takes 0 for male and 1 for female;
EXP= number of years the respondent has accessed loans;
HHS= number of persons in the respondent's household;
NFY= net farm income of the respondent;
FMS= area cultivated by the respondent during the period in ha;
AMT= amount of money collected by the farmer;
LSZ= amount of loan collected; and
INT= rate of interest on borrowed money in percentage.

RESULTS AND DISCUSSION

Sources of Funds for the cassava farmers

Study results (Table 1) shows that majority of the respondents (64%) obtained their loans from BOA while 22% obtained their loans from Union Bank and First Bank Plc respectively. also Bank of Industry supplies 20% of the loan funds. The implication of this finding is that cassava farmers obtain their fare share of loan funds from different sources. However, it is instructive that more of the funds should be made available to them in order to boost further production in order to make for possible improved repayment rate of the farmers.

Determinants of Loan Repayment Performance of Cassava Farmers

Table 2 shows that the Tobit model adopted in the analysis had a log likelihood ratio of -237.65 and a pseudo R^2 of 0.356 indicating that 36% of the changes in the dependent variable were brought about by changes in the explanatory variables. The Prob>Ch^2 was 0.000 which showed that the model was significant at 1%.

Significant variables were educational level, experience in loan use, household size, and net farm income. Educational level was significant at 1%, indicating that as more years are spent in educational attainment, repayment performance increased. This finding has been reported by Eze & Nwibo (2014) who worked on technical efficiency of cassava production in North East LGA of Delta State.

Experience in loan use was also significant at 1% indicating that having obtained loan for many years made borrowers repay highly than when they are new borrowers. This finding is also significant in the sense that those who know the importance of borrowing to their business usually avoided defaulting in loan repayment. This finding was also reported by Ibekwe, Chikezie, Obasi, Eze & Ukoha (2012).

Household size was also significant at 1% but negatively impacting on loan repayment rate. This means that the longer the number of persons in the farmers household, the more difficult the farmer to repay due to the weight of the bills of the household members. This is according to *a priori* expectation. The bills of the home in terms of food, health, education and other exigencies will make repayment low. This result has been reported by Fortong and Suriya (2011) and Wogna and Awunyo-Vitor (2013).

Net farm income was also significant at 5%. This indicates that as the farmer makes enough income in his business, repayment is higher. This indicates that more income in the farmers business will lead to better performance in loan repayment. This finding was also reported by Ohaka (2016).

CONCLUSION

The study concluded based on findings of the study that repayment performance is enhanced by socioeconomic characteristics such as educational attainment of cassava farmers, experience in loan use, household size and net farm income of cassava farmers. The study also recommends that lender should emphasize critically the above mentioned characteristics in lending in order to guarantee the repayment of loan given to cassava farmers.

Table1: Sources of Loanable Funds for cassava production

Source	Frequency*	Percentage*
BOA	97	64
UBA Plc	20	13
MFB	15	10
Skye Bank	15	10
First Bank Plc	34	22
Union bank Plc	34	22
Diamond Bank Plc	18	12
Bank of Industry	30	20
Total	**152**	**100**

***Multiple responses recorded**

Source; Field Survey 2015

Table 2: Tobit Model Estimates for Determinants of Loan Repayment Performance of Cassava Farmers

Variable	Coefficient	Standard Error	T – Value
AGE	.0156	.029	0.55
EDL	1.0085***	.258	3.91
GDR	1.83e-04	1.46e-06	1.26
EXP	.357***	.0610	5.86
HHS	-1.645***	.255	-6.44
NFY	1.386**	.671	2.07
FMS	.1932	.227	0.85
LSZ	.0000104	7.22e-06	1.44
INT	-.3431	.309	-1.11
Constant	61.172	7.408	8.26
Pseudo R^2	0.3556		
Prob> Ch^2	0.000		
Loglikelihood	-237.65		
N	152		

Source: Field study 2015

Note: *** significant@1%, ** significant @ 5%, * significant @ 10%.

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DETERMINANTS OF COMMERCIALIZATION ON THE WELFARE OF CASSAVA FARMERS COOPERATIVES SOCIETIES IN ABIA STATE, NIGERIA

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ABSTRACT
Nigeria, the world largest producer of cassava is still struggling with commercialization of the crop despite efforts by government to create marketing outlets for it. This paper focuses on identifying the factors that determine commercialization on the welfare of cassava farmers' cooperative societies in Abia state. Forty five cooperatives were randomly selected from the three agricultural zones that make up the state. Relevant information from respondents was collected with a well-structured questionnaire. Both descriptive and inferential statistics were used to analyze data collected. Specifically, regression analysis was employed to estimate the determinants of commercialization of cassava in the study area. The result shows that level of education, household size, input cost, income and access to credit were the major factor that determines commercialization of cassava in the study area. Among the constraints to cassava commercialization identified in the study was: Insufficient capital, poor road network, high cost of living and pest and diseases infestation. It was therefore recommended that these factors identified to have influence on commercialization of cassava, be addressed by government and its agencies in partnership with the private sector, in order to trigger investments in cassava production.
Keywords: Cassava, commercialization, farmers, cooperatives,

INTRODUCTION
Cassava (*Manihot esculenta)* ranks first among the major food crops in Nigeria, in terms of calories; hardly will you find a family who doesn't consume cassava. It is a major source of food to producer in Nigeria and the most important root crops of the tropics. It is rich in energy and a source of raw material for the production of snacks such as bread, cake, chin-chin and also used as animal feed. It has other diverse uses in the pharmaceutical confectionery and livestock industries in Nigeria. Its production and processing provides employment and income for the poor masses especially women and children. Cassava has a lot of uses and by-products (Truman *et al.,* 2004).
Commercialization of this crop is one of the key strategies to promoting, accelerated modernization, substantive economic growth and development, hence eradicates poverty in the society (Manyong *et al.,* 2003). Commercialization of cassava products leads to greater market orientation of large production and a good source of economic growth. Commercialization is a rise in the share of market output or of purchased inputs per units of output. It is to increase in productivity of resource like land, capital and above all it helps to increase export potentials of agricultural products of Nigeria (Nkamileu, 2003). It leads to increase in income which in turn is a major determinant of welfare.
Welfare represents the people standard of living. It refers to economic wellbeing of an individual. Welfare is largely determined by agricultural productivity like (cassava) (Markus *et al.,* 2003). Much of the increase in Agricultural output in recent years has resulted from expansion of the area under cultivation, rather than from increased productivity (Akande, 2006). The challenge is to intensity agriculture commercialization of cassava in a suitable manner (Akande, 2006).
The main problem still remains the incidence of high rate of poverty among the people and its geometric increase by years. One of the causes remains narrow markets and commercialization for years has a negative influence on cassava, others factors highlighted includes inefficient marketing institution and inadequate rural infrastructure, lack of access to credit funds etc. couple with farm input like fertilizer poses a significant risk to commercialization of cassava production. Cassava production plays a major role in all issues concerning agriculture. There is need to harness the huge potentials of cassava in order to fight poverty through commercialization. This paper therefore seeks to identify the factors that determine commercialization on the welfare of cassava farmers' cooperative societies in Abia state.

METHODOLOGY
The study was conducted in Abia State, Nigeria. Agricultural cooperatives were identified through the Abia ADP and spread across the state. However, a list of the cooperatives separated by the three agricultural zones in the state (Umuahia, Aba and Ohafia) formed the sample frame. From this list, 15 Cooperatives were randomly selected from each agricultural zone, making a total of 45 agricultural cooperative used for the study. A structured questionnaire was used to collect relevant information from respondents. Data collected were analyzed with both

descriptive and inferential statistics. Specifically the regression analysis was used to know the determinants of commercialization of cassava in the study area. The regression model is implicitly stated as follows;

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) + e_1$$

Where:

Y = commercialization index

$$\frac{\text{value of cassava sold}}{\text{total value of cassava produced}} \times \frac{100}{1}$$

X_1 = education (years)
X_2 = household size (number of people living under same roof)
X_3 = faming experience (years)
X_4 = farm size (hectares)
X_5 = input cost (Naira)
X_6 = access to credit (access to credit = 1, non to access = 0)
X_7 = income (Naira)
X_8 = farmers asset (Naira)
e_1 = error term

t-test was used to test if there is significant difference in the welfare of those fully and not fully commercialized. The T-test formula is shown below;
T cal = x

$$S\,x_1 - S\,x\,2 = \frac{x_1 - x_2}{\sqrt{\frac{S^2\,x_1}{n_1} - \frac{S\,^2x_2}{n_2}}}$$

Where;

X_1 = welfare value of those fully commercialized
X_2 = welfare value of those not fully commercialized

Double log regression analysis was chosen as the best fit model because it has the highest number of significant variables and highest R^2 values.

RESULTS AND DISCUSSION

The regression output of the four functional forms shown in Table 1 indicates that the double log function had the best fit and was used in the analysis. The Double Log was chosen as the lead equation based on the value of R^2 (Coefficient of multiple determination), F-ratio and the conformity of the sign of regression coefficients with *a priori* expectation. The value of R^2 is 0.690, meaning that 69% of total variations in the dependent variable is accounted for by the independent variables included in the model. Specifically level of education, household size, income and access to credit, were significant and positively related to commercialization while input cost was significant but negatively related to commercialization of cassava. This means that as such factors as level of education, household size, income and access to credit increases, commercialization of cassava also increases. Measures taken to increase these variables will also increase commercialization. Conversely, if the cost of production inputs increase in the study area, commercialization of cassava in the area will decrease. So stakeholders in the cassava industry should as much as possible reduce the cost inputs as to encourage commercialization of cassava in Abia State.

Table 2 shows the constraints associated with commercialization in the state. The result indicated that major commercialization constraints such as insufficient capital, poor road network, high cost of living, pest and disease were the major problems faced by farmers on commercialization.

CONCLUSION

Commercialization is an imperative if the farmer cooperative will benefit from their effort in cassava production. The study has identified the factors influencing commercialization of cassava. Such factors as level of education, household size, income, access to credit and input costs should be taken seriously in cassava production. Consequence of these, operators of cooperatives should embark on enlightenment campaign among farmers on the need to increase their marketable surplus and reduce waste through excessive consumption and gifts etc. by putting more resource on the education of their members. This will ensure more farmers getting fully commercialized consequently influencing their welfare positively. Cooperatives societies should collaborate with government and its relevant agencies on food security to access funds and farm inputs for her members (farmers). Cassava farmers should be empowered with credit and agricultural inputs. This will help achieve commercialization of cassava in the study area.

Table 1: Determinants of commercialization of cassava among farmer cooperatives societies

Variables	Linear	Exponential	Semi-Log	Double Log
Constant	375.161	5.674	455.240	0.011
	(2.208)**	(6.737)**	(-0.972)	(0.007)
Education	4.091	-0.001	34.740	0.530
	(0.757)	(-0.024)	(0.711)	(3.011)***
Household	31.052	0.167	-103.258	0.586
	(1.883)**	(2.045)**	(-1.040)	(1.635)*
Experience	-0.766	0.013	-23.094	0.181
	(-0.199)	(0.678)	(-0393)	(0.852)
Farm size	0.179	0.001	21.885	0.054
	(1.042)	(1.041)	(0.868)	(0.589)
Input cost	-3.647	-0.012	-71.575	-0.278
	(-1.818)**	(-1.211)	(-1.827)**	(-1.968)**
Access to credit	157.142	0.696	-164.173	0580
	(1.952)**	(1.743)*	(-1.977)**	(1.935)**
Income	0.001	3.78E.006	86.763	0.615
	(4.197)***	(4.195)***	(3.337)***	(6.546)***
Farmer asset	0.119	-0.001	3.488	0.165
	(0.718)	(-1.045)	(0.072)	(0.942)
R^2	0.563	0.507	0.482	0.690
R^{-2}	0.424	0.350	0.317	0.591
F-ratio	4.031***	3.218***	2.911***	6.954***

Source: Field survey, 2012.

Table 2: Constraints faced by cassava farmers in Abia State

S/N	Constraints	Ranking	Frequency	Percentage
1	Insufficient capital	1st	45	100
2	Lack of patronage	7th	11	24.4
3.	Unfavourable Government	4th	39	86.7
4	Late delivery of inputs	6th	14	31.1
5	Poor road network	2nd	44	97.8
6	Pest and diseases	3rd	42	93.3
7	Community unrest	8th	4	8.9
8	High cost of living	2nd	44	97.8
9	Climate change	5th	27	60

Source: Field survey, 2012.

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TECHNICAL EFFICIENCY OF CASSAVA-BASED SMALLHOLDER FARMERS IN ABIA STATE, NIGERIA: A DATA ENVELOPMENT ANALYSIS (DEA) APPROACH

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ABSTRACT
In this paper, we employed the Data Envelopment Analysis (DEA) to estimate technical efficiency of cassava-based farmers in Abia State. The findings of the study have implications for increased cassava production in the study area. Attainment of 85% efficiency means that farmers still have room to increase their efficiency to the optimum (100%).
Key words: Technical efficiency, Data envelopment analysis

INTRODUCTION
The question of efficiency in resource allocation in traditional agriculture is not trivial. It is widely held that efficiency is at the heart of agricultural production (Umoh, 2006). This is because the scope of agricultural production can be expanded and sustained by farmers through efficient use of resources (Udoh, 2000). For these reasons, efficiency has remained an important subject of empirical investigation particularly in developing economies where majority of the farmers are resource-poor. Also, efficiency measurement is important because it leads to a substantial resource savings (Bravo-Ureta and Rieger, 1991). However, three types of efficiency are identified in the literature. These are technical efficiency, allocative efficiency and overall or economic efficiency (Farrell, 1957; Olayide & Heady, 1982). Technical efficiency is the ability of a firm to produce a given level of output with minimum quantity of inputs under a given technology. Allocative efficiency is a measure of the degree of success in achieving the best combination of different inputs in producing a specific level of output considering the relative prices of these inputs. Economic efficiency is a product of technical and allocative efficiency (Olayide & Heady, 1982). According to Quan (2011), smallholder and family farming agriculture remain the key and leading sector in overall economic development of many developing countries in the world in addition to producing staple crops for domestic markets; smallholder farmers produce large shares of traditional exports in these countries. This shows how the economies of many developing countries still rely on smallholder-based agriculture.
Cassava production in Nigeria, the highest producer globally, was 156.8 per cent of that of Indonesia, the second top producer (FAO, 2013). According to Egesi *et al* (2006), Nigeria cassava transformation is the most advanced in Africa. It is strategically valued for its role in food security, poverty alleviation and as a source of raw materials for agro-allied industries in Nigeria. It has huge potential for the export market; and provides the livelihood for over 30 million farmers and countless processors and traders (Egesi *et al.,* 2007; CEDP, 2005).
According to Cooper *et al* (2011) Data Envelopment Analysis (DEA) is a relatively new "data oriented" approach for evaluating the performance of a set of peer entities called Decision Making Units (DMUs) which convert multiple inputs into multiple outputs. Meanwhile, there are two kinds of Data Envelopment Analysis models namely Charnes, Cooper and Rhodes (CCR) and Banker, Charnes and Cooper (BCC) models. The CCR model (Charnes *et al.*, 1978) is built on the assumption of constant returns to scale (CRS) of activities. Constant returns to scale (CRS) imply that a given increase in inputs would result in a proportionate increase in outputs and the feasible region of the envelopment problem becomes a conical hull (Pahlavan, 2012). Contrastingly, the BCC model (Banker *et al.*, 1984) is built on the assumption of variable returns to scale (VRS) of activities which is a restriction on intensity of the efficient DMUs in projecting inefficient DMUs onto the efficient frontier that leads to no condition on the allowable returns to scale. Thus, technical efficiency in this study was estimated using the input-orientated variable returns to scale (VRS) DEA model.

Banker *et al* (1984) recommended the use of variable return to scale (VRS). This decomposes technical efficiency to pure technical efficiency and scale efficiency. The model is specified as follows:

$$\begin{aligned} &\min \theta \\ &s.t.: \\ &y + Y\lambda \geq 0 \\ &\theta X_0 - X\lambda \geq 0 \\ &\lambda \geq 0 \\ &N_i\lambda = 1 \end{aligned} \qquad (1)$$

where

θ = the TE of DMU to be evaluated,
λ = the intensity of the efficient DMUs in projecting inefficient DMUs onto the efficient frontier, also called the convexity constraint. The optimal efficiency of a *DMU*, θ*, will be less than or equal to 1. *DMUs* with θ* < 1 are inefficient while *DMUs* with θ*= 1 form a set of boundary (frontier) points.
The question is: are cassava-based smallholder farmers efficient in the use of resources? This study is an attempt to answer this question with specific emphasis on the technical efficiency of smallholder farmers. The broad objective of this study was the technical efficiency of cassava-based smallholder farmers in Abia State, Nigeria. Specific objectives were to examine the socio-economics characteristics of cassava-based farmers and analyse the technical efficiency of resource use in cassava-based farming.

METHODOLOGY

The study was carried out in Abia State. Abia State is located within latitudes 40^0N – 47^0N of equator and longitude 70 – 80E of the Greenwich Meridian (NRCRI, 2010). The state has a total land area of about 5,410sq kilometers, with a human population of about 2,833,999 (NPC, 2006). The State is made up of 17 Local Government Areas (LGAs). The state is demarcated into three (Aba, Umuahia and Ohafia) agricultural zones. The people are predominantly farmers, producing such arable crops as cassava, yam, cocoyam, maize, vegetables, melon, banana/plantain and rice. Multi stage sampling technique was used. One hundred cassava-based farming households were sampled for the study. However, ninety four questionnaires were used for analysis. Data were collected in 2011. Data were collected on output of cassava (kg/ha), labour (mandays), fertilizer (N/Kg), herbicides (N/litre), and land (ha). Data were analyzed using descriptive statistics and Data Envelopment Analysis (DEAP version 2.1).

RESULTS AND DISCUSSION

Table 1 below shows the socio-economic characteristics of cassava-based farmers. The table revealed the mean age of the farmers to be about 59.4years. The implication of this is that the farmers are ageing. This may not be unconnected with the fact that agriculture is increasingly being rejected among the youths particularly because of preference for white collar jobs (Abdulazeez, *et al.*, 2014). In addition, the table shows that mean household size of the farmers is about six persons per household. This implies that the farmers can use members of the household as family labour thereby reducing the cost of labour in cassava production. Similarly, the table revealed the mean farm size of the farmers to be about 1 hectare. This shows that the farmers are smallholder farmers who perhaps depend more on low external inputs use.
Furthermore, table 2 below shows the efficiency measures and frequency distribution of return to scale for the sampled farmers. The table revealed that the mean technical efficiency (VRS) score of 0.85 suggests that input usage can be reduced by about 15 per cent while maintaining the same output level in cassava production. In addition, the table shows that 38 percent of the sampled farmers are operating under increasing return to scale (IRS) assumption. This implies that the output increases more than the inputs. Return to scale using Data Envelopment Analysis (DEA) shows the relationship of outputs to inputs. Return to scale can be constant, increasing or decreasing depending on whether the outputs increases in proportion to, more than or less than the inputs respectively. In other words return to scale indicates what would happen to output if all the inputs are increased simultaneously (Shehu *et al.*, 2010).

CONCLUSION

In this paper, we employed the Data Envelopment Analysis (DEA) to estimate technical efficiency of cassava-based farmers in Abia State. Overall, the farmers performed at an average technical efficiency of 85%, only about 40% of the farmers operated at increasing return to scale (IRS). The findings of the study have implications for increased cassava production in the study area. Attainment of 85% efficiency means that farmers still have room to increase their efficiency to the optimum (100%).

Table I. Socio-economic Characteristics of cassava-based farmers

Characteristics	Number of farmers	Percentage (%)
Age (Years)		
20-39	2	2.10
40-59	45	47.90
>60	47	50.00
Mean	59.4	
Household Size (No. of person)		
1-5	22	23.40
>5	72	76.60
Mean	6.4	
Farm size (ha)		
<1	28	29.80
>1	66	70.20
Mean	1.0	
Membership of farmers group		
Yes	70	74.50
No	24	25.50
Marital Status		
Yes	88	93.60
No	6	6.40

Source: Field Survey 2011.

Table 2. Efficiency measures and frequency distribution of return to scale for the sampled farmers

Scale of Operation	Mean TE	CRS	IRS	DRS	Total
TE (VRS)	0.85	28(30)	38(40)	28(30)	94(100)

Source: Field Survey 2011.

TE (technical efficiency), CRS (constant return to scale), IRS (increasing return to scale), DRS (decreasing return to scale). Figures in parenthesis are percentages

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EFFECT OF SELECTED COOPERATIVE SOCIETIES ON THE DEVELOPMENT OF RURAL SOCIETIES OF ABIA STATE, NIGERIA

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ABSTRACT
The study examined the effect of cooperative societies in the development of rural areas in Aba area of Abia State. A purposive sampling technique was used to select two local government areas Aba north and Ossisoma local out of the four local government area that make up the Aba area. Primary data was used for the study and a total of sixty cooperative societies were sampled. Data were analysed using descriptive statistic such as mean, percentage, frequency and standard deviation. Results shows that mainly (57.00%) of the cooperators were women while (43.00%) were men. The study revealed that majority of the cooperators (13.00%) were less than 31years old while 9.00%, 51.00% and 19.00% had age range of 31-40, 41-50 and 51-60 years respectively, most of the respondents were still young and active. Majority (60.00%) of the cooperators were part-time farmers while 40.00% were full-time farmers while 9.00%, 60.00%and 14.00% had cooperators experience range of 1-4, 5-8 and 9-12 respectively while 17.00% had more than 12 years of experience. From the results 23.00%, 54.00% and 12.00% of the cooperators had household size range of 1 - 3, 4 - 6 and 7-9 persons respectively while 11.00% had more than 9 persons. The mean responses of the outreach performances were all greater than 3.00 while the most important outreach performance was (7) (4.85) which ranked the highest, followed by (4) (4.66) and (5) (+4.43) which ranked second, third and fourth respectively. Others were (3) and (1) (4.40) each and (2) (3.49) which ranked fifth and seventh respectively.
Keywords: Cooperatives, rural societies, effect, Nigeria

INTRODUCTION

The problem of developing the rural area has received the attention of many experts and researchers as well as the government. This is because it constitutes a serious bottleneck to the socio-economic development of the country as well as the communities. It is in the light of this that I have decided to examine how rural areas would be developed with the help or assistance of co-operative societies in Abia State.

Rural development according to Diejomoah (2003) is "The process of not only increasing the level of per capital income in the rural area but also the standard of living of the rural population measured by food and nutrition level, health, education, housing, recreation and security. Also Rural development according to UNO (1960) is "The process by which the effort of the people themselves are United with effort of government authorities to improve the economic social and cultural conditions of the rural communities to integrate those community into life of the nation and to enable them contribute meaningful to national development.

Therefore, Rural Development is an integration activity involving the Implementation of programmes of agriculture, health, education, home management, provision of infrastructure and other community facilities under the supervision of the government, its agencies and the local people.

Co-operative society is one of the principal agents of rural development. It is not only an avenue for job opportunities, but also as a training ground for the rural dwellers and other society and economic benefits. Hence, it is a strong factor in the nation's economic development.

Helms (2005) on the other hand defines co-operative society as an association of persons who have voluntarily joined together to have a common end through the formation of a democratically controlled enterprise, making equitable contribution to the capital required and accepting a fair share of the risk and benefit of the undertaking in which the member activity participate. On the other hand it could be seen as a voluntarily association of persons having mutual ownership in providing themselves some needed service on non-profit basis usually organized as a legal entity to accomplish objectives through joint participation of its members.

As it is, the problem faced by the rural dwellers in Nigeria today is complex. It is those in the rural areas who have to produce not only enough for their families but also for industries and urban population. They also have to produce cash crops either for processing by local industries or for export. Still they lack the basic necessities of life.

Co-operative is a vital issue in every community in this world. This paper therefore, sought to examine rural development and discuss or diagnose strategies adopted by co-operative societies in developing rural areas and examine the problem areas of co-operative societies.

METHODOLOGY

The study was carried out in Abia State, Nigeria. The state is approximately within latitudes 4^0, $41^0$and 6^0, 14^0 north of the equator and longitudes 7^0, 10^0 and 8^0 east of the Greenwich meridian. It has seventeen (17) local government areas (LGAs) that are divided along three (3) agricultural zones namely: Ohafia, Umuahia and Aba. Abia State has seventeen (17) local government areas (LGAs) namely; Aba North, Aba South, Arochukwu, Bende, Ikwuano, Isialangwa South, Isiukwuato, Obingwa, Ohafia, Osisioma Ngwa, Ukwa East, Ukwa West, Umuahia North, Umuahia South, Umunneochi, and Isialangwa North(NPC, 2009). Majority of the inhabitants are Igbo's and their occupation are mainly agricultural-based which implies that most of the inhabitants are farmers. There are many Cooperative societies in Abia State, all of which support rural livelihood and creates roadmap for rural development.

The primary data which were used for the study were obtained through questionnaire. A purposive sampling technique was used to select 30 cooperatives from Aba North and 30 Cooperatives from Osisioma to make a sampling size of 60 respondents.Selected cooperatives include Amaelu (Aba North) MCS, Amos Memomorial (Osisioma),Akanwanna Abayi (Osisioma), Multipurpose Cooperative Society, Niger Delta Youth (Osisioma) MCS Ltd, Nwangozi (Aba North) MCS,Njionye (Aba) MCS Ltd, Nworgu (Aba North) MCS Ltd, Nagode(Osisioma) MCS Ltd,Ndienyioma (Aba) MCS Ltd. Nwabuike Amuke (FUG) Cassava Processing.

Data Analysis

Descriptive analytical tools were used access the profile of the selected co-operative societies and also to identify the outreach performances of the selected co-operative societies in Abia State.

5 Point Linkert Scale with the following: Excellent =5, Good =4, Fair =3, Poor =2 and Very Poor =1 were used to examine the roles of the selected co-operative societies in the development of rural societies in Abia state.

Model for 5 point Linkert Scale

$$\underline{X} = \frac{5+4+3+2+1}{5} = \frac{15}{5} = 3$$

Any mean of responses (X_R) higher than 3 will be regarded as being significant.

RESULTS AND DISCUSSION

The result in Table 1 showed that the mean responses of the outreach performances were all greater than 3.00 while the most important outreach performance was (7)(4.85) ranked the highest, followed by (4) (4.66) and (5) (+4.43) which ranked second, third and fourth respectively. Others were (3) and (1) (4.40) each and (2) (3.49) which ranked fifth and seventh respectively. The results show a mean performance rating of 1.54 which was lower than 2.00 indicating that the respondents were not satisfied with the performance of the cooperatives towards the development of the rural communities.

Table 2 shows a mean performance rating of 1.54 which was lower than 2.00 indicating that the respondents were not satisfied with the performance of the cooperatives towards the development of the rural communities. Table 3 shows that majority (92.00%) indicate that government and financial institutions were helpful in enhancing the role of cooperatives. Table 4 indicates that all the respondents (100.00%) indicated that government and financial institution help to enhance the role of cooperatives by equipment/materials and financial aids while 41.00% indicated loans.

Table 5 reflects the mean rating scale of 3.93 which higher than 3.00, indicating that the respondents were in agreement that cooperatives provide infrastructure towards the development of rural areas. Table 6 reveals that with a mean response rate of 3.25 which was higher than 3.00 indicate that the level of provision of infrastructure by cooperators was higher. Table 7 reflects a mean response rate of 4.71, implying that the respondents were in agreement that training of cooperative personnel was important towards enhancing their performance as instruments of development

Table 8 presents a mean response rate of 4.25 which was greater than 3.00 indicating that government policies and programmes affect the activities of the cooperative societies. Almost all the respondents (98.00%) indicate that such policy effect was in the positive direction.

CONCLUSION

The study analyzed the effect of selected cooperatives societies on the development of rural societies in Abia State. The results show that cooperative is indeed a strategy for rural development although the level of impact on rural development is low. Their activity can be improved through sound government policies and training that will ensure stability, sustainability and enhancement of rural development in the state.

Table1: Rating scale Analysis of Outreach performance of the selected Cooperative societies in the Development of Rural societies in Abia State

Performance	SA	A	U	D	SD	Obs	Total	Mean	Rank
Enhances socio-economic status of its members	40 (200)	60 (240)	-	-	-	100	440	4.40	5
Organizes educational programmes for members and host communities	8 (40)	37 (148)	51 (153)	4 (8)	-	100	340	3.49	7
Carry out projects in the community under review	48 (240)	50 (200)	-	-	-	98	440	4.40	5
Seeks Government support in Alleviating sufferings of the rural communities	68 (340)	30 (120)	2 (6)	-	-	100	466	4.66	2
Provision of farming inputs to boost Agricultural production	47 (235)	49 (196)	4 (12)	-	-	100	443	4.43	4
Enables the rural community in land acquisition for Agric purposes	46 (230)	54 (216)	-	-	-	100	446	4.46	3
Helps members and the rural communities in saving towards a common purpose.	60 (300)	38 (152)	2 (6)	-	-	100	458	4.58	1

Table 2: Rating scale Analysis of rate of performance of cooperative society towards Development of rural communities

Variable	Satisfactory	Not satisfactory	Poor	Total	Mean
Performance	27 (81)	-	73 (73)	154	1.54

Source: field survey data, 2016

Table 3:How helpful the Govt. and financial institutions enhance the roles of cooperators

Variable	Frequency	Percentage
Very helpful	92	92.00
Not helpful	8	8.00
Total	100	100.00

Source: field survey data, 2016

Table 4: Means by which the Government and financial institutions help to enhance the role of cooperatives.

Variable	Frequency	Percentage
Equipment/ materials	100	100.00
Loans	49	49.00
Financial Aids	100	100.00

X = Multiple responses

Table 5:Rating Scale Analysis of provision of infrastructure by cooperatives towards the development of the rural areas

Variable	SA	A	U	D	SD	Total	Mean
Infrastructure	9 (35)	85 (340)	6 (18)	-	-	393	3.93

Table 6: Rate of level of provision of infrastructure by cooperatives

Variable	Very high	High	Moderate	Low	Very low	Total	Mean
Infrastructural	-	25	75	-	-		
Provision		(100)	(225)			325	3.25

Table 7: Rating Scale Analysis of Training Cooperative personnel as important factor towards enhancing their performance as instrument of development

Variable	SA	A	U	D	SD	Total	Mean
Training	71 (355)	29 (116)	-	-	-	471	4.71

Table 8: Effect of Government policies and programmes

Variable	SA	A	U	D	SD	Total	Mean
Policies &	29	67	4				
Programmes	(145)	(268)	(12)	-	-	425	4.25

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SELLING ON-FARM OR OFF-FARM AMONG SMALL HOLDER YAM FARMERS IN OBINGWA LGA ABIA STATE, NIGERIA

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ABSTRACT
The study analyzed the determinants of selling at the farmgate or market among small holder yam farmers in Obingwa LGA, Abia. A multi stage random sampling technique was used to select 90 yam farmers with the aid of structured questionnaire. The study described the socio economics characteristics of the respondents and determinants of choice of selling point for yam in the study area using descriptive statistics and Probit regression model respectively. The results show a mean age of 43.23 with a large household size of about 5 persons. The respondents were educated and have long years of marketing experience. The distance from the farm to the market was 5.45km and the farmers had a mean farm size of about 1.02 hectares. Majority (54.17% and 63.33%) of the yam sellers had access to credit and sell their yam at the market respectively. The Probit regression estimates of the determinants of choice of selling point for yam among the yam farmers in the study area show that the coefficient of membership of cooperatives was negative and significant at 5% level. This implies that farmers who belong to cooperative have increased probability of selling at the farm gate than their counterparts who are not members. The coefficients of credit access and communication facilities were positive and significant at 10% level each. This implies that farmers who had access to credit and communication facilities had increased probability of selling at the market than their counterpart whom does not have access. The coefficient of distance to market and transportation cost were negative and highly significant at 1% level each. This implies that any increase in these variables will lead to a corresponding decrease in probability of selling at the market. The result calls for institutional facilities like credit to reduce the transaction cost of participating in the market and infrastructural facilities like construction of good roads for easy evacuation of yam from the farm to the market for sale.
Keywords: Farmgate, Market and Yam Sales

INTRODUCTION
Yams (*Dioscorea spp*) are the most important staple food crops in west Africa (Ekpe *et al*, 2005) and also form an important staple food source in Africa, America, Caribbean, south pacific and Asia. In Nigeria, it is produced in large quantities, comprising 71% (37 million ton) of the world production (FAO, 2007). Common yam species are white yam (*Dioscorea rotundata*), water yam (*Dioscorea alata*), yellow yam (*Dioscorea cayanensis*), three leaf yam (*Dioscorea dumentonum*) and aerial yam (*Dioscorea bulbifera*). Among these cultivated species, white yam (*Dioscorea rotundata*) is common to be indigenous in West Africa (Degras, 1993). Consumer demand for yam is generally very high in Nigeria and yam production is very profitable despite its high production cost. Yams are perishable and bulky commodities and decision of place to market is invariably associated with farmers' choice, which if not contained may ultimately affect producers' competitiveness in the value chain or perhaps increase to a level where markets may be adjudged to be 'missing' (de Janvry *et al.*, 1991). This affects the choice of selling point, cost of production and consumption of yams across the country. As a result of poor market information coupled with bad infrastructure, the market women and buying agents usually worsen the situation by exploiting the farmers in offering a low farm gate price and ultimately low income. According to Kirsten *et al.* (2008), most often, markets are highly segmented and restricted, leading to farm gate sales, market failure and missing markets in some instances. De Janvry *et al*. (1991) define market failure as when the cost of transacting through market exchange creates disutility greater than the utility gain that it produces, with the result that the market is not used for transaction. Transaction costs also affect the choice of selling point (de Silva *et al.*, 2008).

For farmers, decision to sell in market or farm gate depends on distinctive characteristics, such as a variable responsiveness to price changes, low entry barriers, high transaction costs, and a lack of regulated contract schemes (Boughton *et al.*, 2007). Price-based interventions or imposed transaction costs are those associated with participation in the increasingly vertically coordinated markets. Such costs can be household specific, such as access to assets, or they can be the same for all farmers in a particular location, such as land quality, or producing a specific product, such as yams. Farmers will not enter markets when the value of participating is outweighed by the costs of undertaking the transaction (Sadoulet and de Janvry 1995). Therefore, this study analysed the determinants of choice of selling point among small holder yam farmers in Obingwa LGA of Abia State.

METHODOLOGY
The study was carried out in Obingwa Local Government Area of Abia State. A multi-stage random sampling technique was used to select 90 yam farmers in the LGA. At the first stage, 3 towns were randomly selected from

the LGA. In the second stage, 2 communities were randomly selected from each town given a total of 6 communities. And finally, 15 farmers were randomly selected from each community using the community list of farmers giving a total of 90 farmers for detailed study. The study made use of primary data (information on farmer's socio economics and transaction cost related) collected using the structured questionnaire. Descriptive statistics like means, percentages, and tables and Probit regression analysis were used for the study. The probit model was implicitly specified as:

$P_1 = P_r\{y_1 = 1) = P_r(^{u}{}_{1i} > {}^{u}{}_{oi}) = F_i(X_i\beta)$…………………………………………….. (1)

If Pi is the probability of participating in yam market which is unobservable and was only observed by the outcome Y=l if an individual sold at the markets and Y=0, if they sold at the farm gate.

Pr(Yi=l) =Pi………………………………... (2)

Pr (Yi=0) =l-Pi……………………………………………………………………………… (3)

Pr (Uli>U0i) implied that the probability of individuals that sold yam in the market or farmgate is dependent on the individual utility maximization which is subject to their socio-economic variables and beta estimates $X_i\beta$ (Normal cumulative function of error term Ui) of individual farmers.

X_i = matrix of the explanatory variables
X_1= Age in years
X_2 = Gender (dummy variable, 1 = male, 0 = female)
X_3 = Household size
X_4 = Membership of co-operative (dummy variable, 1 = member, 0 = non-member)
X_5 = Educational level in years
$X_{6=}$ Access to credit (dummy variable, 1= access, 0 = no access)
X_7 = Distance from farm to market
X_8= Transportation cost (1=yes, 0=no)
X_9=ownership of means of communication (1=yes, 0=no)
X_{10}=Road condition (1=good, 0=bad)
β = vector of parameters to be estimated
P_r = Probability function (1,0)
F $(X_1\ \beta)$ = Cumulative distribution function for random error term ($^{u}{}_{i}$) evaluated at X_1 β.

RESULTS AND DISCUSSION

The results in Table 1 show the socio economic characteristics of the respondents in the study area. The results show a mean age of 43.23 with a household size of about 5 persons. This indicates that the yam sellers were still strong and active and may sell more yam than their aged counterparts. Large households are more likely to provide labour that might be required to sell more yams to the markets. The results also show a mean value of 10.3 and 7.83 years of education and marketing experience. This shows that the respondents are educated and experienced. Education matters in terms of reducing the cost of searching for information. Moreover, the time taken to process and act on information decreases with education (Pingali *et al.*, 2005). Marketing experience is expected to reduce the transaction cost of participating in the yam market. The distance from the farm to the market was 5.45km and farm size of about 1.02 hectare. Increased farm size is expected to increase yam output and quantity sold. The results also show that many (53.33% and 51.67%) of the yam sellers were females and married. Less than half (48.33% and 40.00%) of the respondents were member of cooperative and owns means of transportation respectively. Well managed farmer groups have indeed proved reasonably successful in generating better terms of trade for producer members (Okoye, 2011). About 54.17% of the yam sellers had access to credit. Most (63.33%) of the yam seller sell their yam at the market. Mathye *et al.*, (2000) addresses the choice of marketing channel for small holder farmer and found that not all farmers sell their product. Those who sell tend to use different channel. Different factors affect the choice of the market channel which transaction cost is the key factor.

The results in Table 2 show the Probit regression estimates of the determinants of choice of selling point for yam among the yam farmers in the study area. The chi^2 value of 74.23 was highly significant at 1% indicating goodness of fit of the Probit regression line. The coefficient of membership of cooperatives was negative and significant at 5% level. This implies that farmers who belong to cooperatives have increased probability of selling at the farm gate than their counterparts who are not members. Fafchamps and Hill (2005) noted that if poor farmers receive a lower price because they sell in the farm gate, their welfare could be raised by offering institutional alternatives to farm gate sales, such as producers cooperatives. The coefficient of credit access was positive and significant at 10% level. This implies that farmers who had access to credit had increased probability of selling at the market than their counterparts whom do not have access. The coefficient of distance to market and transportation cost were negative and highly significant at 1% level each. This implies that any increase in these variables will lead to a corresponding decrease in probability of selling at the market. This may be because of the huge costs involved in moving the product from the farm to the market. Farmers may choose to sell at the farm gate as a result of this.

The coefficient of communication facilities was positive and significant at 10% level. This implies that farmers who have access to communication facilities sell at the market more than their counterparts who do not own one. With communication facilities, the farmers are expected to be more market efficient in term of source of market information and prices.

Table 1: Socio Economics Characteristics of the Respondents in the Study Area

Variable Description	Means	Std. Dev	Minimum	Maximum
Age (years)	43.23	10.51	18.00	60.00
Household size	5.13	1.73	2.00	9.00
Education (years)	10.03	2.67	5.00	16.00
Distance from farm to market	5.45	3.68	4.00	1.35
Farm size (Km)	1.02	0.46	0.20	1.50
Marketing Experience (years)	7.83	3.92	1.71	7.02
Quantity sold (Kg)	514.56	333.79	100.00	1350.00
Dummy	**Percentage (%)**			
Gender(female)	53.33			
Married	51.67			
Member of cooperative	48.33			
Access to credit	54.17			
Ownership of transportation	40.00			
Choice of selling yam(market)	63.33			

Source: Field survey, 2016

Table 2: Probit Regression Estimates of the Determinants of Choice of Selling Point for Yam in the Study Area

Variable	Coefficient	Std. error	t-value
Constant(b_0)	3.2250	1.3032	2.47*
Age (X_1)	-0.0143	0.0184	-0.78
Gender (X_2)	0.1959	0.4221	0.46
Household size (X_3)	0.1074	0.1137	0.94
Membership of cooperative (X_4)	-1.7859	0.663	-2.60**
Education (X_5)	0.0591	0.0756	0.78
Credit access (X_6)	1.2442	0.6209	2.00*
Distance to market (X_7)	-0.0031	0.00078	-3.02***
Transportation cost(X_8)	-2.0164	0.5187	-3.89***
Ownership of communication facilities (X_9)	0.9275	0.4143	2.24*
Road condition (X_{10})	0.1096	0.6481	0.17
Chi^2	74.23***		
Pseudo R^2	0.4946		
Loglikehood	-37.9272		

Source: Computed from STATA4A
*, **, *** is significant at 10%, 5% and 1% level

CONCLUSION

The study analyzed the effect of transaction cost of choice of selling point for yam among small holder farmers in Obingwa LGA of Abia state. The result show that majority of the yam farmers sell more yams in the market than at the farm gate. Importance factors influencing the choice of selling point includes; membership of cooperatives, credit access, distance to market, transportation costs and ownership of means of communication facilities. The study therefore calls for policies aimed at provision of communication facilities and construction of rural feeder roads to mitigate the effect of transaction costs and enhance market participation for yam by the farmers

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DETERMINANTS OF DEMAND FOR RAW MATERIALS AND SUPPLY OF FINISHED GOODS AMONG BAKERY ENTERPRISES IN ABIA STATE, NIGERIA

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ABSTRACT

The study assessed the determinants of raw materials demanded and finished goods supplied among bakery enterprises in Abia state, Nigeria. Data were collected by the use of a structured questionnaire, in all 50 respondents were selected for the study. Using multiple regression analysis, the coefficient of elasticity, frequencies, percentages and mean, data were analyzed. The number of costumers was a significant determinant of demand for raw materials in bakery enterprises. However, educational status, income level, the quantity of material and price of finished goods were all positive determinants of finished goods supplied to consumers hence an increase in these variables will result in an increase in the supply of finished goods. It was also revealed that elasticity of finished goods supply was significantly affected by raw materials, educational status, age, religion, labour size, means of supply, source of finance, income level and quantity of raw material implying that a change in any of the above factors will lead to a significant change in the finished goods supplied by bakery enterprises in Abia State. The result showed that in elasticity of raw material demand, age, labour size, years of experience, source of finance, income level, quantity of raw material, quantity of finished goods supplied, price of finished goods and finished goods available significantly affects the elasticity of raw materials demand which implies that a change in any of the above factors will lead to a significant change in raw materials demanded by bakery enterprises in Abia State. Having considered the study, it was revealed that age in years, educational status, labour size, means of supply, finance, income in naira, quantity of raw material (kg), type of raw material used are determinants of raw material demand and finished goods supply among bakery enterprise in Abia State, Nigeria.

Keywords: Bakery, Demand, Supply and Elasticity

INTRODUCTION

The bakery production which has been increasing steadily in the country is among the largest processed food industries in Abia. The two major bakery industries focus on bread and account for about 82% of the total bakery products. The bakery industries in Nigeria comprise organized and unorganized sectors. The organized sector consists of large, medium and small-scale manufacturers who produced majorly packaged bread. The unorganized sector consists of small bakery units, cottage, and household-type manufacturing goods and distributing their goods in the surrounding areas (World bank, 1995; BFW, 2005 and Warren 2002). Bakery products contain high nutritive value and are manufactured from combinations of wheat or other flours, sugar, baking powder, condensed milk, fat (ghee), salt, jelly, dry fruits, various essences, and flavoring. Different type of bakery products can be classified as dry bakery products and moist bakery products. Dry bakery products include soft biscuits, hard biscuits, cookies, crackers, fancy biscuits and cream wafer biscuits. Moist bakery products include sweet bread, milk bread, fruit bread, various types of buns, cakes, pastries etc. These products are available in various sizes, shapes, and forms (Beverage and Food World, 1998). The current demand for bread is likely to exceed 2.2 million tonnes considering their leading role as one of the major sources of energy, protein, iron, calcium, and several vitamins. Some commercial bread contains around 7.5% to7.8% protein respectively. In terms of cost, biscuits are amongst the lowest cost processed food in the country when compared to other salted snacks. Most of the bakery products are easy to use during travel or at home because of its availability in a variety of pack sizes. They are no longer viewed as a luxury tea-time snacks but essentially daily food component for an average Nigerian household. Considering the expanded product set of bakery enterprises, there is a need for advanced technology to optimize its category management processes to help meet business goals and deliver full value to its customers. Also with the population and purchasing power rising at a record breaking pace, there is a need for extended market share through immense investment. Effective production among bakeries in Nigeria has been hampered by poor innovations consequent upon poor performance. The majority of the bakeries which bumped into the market sometimes ago fizzled out of it due to business road bumps associated with the enterprise development. There have been the recurrent loss of market share and dropping of sales volume in the bakery enterprises operation in Abia. The identifiable road bumps to efficient bakery production in Abia included "a firm saddled with the burden of manual processes and cumbered with the inability to deliver in terms of efficiency"

(BFW, 2005). Bakery firms in Abia had the difficulty of inventory management contributing to thrift (waste in bakery business) and units (missed shipments to ultimate consumer). Financial uncertainties and capitalization inconsistencies have plagued and plundered bakery enterprise investment performances in Abia. In commercial bakery products venture, the acceptability of the product depends on the extent of capital invested into the firm to produce competitive products. In bakery firms, for instance, capital is needed to develop market acceptable packaging quality. The packaging of the bakery product is closely interlinked with the production, presentation, storage, transportation, marketing and other capital variables. The importance of the packaging can further be gauged from the fact that packaging constitutes a fair portion (10 to 25%) of the entire cost of production and the entire capital needs a functional bakery firm, (Cauvain and Young, 2005). The main objective of this study is to examine determinants of raw materials demand and finished goods supply among bakery enterprises in Abia State, Nigeria.

METHODOLOGY

The study location was Abia State of Nigeria. Abia State was carved out of the former Imo state on 27th August 1991 with its capital at Umuahia. The state is located in the southeastern region of Nigeria and has within the approximate latitude of 4º40 and 6o14 North and longitude 7º10 and 8º East (National Bureau of statistic, 2008) and its population is about 2,845,380 million (N.P.C. 2009a). The state is bounded by the North and Northeast by the states of Anambra, Enugu, and Ebonyi. To west it is Imo state, to the West and south-east are Cross River state and Akwa-Ibom state and to the South is River State. The Southern part of the state lies within the river line part of the country. It covers an area of about 5,24375 sq. km. The state is low lying with a heavy rainfall of about 2,400mm which is evenly distributed between months of April through October Agriculture is the major occupation of the people of Abia state. The data required for analysis of the study were culled from bakery enterprises records and account for the period 2007-2008. Questionnaire was also used to elicit other necessary information. Descriptive statistics, multiple regression analysis and elasticity of demand and supply function

For the demand elasticity function, it is stated thus:

ED/ (Raw material) = $\frac{\%Changeindemandofrawmaterial}{\%Changeinpriceofrawmaterial}$

For the supply elasticity function, it is stated thus:

ES/ (Finished goods) = $\frac{\%Changeinsupplyoffinished\ goods}{\%Changeinpriceoffinished\ goods}$

The multiple regression analysis is specified as follows

$\therefore Y_{a,b,c,d} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 \ldots\ldots + b_nx_n$+ei

Where

Y_a = Value of finished goods supplied in naira

Y_b = Value of raw materials demanded in naira

Y_c = Elasticity of finished good supplied

Yd=Elasticity of raw materials demanded

x_1 = Age in years

x_2 = Education in years

x_3= Religion (Christianity =1, others = 0)

x_4= Labour size (number of workers)

x_5= Years of experience

x_6= Means of finished raw material supply (farmer = 1, others = 0)

x_7= Finance = Naira

x_8= Income in Naira

x_9= Quantity of raw material (kg) (quantity of finished goods)

x_{10} = Type of raw material (wheat = 1, others = 0)

x_{11}= Price of finished goods/raw material

ei = Error term

$b_1 - b_n$ = Coefficient

b_0 = Constant

For elasticity models, the dependent variable $x_1 - x_{11}$ is the percentage change in the variables.

RESULTS AND DISCUSSION

Determinants of Raw Materials Demanded

This was achieved using multiple regression analysis. The outcome of the regression analysis is presented in Table 1. From the result of the regression analysis presented in table 1, the double-log model shows the line of best fit due to number of significant variables,R^2 value of 0.863 which is the coefficient of multiple determination implying that 86.35% of the total variation in the regression,were accounted for by the variables included in the model while the remaining 13.7% were due to variables not included in the model. The F-ratio 17.453 which was significant at 1% shows the overall significance of the regression model. From the result, educational status, religion, labour size, years of experience, the source of finance and income level were not significant determinants affecting the demand for raw materials in bakery enterprises. However, means of supply, the quantity of raw material available, the price of raw material, finished goods available, the price of finished goods and quantity of finished goods available were significant determinants affecting the demand for raw materials in bakery enterprises. An increase in all significant variables will result in an increase in the variability of raw materials demanded.

Determinants of Finished Goods Supply

From the result of the regression analysis presented in Table 2, the linear model shows the line of best fit due to number of significant variables, R^2 values of 0.943 which is the coefficient of multiple determination implying that 94.3% of the total variation in the regression were accounted for by the variables included in the model. While the remaining 5.7% were due to variables not included in the model. The F-ratio 45.984 which was significant at 1% shows the overall significant of the regression model. From the result, age, religion, labour size, years of experience, means of supply, the source of finance, raw materials and price of raw material are not significant, implying that they are not determinants affecting the supply of finished goods. However, educational status, income level, the quantity of raw material and price of finished goods were all positive determinants of finished goods supplied, hence an increase in these variables will result in an increase in the supply of finished goods.

Elasticity of Finished Goods Supply

The elasticity of finished goods supplied by bakery enterprise in Abia State was analyzed using multiple linear regression. The outcome of the regression analysis is presented in Table 3. From table 3, it was revealed that the F-test value of 45.984233 which was significant at 1% shows the overall significant of the model. It showed that raw materials, educational status, age, religion, labour size, years of experience, means of supply, source of finance, income level, quantity of raw material and price of raw material significantly affects the elasticity of finished goods supply, implying that a change in any of these factors will lead to a significant change in finished good supplied by bakery enterprises in Abia State.

From table 4, it was revealed that F-test value of 4.790557 which was significant at 1% shows the overall significance of the model. It showed that age, religion, labour size, years of experience, source of finance, income level, quantity of raw materials purchased price of raw materials purchased, price of material, quantity of finished goods supplied, price of finished goods and finished available significantly affected the elasticity of raw materials demand, implying that a change in any of these factors will lead to a significant change in raw materials demanded by bakery enterprises in Abia State.

CONCLUSION

This study assessed the determinants of raw materials demand and finished goods supply among bakery enterprises in Abia state, Nigeria with particular focus in analyzing their socio-economic characteristics, determinants of supply and demand in bakery enterprise and its effect. Findings from the study records that majority of the bakery enterprises were well educated and of experienced personnel, managed by middle aged with an appreciable income level and sizable labour were discovered to be instrumental to the performances of bakery enterprises Similarly, the price of finished goods and quantity of raw materials demanded were also found to determine the progress and smooth efficiency of bakery enterprise. However, religion was of no significance contribution to the determinants of supply and demand elasticity on the performances of bakery enterprises. It was observed that educational status, income level, the quantity of raw materials, and prices of finished goods were all determinants of finished goods supplied to the consumers and hence increase in these variables will result in an increase in the supply of finished goods and vice versa. Finally, the study also suggests that periodic training and capacity building programs be organized to enhance effective performances of bakery enterprise ,coupled with employing attractive incentives by the firms to increase their labour size, however quantity of raw materials and price of finished goods were all positive determinants of finished goods supplied and it's like which implies that there should be an effective communication between the consumers (customers) and the suppliers of raw materials to the bakery enterprise so as to minimize spoilage of finished goods and to determine the progress and smooth operation of bakery enterprise in Abia State. Nigeria.

Table 1: Determinants of Raw materials demanded

Variables	Linear	Exponential	Double-log	Semi-log
Constant	22524.719	8.124	0.995	-182104.211
	(0.389)	(3.891)***	(0.539)	(-3.409)**
Educational status	-5821.911	-0.082	-0.287	-9381.139
	(-0.666)	(-0.262)	(-1.079)	(-0.429)
Religion	-1501.631	-0.039	-0.107	-1290.556
	(0.142)	(-0.103)	(-0.142)	(-0.075)
Labour size	-7482.922	-0.489	-0.288	-3186.434
	(0.867)	(-1.571)	(-0.487)	(-0.321)
Years of experience	-9136.959	-0.301	-0.262	-17052.495
	(1.905)*	(-1.741)*	(-0.764)	(-2.748)**
Means of supply	10923.093	0.459	-0.446	5390.391
	(1.112)	(1.296)	(-2.081)*	(0.327)
Finance	8854.260	0.364	0.261	1282.434
	(1.358)	(1.547)	(0.459)	(0.172)
Income level	-5981.725	-0.243	0.034	-9222.319
	(1.229)	(-1.383)	(0.131)	(-1.131)
Quantity of raw material available	1838.003	0.073	-0.525	21035.069
	(4.998)***	(5.503)	(-1.863)*	(3.168)**
Price of raw material	0.063	2.132E-006	0.786	11704.833
	(1.548)	(1.443)	(3.425)**	(5.194)***
Finished goods available	0.196	-1.183E-007	0.476	-252434.249
	(0.568)	(-0.010)	(6.104)***	(-0.961)
Price of finished goods	42.802	0.04	-13.678	-245526.476
	(0.340)	(0.909)	(-2.692)*	(-0.941)
Quantity of finished goods supplied to the customers	-22.935	6.302E-005	-13.365	258123.717
	(0.362)	(0.028)	(-2.661)*	(0.984)
R^2	0.620	0.654	0.863	0.836
R^{-2}	0.497	0.542	0.814	0.777
F – ratio	5.036***	5.835***	17.453***	14.146***

Source: Field survey data, 2016.

Note: () = t ratio;*** = significant at 1%; ** significant at 5%;* = significant at 10%

Table 2: Determinants of finished goods supplied

Variables	Linear	Exponential	Double-log	Semi-log
Constant	-77014.212	8.650	5.424	-224733.810
	(3.066)**	(19.555)***	(3.830)	(-2.685)*
Age	1486..912	-0.025	-0.085	1803.820
	(0.686)	(-0.645)	(-0.367)	(0.132)
Educational status	5335.593	-0.002	-0.357	-155.430
	(4.450)***	(0.022)	(-0.529)	(-0.004)
Religion	4706.234	-0.030	0.759	62957.452
	(-0.918)	(-0.331)	(1.451)	(2.037)*
Labour size	-3026.596	0.006	-0.120	-11627.553
	(-0.726)	(0.076)	(-0.421)	(-0.693)
Years of experience	-3152.010	0.036	-0.142	-18802.288
	(-1.321)	(0.855)	(0.703)	(-1.573)
Means of supply	-1938.804	0.000	0.032	-8953.613
	(-0.406)	(0.003)	(-0.062)	(-0.292)
Finance	3080.483	-0.043	-0.200	-3359.987
	(0.974)	(-0.768)	(0.851)	(-0.243)
Income level	2411.598	0.025	0.528	31717.000
	(2.149)*	(0.597)	(2.452)*	(2.492)*
Quantity of raw material	-393.879	-0.001	-0.108	-2331.574
	(-1.798)*	(-0.295)	(-1.139)	(-0.163)
Price of raw material	0.011	-3.511E.007	0.169	-4505.038
	(0.548)	(-0.971)	(1.161)	(-0.805)
Raw material available	0.033	1.898E-006	0.169	5384.195
	(0.417)	(1.348)	(1.161)	(0.625)
Price of finished goods	330.261	0.006	0.788	41959.398
	(12.833)	(12.830) ***	(4.225)***	(3.809)**
R^2	0.943	0.946	0.653	0.603
R^{-2}	0.923	0.927	0.541	0.475
F – ratio	45.984***	48.696***	5.805***	4.691***

Source: Field survey data, 2016

Note: () = t ratio;*** = significant at 1%; ** significant at 5%;* = significant at 10%

Table 3: Elasticity of Finished Good Supply

Variables	Elasticity	Standard error	T-statistics
%Constant	-1.537885	0.501601	1.072336
%Raw material	0.040809	0.097785	9.809174***
%Educational status	0.385695	0.303539	2.023809***
%Age	078387	0.114259	8.066006***
%Religion	0.25562	0.278443	-2.673365*
%Labour size	-0.091865	0.126572	-7.174833***
%Years of experience	0.104484	0.079085	-11.323515***
%Means of supply	0.106081	0.261065	-3.424123**
%Source of finance	0.100882	0.103553	-8.682669***
%Income level	0.09824	0.095481	-9.444417***
%Quantity of raw material	-0.192228	0.106914	-7.555375***
%Price of raw material	0.010942	0.019958	-49.555907***
%Quantity of finished goods	0.979078	0.070579	-0.296427
%Price of finished goods	1.082889	0.501601	0.982263
R^2	0.943199		
R^{-2}	0.922688		
F – test	45.984283***		

Source: field survey data, 2016

Table 4: Elasticity of Raw Materials Demand

Variables	Elasticity	Standard	T-Statistics
%Constant	0.165374	0.957379	-0.871782
%Age	0.220856	0.192046	-4.057075***
%Religion	0.058565	0.47885	-1.966033*
%Labour size	0.205432	0.21406	-3.711893***
%Years of experience	0.265623	0.130379	-5.63265***
%Source of finance	0.218191	0.174632	-4.476897***
%Income level	-0.196871	0.161415	-4.97554***
%Quantity of raw materials purchased	0.725083	0.14632	-1.878871*
%Price of raw materials	0.041273	0.033375	-28.72557***
%Quantity of finished goods supplied	0.063235	0.302113	-3.100707**
%Price of finished goods	0.158438	0.33773	-2.491817*
%Finished goods available	0.117982	0.282702	-3.119956**
%-Education	-0.448091	0.522244	-1.056802
%Means of supply	0.47349	0.437854	-1.202478
R^2	0.633689		
R^{-2}	0.501411		
F-test	4.790557		

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DETERMINANTS OF EFFICIENCY AMONG LIVESTOCK FARMERS IN ABIA STATE, NIGERIA

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ABSTRACT
This study analyzed the determinants of profitability and efficiency of livestock farmers In Abia State, Nigeria. The specific objectives are to determine the cost and returns associated with livestock production in the study area; identify the factors affecting the profit efficiency of livestock farmers in the study area and identify the constraints to profitable production of livestock in the study area. One hundred and twenty livestock farmer were selected via multi-stage random sampling method and questionnaires were used in the data collection. Descriptive statistics, farm budget technique, Cobb-Douglas function, and multiple regression analysis were used to analyze the data. The average PI for all farms was 0.64, the Rate of Returns on Investment was 181.1%, the Rate of Returns on Variable Cost (RRVC) was estimated to be about 386.76%, Operating Ratio (OR) was found to be 0.26 The Benefit-Cost Ratio (BCR) was estimated to be 2.81. The majority (83.3%) of the livestock farmers had attained a profit efficiency of above sixty (60) percent in their livestock farming. The government should make favorable policies on land acquisition procedures for livestock farmers who identified the cost of rent on land as a limiting factor to a profitable and efficient livestock business.
Keywords: Livestock, profit and efficiency

INTRODUCTION

Achieving profitability and efficiency is one of the major aims of livestock business in most rural and urban areas in Abia state. Livestock farming in the state is predominantly done in a semi-intensive management system and intensive in the rural areas and urban areas respectively mainly at a subsistent level. Livestock serves as an asset as well as a source of income for many Nigerians, creating jobs, the source of food and meat to meet the protein requirements, provides animal manure for crop production and provides power and transport options (Rahman and Yakubu, 2006). The value of livestock cannot be over-emphasized, considering the role they play in the society. Livestock makes use of left-over products, such as meat, milk, eggs, fibre etc. In addition to providing food, they provide income and other useful product to the people (Owolade *et al*, 2013). They contribute substantially to the livelihood of many rural households (Duru, 2006). However, livestock consumption is gaining wide prominence particularly in developing countries where 50% or more of their protein comes from livestock's Livestock production in Nigeria. This is because livestock products are more affordable, palatable and readily available than other sources of animal product (Mburu *et al.,* 2007). Otieno et.al (2009) estimated the total demand for livestock products in Nigeria stood at 2.1 million tonnes at 11.5kg per capita consumption whereas the domestic production is 352,460 metric tons. In Nigeria, a greater proportion of the livestock products is marketed fresh, while negligible quantity is preserved through Ice, smoking and sun-drying by main women at artisanal level. The preservation of livestock helps to increase utilization in the menu, reduced wastes of bulk catches and increased protein availability (Nganga, 2010). Income from livestock farming enhances productivity and standard of living by breaking the vicious cycle of poverty among rural farmers. There are indications that livestock farmers are limited by a lot of factors which limits their scale of operation and invariably affecting the level of pro accruing from the livestock business. In Nigeria, rigorous and inconsistent methods of production in addition to price fluctuations have an adverse effect on the level of profitability to farmers (Sani, 2000). Muburu et al., (2010) went further to buttress this problem faced in livestock production by stating that gender inequality in the ownership of assets, credit, services, markets and information on new technologies, consumer preferences and export trade requirements also affects the efficiency and profitability of livestock farmers. This reduces their chances of entering into contract farming agreements that could change their lives for good. Due to their lack of access to production resource effective livestock production activities are affected. In view of the unfolding reality coupled with the protracted debates, this study will attempt at examining the determinants of profitability and efficiency among livestock farmers in Abia state, Nigeria.

METHODOLOGY

The study location was Abia State of Nigeria. Abia State was carved out of the former Imo state on 27th August 1991 with its capital at Umuahia. The state is located in the southeastern region of Nigeria and has within the approximate latitude of 4°40 and 6o14 North and longitude 7°10 and 8° East (National Bureau of statistic, 2008) and its population is about 2,845,380 million (N.P.C. 2009a). The respondents were selected via multi-stage random sampling method. This technique was chosen based on the need to reduce the risk of bias and draw an inference from the sample about the population from which the sample is drawn with levels of confidence that can be statistically estimated (Alemandor, 2010). In the first stage, A Local Government Areas was randomly drawn from each of the three agricultural zones in the state. The agricultural zones are Umuahia agricultural zone, Aba agricultural zone, and Ohafia agricultural zones. In the second stage, two communities were randomly drawn from each of the three selected Local Government Areas from each of the three agricultural zones in the state. The third stage involved selecting two villages from each of the selected communities. The fourth stage involved the selection of 20 farmers into livestock production making a total of 120 respondents that was used for the study. Primary data were collected via the administration of a well-structured questionnaire. The study employed the stochastic profit frontier model to evaluate profit efficiency of the livestock farmers. The profit efficiency of the livestock farmers, efficiency equation model was used. The estimation was done using the Ordinary Least Squares method. The profit efficiency equation is fitted as:

$PE_i = a_o = a_iZ_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + a_7Z_7 + a_8Z_8 + a_9Z_9 + a_{10}Z_{10} + e_i$

Where,

PE_i = profit efficiency of the i^{th} livestock farmer

Z_1 = Age of the farmer (in years)

Z_2 = Household size

Z_3 = Farmer's level of education in years

Z_4 = Livestock rearing experience in years

Z_5 = Annual household non-farm income in naira

Z_6 = Amount of credit used (naira)

Z_7 = Membership of farmers' association or cooperative society (a dummy which takes the value of unity for members and zero if otherwise)

Z_8 = Distance to market commonly used (Km)

Z_9 = Foot and mouth disease zone (Yes = 1; No = 0)

Z_{10} = Information on livestock management access (Yes = 1; No = 0)

$a_0, a_1, a_2, \ldots a_{10}$ = regression parameters to be estimated

Four functional forms of linear, exponential, double-log and semi-log were fitted to the observed data. The choice of the lead equation was based on the magnitude of the coefficient of multiple determinations (R^2), the magnitude of the regression coefficient and conformity with a priority expectation of signs and the number and significance of the regression parameters.

RESULTS AND DISCUSSION

Cost and Returns in Livestock Production

The average cost and returns in livestock production among the farmers in the study area is presented in Table 1. Table 1 showed that the profitability ratios computed to establish profitability levels of the enterprise included profitability Index (PI), Rate of Returns on Investment (RRI), Rate of Returns on Variable Cost (RRVC) and Operating Ratio (OR). The average PI for all farms was 0.64, indicating that out of every naira earned; about 64 kobo accrue to the farmers as net income. The Rate of Returns on Investment was 181.1%, indicating that a farmer makes about ₦181 profit on every naira spent on livestock production. The Rate of Returns on Variable Cost (RRVC) was estimated to be about 386.76%, indicating that every ₦1 cost incurred on variable inputs generates about ₦386.76. This suggests that improvement in the profitability of livestock production in the study area was made possible through increased efficiency in the use of variable inputs. Moreover, the Operating Ratio (OR) of 0.26 indicates greater total revenue over total variable cost. The Benefit-Cost Ratio (BCR) was estimated to be 2.81, indicating that livestock production in the study area was viable as it returns ₦28 for every ₦1.00 spent. It can, therefore, be concluded that livestock production in the area is profitable. People should take up livestock productions as a means of livelihood.

Profit Efficiency of Livestock Farmers

The profit efficiency of livestock farmers was computed and the result is presented in Table 2. Table 2 shows that the majority of the respondents about eighty-three (83.3%) percent of livestock farmers had attained a profit efficiencies of above sixty (60) percent in their livestock farming. This result reflects the fairly high level of skills and expertise the farmers have acquired over time. This is hardly surprising considering the fact livestock farming is indigenous and integral part of most farmers in the study area and therefore most of the people grow up learning how to rear the livestock. The model technical efficiency was 0.61 -0.70 for the respondents.

Factors influencing the profit efficiency of Livestock farmers in the Study Area

The regression results on the factors that influenced the profit efficiency of livestock farmers in the study area are shown in Table 3. The exponential function was chosen as the lead equation based on the number and signs of the significant variables. The overall goodness of fit of the equation, as indicated by the coefficient of multiple determinations (R^2=0.883), showed that the independent variables included in model explained about 88.3% of the variations in waterleaf output (dependent variable) in the study area. The F-statistic was significant and confirms the significance of the entire model. Evidence from the result in Table 3 indicated that age, education, rearing experience, non-farm income, the amount of credit and disease were significant factors that influenced the profit efficiency of livestock farmers in the study area. Age was positively related to profit efficiency of livestock farming, an indication that profit efficiency of livestock farming increased as age increased. The level of profit made from livestock production depends on the age of the farmer because age determines the level of experience a livestock farmer would have gained over the years (Duru, 2006). According to Nwaru (2004) experience of a farmer increases with age. Experience creates confidence and could predispose a farmer to produce more. Profit efficiency of livestock farming is likely to increase as age increases. This relationship conforms to a priori expectation. Education (years) was positively related to Profit efficiency of livestock farming, an indication that profitability in livestock increased as the level of education increases. High level of education is an advantage to the livestock farmer, who would be privileged to have access to modern techniques of rearing livestock which will in turn translate into a profitable venture. Profit efficiency of Livestock farming is likely to increase the level of education increases.

Rearing experience was positively related to Profit efficiency of Livestock farming, an indication that Profit efficiency of Livestock farming increased as experience in livestock rearing increases. Farmers with relatively more experience can manage their farm operations better than those with less or no farming experience Nonfarm income of livestock farmers was positively related to Profit efficiency of Livestock farming, an indication that Profit efficiency of Livestock farming increased as non-farm income of livestock farmers increased. Nonfarm income is an incentive to the livestock farmers, income from farming activities are supplemented with non-farm income to increase the size of the livestock business and improve on the type of technology and techniques been adopted for the livestock farm. The amount of credit was positively related to Profit efficiency of Livestock farming, an indication that Profit efficiency increased as the amount of credit used by the Livestock farmers increased. The disease was statistically significant but negatively related to Profit efficiency of Livestock farming, an indication that Profit efficiency of Livestock farmers decreases as the incidence of disease increased. Disease incidence has a negative effect on profit efficiency because it reduces the output quantity and quality of the livestock farm.

CONCLUSION

The study revealed that livestock production in the area is profitable and the farmers had attained the fairly high level of profit efficiency from their livestock farming in the study area. Value of breeding stock, feed/fodder cost, family labour, capital employed, veterinary cost and cost of hired labour were the significant variables that influenced profitability of livestock farmers whereas age, education, rearing experience, non-farm income, amount of credit and disease were significant the factors that influenced the profit efficiency of livestock farmers in the study area. Based on the findings of the study the following recommendations are proffered; The government should make favorable policies on land acquisition procedures for livestock farmers who identified the cost of rent on land as a limiting factor to a profitable and efficient livestock business. The study revealed that most of the livestock farm operators in the study area were literate This, therefore, calls for the attention of the government to make protective policies that will encourage more literate people to be self-employed through starting up a livestock business. Such policies may include setting up a maximum price ceiling for livestock feeds and medication drugs, and regulating the prices of livestock in the market. Any effort to enhance the performance level of livestock enterprises in the study area should give serious consideration to those socio-economic factors that significantly influence the profitability level of the livestock farmers. Such efforts should be concentrated in reductively the high cost of inputs used in livestock production and scarcity of these inputs in the market. Any policies meant to increase production for should be geared towards improving the accessibility and affordability of producer to improved breeding stock.

Table 1: Average cost and returns farm of livestock production in the study area

Variables	Value (₦)	Percentage of total cost
Rent on Land	7,348.33	4.3
Depreciated Value of Farm Equipment	10,805.27	6.4
Cage and feeding troughs	28,040.83	16.6
Total Fixed Cost (TFC)	46,194.43	27.4
Feeding	42,015.0	24.9
Labour	10,091.67	5.9
Vaccination	6555.00	3.9
Purchase of new breeds/re-stocking	56,986.67	33.8
Water	6 736.00	3.9
Total Variable Cost (TVC)	122,384.34	72.6
Total Cost (TC)	168,578.77	
Revenue	473,800.67	
Net Farm Income (Profit) = (TR-TC)	305,221.91	
BC-Ratio = (TR/TC)	2.811	
Profitability Index =(NI/TR)	0.644	
Rate of Returns on Investment(%) = (NI/TC*100)	181.06	
Rate Of Returns On Variable Cost (%) = (TR-TFC/TVC*100) =	386.76	
Operating Ratio (OR) = TVC/TR	0.26	

Source: Field Survey, 2016

Table 2: Frequency Distribution of the Profit Efficiency of respondents

Technical Efficiency	Frequency	Percentage
<0.50	8	6.7
0.51 – 0.60	12	10.0
0.61 – 0.70	43	35.8
0.71 – 0.80	28	23.3
0.81 – 0.90	23	19.2
0.91 – 1.00	6	5.0
Total	**120**	**100.0**
Maximum profit efficiency	0.96	
Minimum profit efficiency	0.19	
Mean technical efficiency	0.67	

Source: Field survey, 2016.

Table 3: Regression results on the factors influencing profit efficiency of livestock

Variable	Linear	Exponential+	Double-log	Semi-log
Constant	-609.117	6.193	5.149	-4907.344
	(-0.884)	(3.632)***	(5.968)***	(-2.011)**
Age	480.900	0.238	0.147	262.168
	(2.571)**	(3.210)***	(3.375)***	(2.117)**
Household size	23.385	0.010	0.068	244.999
	(2.111)	(1.221)	(0.918)	(1.169)
Education	9.072	0.003	0.085	212.002
	(2.942)***	(2.576)**	(1.501)	(1.323)
Rearing experience	10.891	0.004	0.021	152.461
	(2.467)**	(2.349)**	(0.420)	(1.089)
Non farm income	124.916	0.201	0.720	552.641
	(0.424)	(1.717)*	(2.751)***	(0.743)
Amount of credit	17.856	0.011	0.037	-1.601
	(0.817)	(1.251)**	(0.924)	(-0.013)
Cooperative membership	-14.640	0.009	-0.070	-186.396
	(-0.638)	(0.977)	(-0.727)	(0.679)
Distance to market	18.197	0.009	0.277	366.980
	(1.977)*	(2.539)	(1.409)	(1.124)
Diseases	10.504	-0.003	0.003	9.808
	(9.323)***	(-8.996)***	(7.524)***	(9.948)***
Management information	-2.183	0.004	0.003	26.216
	(-0.204)	(0.927)	(0.071)	(0.212)
R-squared	0.903	0.883	0.906	0.915
Adj. R-squared	0.876	0.851	0.870	0.882
F-statistic	32.934***	26.830***	25.264***	28.044***

Source: Field survey, 2016

*** = significant at 1% level; ** = significant at 5% level; * = significant at 10% level. Figures in parenthesis are t-ratios. + = means lead model.

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PROFITABILTY ANALYSIS OF VALUE ADDED CASSAVA PRODUCTS IN IKWUANO LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

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ABSTRACT

Value addition has been the catalyst for increased income for agribusiness households. The study examines the value added cassava products in Ikwuoano local government area in Abia state; their profitability and determinants of value additions in the area. Data was elicited through a well-structured questionnaire administered to 60 cassava farmers in the area. Profitability analysis and regression analysis were the major tools of analyses. Garri was the most profitable value added cassava products in the study area with net returns of N82903; followed by Fufu with N71009 as net returns. Household size and education were significant and positively related to profit while experience, extension visits access to credit were significant and negatively related to profit of value added cassava products. Government and development agencies should organize sensitization programmes for cassava processors on the potentials that exist in the new emerging markets for value added cassava products.

Key words: value addition, cassava and profitability

INTRODUCTION

One of the major advantages cassava has over other tuber crops is its ability to be transformed into many products like garri, fufu, tapioca, starch, flour, chips, ethanol among others. Cassava is widely produced in Nigeria especially in the northern and eastern parts of the country because of its ability to withstand harsh weather conditions; it can be processed into different products, its appropriateness to the prevailing climatic conditions in the area and it's widely available and easy to plant and process. Nigeria is one of the leading producers of cassava. According to FAO (2015) statistics; Nigeria cassava production is by far the largest in the world; a third more than production in Brazil and almost double the production in Indonesia and Thailand. Ukpongson *et al* (2011) postulated that the concept cassava processing and value addition entails the special treatment of the cassava root before it is consumed to make it last longer. Traditionally, cassava is produced on small-scale family farms. The roots are produced and processed as a subsistence crop for home consumption and sometimes for sale in village and urban markets. The presence of high level of hydrogen cyanide (HCN) in roots of bitter cassava makes processing indispensable before cassava can be consumed by human being. Consequently, processing operation in cassava has essentially created an array of opportunities for enhancing the worth, quality and usefulness of primary products of cassava. Thus, the processes of enhancing cassavas worth, quality and usefulness is called value addition. Lawal and Jaiyeola, (2007) opined that value addition improves the shelf life of agricultural products and generates income for participants. Since most government interventions and policies are aimed at integrating the rural poor into the mainstream of the economy, one of the ways of achieving this is by adding value to their produce. Despite been the world biggest producers of cassava, Nigeria have not fully the tapped the potentials embedded in cassava production. Nigeria still imports starch from other countries and the local production is not sufficient for local production and thus the country has little to nothing left for export. The economic situation in Nigeria which is on a sprinting run to depression has made the cost of living very high. The price of food commodity is on a steady increase. This trend has pushed most farmers to add value to their products in the bid for the products to command a high price and compete favourably in the market. The tries to examine the value added products predominant in the study area; its cost and return and also determinants of value addition in the study area.

MATERIALS AND METHODS

STUDY AREA

The study was carried out in Ikwuano Local Government Area of Abia State, made up of four clans which comprise several villages/communities. These clans include: Ibere, Ariam, Oloko and Oboro. Each of these clans is made up of four autonomous communities.

Sample size and method of data analysis

Multi-stage random sampling technique was employed in the research. First, 4 of the autonomous communities were selected. A list of cassava value-added products consumers were compiled with the aid of the Abia. ADP Extension Agents in the area. Finally, 15 cassava value-added products marketers were chosen randomly from each of the clan giving a sample size of 60 respondents. Sampling was conducted without gender discrimination and replacement. A well-structured questionnaire was used to elicit information from the farmers.

Method of Data Analysis

Objective one was analyzed using descriptive analysis; objective two was analyzed with profitability analysis while multiple regression was used to analyzed the last objective. The multiple regression analysis is stated implicitly as follows;

$Y = F(X_n)$

$Y = F(x_1, x_2, x_3, x_4, x_5, x_6, e)$.

Where

Y = value added. (#)

X_1 = gender (male=1; female=0)

X_2= household size (number)

X_3 = education (years spent in school)

X_4 = labour (naira)

X_5 = extension (number of visits)

X_6 = experience (years)

X_7 = cooperative membership(yes=1; no=0)

X_8 = access to credit (amount recieved)

X_9 = cost of processing equipments

RESULTS AND DISCUSSION

Cassava value added products predominant in the study area

Table 1 show the value added products mainly produced in the area. Multiple responses on various value addition on cassava by farmers in the area. The result indicates that all the farmers 100% transform their cassava into garri in the area. This is no surprise as garri is a major household food which is consumed daily because it's readily availability and low cost. Fufu production followed with a proportion of 80%; 50% of the farmers produced abacha, 25% of the farmers engaged in cassava starch production and marketing, 16.7% added value to transform cassava into flour, while the least proportion of 5% were farmers who produced chips from cassava. This result shows that garri and fufu constitutes over 65% of the total products from cassava in Ikwuano L.G.A. Thereby paying a minimal attention to other possible value added products from cassava, such as cassava cakes, cassava salad creams, alcohol and pharmaceutics.

Costs and Returns analysis on value added cassava products

This section discusses the costs and returns to major products from cassava processing in the study area. The costs and returns to cassava processing are as presented in Table 2. Results from the Table shows that Garri production incurred the highest cost of production when compared with other valued added products at N262305 with cost of cassava accounting for 66.8% of the total cost of production. This is followed by cost of labour, fire wood purchased and transportation accounting for 19%, 7% and 5% respectively. The total revenue gotten from Garri production was N345208. Return on investment shows that 1 naira invested will yield 1.31 per naira invested. This shows the profitability of garri in the study area. For Fufu production, the total cost of production was 183780 which comprise cost of cassava at 70% of the production cost, labour at 14% and fire wood accounting for 7% of the cost of production. The total revenue from Fufu production was N254789. Value added cassava (Fufu) will yield 1.38 per naira invested in the study area. Abacha production in the study area had the least cost of production at N128647 with cost of cassava at 69% of the total cost of production, labour at 12%, transportation cost at 8% and cost of fire wood at 6% of the total cost of production. Abacha had the least return on investment when compared with other valued added products but it was still profitable with 1.16 returns for every naira invested. The results further show that, the cost of cassava is bulk of production cost for Garri, Fufu and Abacha respectively. This comes as no surprise as cassava is the raw material for production. Most of the respondents do not cultivate cassava but buy from the farmers who factor in their cost in the price and the cost of living in Nigeria is on a steady increase. From the table it was observed that Garri was the most profitable of the value added cassava products with net returns at N82903.Garri is an integral part of every household diet in the study and Nigeria at large because it is cheap, readily available and it is complementary to most dishes prepared in the study. This was in accordance with the findings of Muhammad-Lawal *et al* (2013) Achem *et al* (2013) who found garri to be more profitable when compared to other value added cassava products in Kwara state. The return on investement shows that all the three value added cassava products were profitable in the study area with abacha having the least return on investments.

Profitability determinants of cassava processing in the study area

The result of the regression shows that the semi-log functional form had the line the line of best fit among others. This is because it had the highest F- ratio of 2.785 which means the variables in the model have the line of best fit. Also, the semi-log was chosen because it had the highest coefficient of determination (R^2) at 0.635 which means that 63% of the variation on returns of fish farmers was explained by the independent variables in the model.

Household size was positively related to profit of value added cassava products at 10% level of significance. This implies the higher the higher the household size, the higher the profit. This comes as no surprise as high household size is a proxy for cheap labour as everybody contributes in the farm work and this reduces the amount spent on hired labourers. Education was significant and positively related to profit of value added cassava products at 5%. This positive relationship is as a result of the farmer's education which has broaden his horizon and increased their quest for new ideas, varieties and methods that will improve production and the need to add value to his product offering in other to make his products attractive and increase his returns. This result is in accordance with the findings of Ehinmowo *et al* (2015) who discovered that education increases the profitability of farmers in Ondo, Oyo and Ogun state. Number of extension visits was negatively related to profit at 5% level of significance. This means the lower the number of extension visits, the lower the profit. It suffices us to say that due to the fact that there is little or no extension visits from the extension agents, the farmers are not educated on ways to improve on their value addition technique, improved methods of production and this reduces the returns of the farmers. The result was in line with the findings of Onyemauwa (2012). Experience was negatively related to profit at 5% level of significance. This is against the apiori expectation of a positively relationship. This might as a result of most farmers holding tenaciously to old ways of production which might increase the cost of production and lead to low profit. Also, lack of extension contact in the study area might have an effect on the use of obsolete and orthodox production process to add value to products. Access to credit was significant at 10% and negatively related to profit. The high the cost of borrowed fun, the lower the profit. High Interest rate charged on the borrowed fund eats deep into the profit and as such reduces the profit. The high interest rate charged are caused by high defaults rate by the farmers, lack of collateral and the high volatility associated with agriculture.

CONCLUSION

This study was designed to examine the profitability analysis of value addition on cassava products in Ikwuano local government area of Abia state. The result showed that Garri was the most profitable when compared with the other value added cassava products in the study area with net returns of N82903; followed by Fufu with N71009 as net returns. Household size and education were significant and positively related to profit while experience, extension visits access to credit were significant and negatively related to profit of value added cassava products. The recommends that small scale entrepreneurs should seize the opportunities offered by cassava processing as a means of income diversification, more extension agents should be trained to help increase the extension network in the study area to teach farmers on new methods of value addition and usage of modern equipment and Government and development agencies should organize sensitization programmes for cassava processors on the potentials that exist in the new emerging markets for cassava products.

Table 1: Characterization of cassava value addition levels

	Frequency	Percentages (%)
Garri	60	100
Fufu	48	80
Starch	15	25
Abacha	30	50
Flour	10	16.7
Chips	3	5

Source: Field survey, 2016

Table 2: Costs and return analysis of value added cassava products

	Garri	Fufu	Abacha
Total revenue	345208	254789	149743
Cost of cassava (cuttings)	175210	128740	89000
Cost of labour	48620	25690	15090
Cost of transportation	12000	11874	9854
Cost of Take away plates			2000
Water cost	900	550	700
Fire wood	18475	12486	7843
Packaging materials(wraps)	1500	1000	1040
Other processing cost	5600	3440	3120
Total cost	262305	183780	128647
Net returns	82903	71009	21096
Return on investment	1.31	1.38	1.16

Source: Field survey, 2016

Table 3: Factors affecting profitability of cassava processing in the study area

	Linear	Double log	Semi- log+	Exponential
Constant	21675.315	8.398	9.663	15336.051
	(0.746)	(11.931)***	(5.229)***	(0.335)
Gender	8083.640	0.295	-0.637	-12525.559
	(1.090)	(1.641)	(-1.137)	(-1.696)*
Household size	1987.646	0.058	0.592	24310.379
	(2.198)*	(1.209)	(2.153)*	(1.912)*
Education	-719.849	0.021	0.188	-7920.071
	(-0.767)	(0.940)	(2.753)**	(-1.015)
Labour	3038.468	0.130	0.411	4608.103
	(0.815)	(1.444)	(1.404)	(0.645)
Extension visits	-6081.791	-0.214	-0.606	-8918.461
	(-2.026)*	(-2.941)**	(-2.714)**	(-1.713)*
Experience	3173.515	0.171	-0.550	8082.215
	(1.097)	(2.941)**	(-2.387)*	(1.542)
Cooperative membership	-494.084	0.009	-0.255	-7387.740
	(-0.182)	(0.142)	(-1.179)	(-1.377)
Access to Credit	2956.296	-0.067	-0.418	-5202.077
	(21.726)***	(-0.933)	(-1.785)*	(-0.898)
Processing equipment	460.396	-0.003	-0.527	-5193.976
	(5.932)***	(-0.933)	(-1.289)	(-0.513)
R^2	0.558	0.463	0.635	0.394
R^2 adjusted	0.502	0.237	0.523	0.227
F - ratio	(1.905)*	(2.475)*	(2.785)**	(1.556)

Source: Field survey, 2016

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PRACTICE THEORIES OF MOTIVATION AND EMPLOYEE PERFORMANCE: A REVIEW

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ABSTRACT
The paper reviewed practice theories of motivation and employee performance with focus on examining to an in - depth extent the concept of motivation and its relationship with performance. It evaluated a number of motivation theories such as performance management theory by Taylor, reinforcement theory, expectancy theory, goal theory to mention but a few. Critique and descriptive approach were employed as method of analysis. The paper concludes by enumerating available motivational packages that will enhance performance both at employee and organizational levels.
Keywords: Motivation, theories, employee performance

INTRODUCTION
Motivation is a theoretical construct used to explain behavior. It represents reasons for people's action, desires and needs (Elliot et al, 2001). It is a goal directed behavior. This implies that motivation takes place when people expect that a given course of action is likely to lead to the attainment of a goal or a valued reward which satisfies their particular needs (Porter, Lawler, 1968). In other words, when a clearly and perceived valuable relationship exists between performance and outcome and the outcome is seen as a means of satisfying need, motivation takes place (Vroom, 1964). The level and extent of motivation has a direct effect on performance. This implies that a well-motivated workforce has a clearly defined goal and takes actions which they expect will achieve those goals (Erez and Zion, 1984). This understanding underscores the roll of human resource management function of performance management that aims at a targeted level of production or performance. By implication, the function of directing and controlling will not only aim at target production, but also on how or what will motivate employees to achieve set targets. Motivation is a critical factor in organizational performance given its essence of promoting commitment and initiative amongst employees. This can eventually translate into achieving a desired share of the market. However, to sustain a given level of performance, motivation should be geared towards inculcating organizational values, culture, tone and purpose to the employees. It is also a process of stimulating a voluntary and purposive action towards achieving the organizational goal(s). An employee can willingly undertake a designed course of action if his personal goal(s) is achievable with the same purposed action undertaken. This means achieving both organizational and personal goal within the same process (Zafron et al, 2009). Motivation packages must be defined, understood, and enticing to prospective recipient for him to strive to meet the expected target. However, what constitutes appropriate motivational packages or practice that can enhance employee performance or evokes differences of views among scholars, depending on which angle of man's need satisfaction or goal attainment he chooses to discuss. The question is which motivation practice or package can motivate employee to performance. Seeking to answer the arising questions, we shall review the opinion of some motivation practice theorists as to guide us to propose motivational practices or packages that can enhance employee performance.

Theoretical Review of Motivation
Fredrick Taylor (1856 – 1917) postulates performance management theory and it asserts that what will motivate a worker to higher performance includes provision of appropriate training and tools, financial reward and repetitive performance on the same or similar tasks. He emphasized on money as the most veritable motivator as workers are to be paid according to the level of their output. Taylor's theory is related to incentive, reward, and Hum's reinforcement theories. Herzberg (1957) described money as not a satisfier, though its presence is necessary. He further argued that though lack of money can cause dissatisfaction, but its provision does not result in lasting satisfaction either. He rather identified job enlargement, job enrichment and the empowerment of the employee as the real motivators of performance. Maslow (1954) considered money at the lowest level of his need hierarchy. He postulates that human needs are in a hierarchy and a satisfied need can no longer be a motivator. Each of the needs requires entirely a different motivator from another. For example a satisfier for food or safety cannot be a motivator of esteem or self-actualization. Interestingly, Goldthorpe et al (1968) research into the ''affluent worker'' tends to support Taylor's postulations by positing that, the dominant factor in the choice of employer and consideration of pay seem most powerful in binding people to their present job. Vroom (1964) expectancy theory linked performance to motivation as he posited in his three component expectancy theory that a person's belief that if his performance reaches expectation, he will receive a commensurate reward. Or the result of his effort will achieve him the adequate reward or goal attainment. Elton Mayo (1927) Heathron electricity

company experiment on motivation to performance proved that the factor that can influence productivity is relationship. He asserted that, if employees receive special attention and are encouraged to participate; they perceive their work has significance. They will therefore be motivated, provided, there is efficient communication feed-back system. Nevertheless, the other side of the argument is that some may misconceive their importance and constitute themselves into a log in the wheel of progress.

Edwin Locke proposed goal theory states that motivation and performance will be high if individuals are set specific goals which are challenging, but accepted. The goal setting theory of motivation (Locke and Ladham, 1968; 1990) explained that goal specification increases the desire to perform better. Challenging task when accepted results into higher performance than easy tasks. The main strands of goal theory are that, there must be optimal level of challenge, goal clarity, feed-back on activity or performance.

Intrinsic and Extrinsic Motivation

Behavioral theorists believe that understanding what stimulates desires, wants or curiosity can lead to determining what motivates employee performance. Motivation could be intrinsic, extrinsic or both. Pardee (1990) explained intrinsic motivator as the desire to seek out new things and new challenges, to experiment and gain knowledge. It is a drive by the enjoyment of a task that exists within an individual rather than relying on external pressure or desire for a reward. While extrinsic motivation refers to external drive to performance in order to attain a desired outcome (Ryan et al, 2000). Extrinsic desire is prompted by reward or what one wishes to gain or achieve; Mwita (2002) emphasized that extrinsic motivator can have a powerful effect but cannot last long. Unlike intrinsic, extrinsic desire is measured and driven by forces of what one thinks he can gain. The task or goal might not be enjoyable but the reward can attract one to undertake it. Employee who is intrinsically motivated is more likely to engage in the task willingly as well as work to improve his skills which will improve his capabilities (Wigfield et al 2004). Extrinsic motivation is used to attain outcomes which a person would not get from intrinsic motivation. This includes money, grades, promotion etc (Ryan, 2000). A manager's understanding of the role of intrinsic and extrinsic motivation in behaviorial pattern can effectively exploit both to select and apply appropriate motivational packages that can make task enjoyable, and at the same time afford reward or compensation for accomplished task(s).

Motivational Practice That Can Enhance Performance

Scholars of performance management agree that motivation can enhance performance but the challenge has always been choice and application of the appropriate motivational practice or package that can enhance performance. The administration of the appropriate motivational packages is a function of the type of organizations policy, strategy and managerial competencies. Policy is a blue print provided by the top management of an organization directing how the organization's activities and other related matters will be handled. It draws from the vision and mission of the organization to direct on the expected required tone, culture, process and span of control within the organization. The strategy defines the goals, objectives and the means of achieving them. Both policy and strategy need not be static but require periodic review in line with the unfolding economic and social developments within and outside the organization. Verhellam (1994) argued that motivation strategies should aim at creating a conducive working environment and develop policies and practices that will provide for higher level of productivity and thus performance from employees. Strategy must be all inclusive and employee friendly. This means creating an atmosphere of mutual trust amongst various groups, individuals and the organization. Encourage constant interaction between managers and subordinates with a view to locating individual and general needs of the employees. A progressive, easy to understand, transparent policy/ strategy will create the necessary atmosphere for performance; An environment where everyone knows what he requires to accomplish task before him and the reward for performance or what attracts sanctions. Company Strategy/ policy should create room for employees to express their initiative and innovative ideas. It strengthens commitment and desire to do more. The manager who implements the policies and strategies should be competent, impersonal and knowledgeable enough to know how best he can motivate his employees given the psychological and physiological status of the employee and the available incentives, rewards or personal goal attainment. He must have the will to equitably dispense compensation and justice According to Tarkenson (1986), the manager will be concerned with measuring motivation to provide an indication of areas where motivational practices need to be improved; ensuring as far as possible that employees feel, they are valued, improved leadership skill, job designs, compensation and reward management and the application of behavioral modification approaches.

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DETERMINANTS OF INNOVATIVENESS: THE CASE OF SMALLHOLDER RICE FARMERS IN NORTH-EASTERN NIGERIA

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ABSTRACT
This paper sought to identify the determinants of innovative behaviour among rice producers in North-Eastern Nigeria. Cross sectional data was collected from a sample of 270 rice farmers during the 2013/2014 cropping season using interview schedule. Descriptive statistics and logistic regression were used as analytical tools. The results revealed that adopters of modern rice production technologies obtained significantly higher yields than the non-adopters' counterpart. Also, significant differences existed in the two adoption status in terms of farmers' income and literacy level. However, no significant differences were found with respect to household size and farming experience between adopters and non-adopters. Furthermore, farm income, access to information, access to credit, literacy level of the decision maker, family size and membership of cooperative societies significantly influenced innovative behaviour of the farmers. It was concluded that knowledge of households' socio-economic and institutional attributes is invaluable when designing and targeting technologies for smallholder farmers. Policies that will ensure continued access to credit facilities and effective extension system should be vigorously pursued.
Keywords: Innovativeness, Rice Farmers and North-Eastern Nigeria

INTRODUCTION
Nigeria has made substantial investments in agricultural research and extension to increase agricultural production through new technologies. Despite considerable technological change however, agricultural production in this country continued to encounter substantial inefficiencies due to farmers' unfamiliarity with new technology, poor extension and education services, and infrastructure, among others (Shehu, *et al.*, 2007). The slowdown in agricultural productivity growth along with pressures to reform rural research and development (R&D) policy in Nigeria could be said to have escalated interest in finding ways to improve productivity, including through enhancing farmers' innovative capacity. Despite the seemingly simple link, the successful translation of R&D to improved farm productivity depends on many factors. In particular, much relies on farmers' capacity to adopt suitable innovations and successfully integrate them into existing farming systems. A broader understanding of innovative capacity and its contribution to farm innovation adoption and productivity growth can also aid in evaluating policies and investment decisions aimed at improving productivity growth. This study, therefore, was designed to examine innovative (adoption) behaviour among rice farmers in North-Eastern Nigeria. The specific objectives were to: compare the socioeconomic attributes of adopters and non-adopters of modern rice production technologies; identify factors that influence the farmers' innovative (adoption) behaviour towards modern rice production technologies in the region; and

METHODOLOGY
The study was carried out in North-Eastern Nigeria. Purposive and Multi-stage random sampling techniques were used to select respondents for this study. Cross sectional data was collected from a sample of 285 small scale paddy rice farmers on their household production activities during the 2013/2014 cropping season. However, only 270 were correctly filled and hence analysed.

Analytical Techniques
With the aim of achieving the objectives of the study descriptive statistics and binary logistic regression were used as analytical tools.

The empirical Logit Model
The Logit model was used to achieve objective 4 of the study. The empirical model is specified thus:

$(Y_i = 1/X_{ij};\ j = 1 \text{ to } 8) = F(Z_i) = 1/1+e^{-zi} = e^z/e^z + 1;\ i = 1 \text{ to } 270$ *1*

Where $Z_i = (\alpha, \beta_1 X_1, \beta_2 X_2, \ldots\ldots., \beta_8 X_8, \varepsilon)$

F(.) = Cumulative logistic function

Z_i is a theoretical or unobserved or an unobservable variable, that is, although X_i's was generated from the field, the β_i's are not observable. In order to obtain the values of Z_i, the likelihood of observing the sample needs to be formed by introducing a dichotomous response variable Y_i such that

$$Y_i = \begin{cases} 1 \text{ if the } i^{th} \text{ farmer is adopter of modern rice production technology *} \\ \end{cases}$$

0 if the i^{th} farmer is non-adopter of modern rice production technology
X_{ij} is the j^{th} socio-economic and institutional attributes of the i^{th} farmer as contained in Table 1
B_1 to β_8 are parameters to be estimated
α = constant term
ε = disturbance term assumed to have zero mean and constant variance.

Measuring innovative behaviour

The measure of innovative effort developed for each farm was based on the number and extent of innovations (production recommendations) that each farmer had adopted (during the 2013/2014 cropping season). Given that nearly all the farmers had adopted partially or fully at least one innovation (improved seed varieties, fertilizer, herbicide and/or insecticide), they were grouped into two categories of innovativeness: non-innovators (non-adopters) and innovators (adopters). If a farmer fully adopted three innovations, the farmer is regarded as an innovator (adopter) otherwise s/he is a non-innovator (non-adopter). Based on the foregoing, 100 farmers were classified adopters and 170 as non-adopters. This provides a useful basis for empirical analysis of the underlying factors that might contribute to a farmer's innovative capacity or willingness to innovate (adopt).

Determinants of Adoption (innovative) Behaviour

Several studies have indicated that the adoption of improved agricultural technologies are affected by many factors such as farm size, age, family size, education, availability of credit, access to information among others (Yishak, 2005; Taha, 2007). Researchers and institutions both within and outside Nigeria have conducted a number of empirical studies on the adoption behaviour of farmers. For ease of clarity the variables often identified as having relationship with adoption of agricultural technologies could be categorized as household personal and demographic variables (e.g., age, farming experience, household size, level of education, gender), economic factors (farm size, farm and non-farm income) and institutional factors (extension contact, access to credit, distance from market).

RESULTS AND DISCUSSION

Descriptive statistics of the socioeconomic and production factors

A summary of the some socioeconomic attributes of the sampled rice farmers is presented in Table 2. The results indicated that there were significant differences in farm income, education and extension contact between the two adoption status of rice producers at 5% level. Furthermore there were no significant differences between adopters and non-adopters in terms of age, household size and farming experience.

Determinants of innovativeness towards modern rice production technologies

Explanatory variables that were selected for econometric model were discussed based upon the model output. Accordingly, as indicated in Table 3, about 96 % of the total variation for the modern rice production technique is explained by logistic model. The $\chi 2$ result which is significant (P<0.001) shows that the model fits the data. The model correctly predicted sample size of 95 % and 96.5% for adopters and non-adopters, respectively. The odds ratio [Exp(B)] for this variable was 2.261 (Table 3), which suggest that farmers who had more contact with extension agents are more than two times likely to adopt modern rice technologies than those with no access to extension agents. Income derived from the farming activities indicates the level of profit of the farmers. The expectation is that farmers will have as much capital to plough back into the production process in order to increase profit. The results in Table 3 indicate that income was positive and significant (P<0.001). The implication of this finding is that farmers with good returns from their production activities are more likely to be able to afford and apply expensive inputs aimed at increasing productivity. The results in Table 3 revealed that access to information defined by number of visits by the extension agents to farmers significantly (P<0.001) affects adoption of modern rice production technologies. The positive and significant coefficient of access to information could be attributed mainly to the fact that knowledge gained from the contacts with extension agents by the farmers' influence them to adopt new technologies. This is in consonance with the findings of Tiamiyu *et al.* (2009) who reported a positive relationship between extension visits and technology adoption among growers of New Rice for Africa (NERICA) in savanna zone of Nigeria. The coefficient of access to credit had the hypothesized positive sign and significant (P<0.001). The significance of the variable stemmed from the fact that agricultural credit is a basic tool of production which provides farmers with additional source of investment in modern production technologies. The more access farmers have to credit facilities the higher the likelihood that they may adopt modern technologies recommended to them. The positive effect of the variable on adoption is a reflection of ability to purchase productive inputs for farming activities. This concurred with studies by Foti *et al.* (2008) who reported a positive relationship between farm size (taken as a surrogate for wealth and access to credit) and the adoption of selected soil fertility and water management technologies in semi-arid Zimbabwe. Literacy level had a positive coefficient and significant at 5% level. This conformed to *a priori* expectation. This is in consonance with the findings of Lawal *et al.* (2004) who reported positive and significant relationship between education and adoption of improved maize varieties among smallholder farmers in southwestern Nigeria. This shows that being literate farmers easily understand and analyze the situation better than illiterate farmers. Another explanation could be, the more years of formal schooling farmers had, the better enlightened they become and subsequently the easier it becomes for them to better understand and adopt production recommendations. As shown in Table 3, the coefficient of family size, which is defined by the number of people in a household had negative coefficient and statistically significant at 5% level. The negative coefficient of family size could be as a result of low adult ratio in the sampled households. The significance of the variable could be explained by the fact that labour is an important input in rice production. Membership of cooperative society had positive and significant ($p<0.05$) influence on adoption behaviour of the sampled farmers. The result is in agreement with that reported by Mihiretu (2008). Adoption of modern rice technologies could be motivated by belonging to a cooperative society. Cooperative membership popularizes innovation by making farmers exchange ideas, experiences; and makes it cheaper to source information, knowledge, and skills in order to enable them improve their livelihoods.

CONCLUSION

It was concluded that knowledge of households' socio-economic and institutional attributes is invaluable when designing and targeting technologies for smallholder farmers. Therefore, efforts geared towards ensuring that loans and other credit facilities are made available to the smallholder farmers at minimum interest rates. Also, there is need for the revitalization and priority funding of the extension delivery activities of the States' Agricultural Development programmes (ADPs). This is crucial for increased rice production in the country.

Table 1: Description of variables in the logit model

Variable	Variable code	Description and unit	*a priori* expectation
Income	INCOME (X_1)	Revenue from previous harvest farm (Naira)	+
Access to information	INFO (X_2)	Visit by extension worker (number of visit)	+
Access to credit	CREDIT (X_3)	Obtained loan to finance farm work (Yes, 1; No, 0)	+/-
Education	LITERACY (X_4)	Level of formal education attained (years)	+
Farming experience	EXP (X_5)	Duration of time engaged in rice farming (years)	+/-
Farm size	SIZE (X_6)	Total land holding owned by the farmer (hectares)	+
Household size	PEOPLE (X_7)	Individuals in a household (number)	+/-
Membership of cooperative society	CLUB (X_8)	Membership of cooperative society (If affiliated = 1, 0 otherwise,	+

Table 2: Summary Statistics of the socio-economic characteristics of the farmers

	Adopters		Non-adopters			
	Mean	**Standard deviation**	**Mean**	**Standard deviation**	**T-value**	**p-value**
Paddy output (kg)	2633.50	1537.22	1593.94	837.57	2.59*	0.0000
Income (₦)	17025.61	10451.61	4960.27	5899.77	12.13*	0.0000
Household size (number)	7.65	6.17	14.41	8.36	-7.03	1.0000
Education (years)	7.50	5.59	3.77	4.85	5.76*	0.0000
Extension contact (number)	7.61	2.51	2.35	2.29	17.57*	0.0000
Farming experience (years)	12.6	6.31	12.03	5.86	0.90	0.1838
Total number of observation	100		170			

*Significant at 5 % level, (degree of freedom = 268)
Source: Field survey, 2014

Table 3: Logit equation of factors influencing the adoption of modern rice production technologies of farmers

Variables	Coefficients (B)	Standard error	Wald	Significance	Exp (B)
Constant	-3.704	1.673	4.902	0.027*	0.025
INCOME	0.0003	0.000	20.334	0.000**	2.522
INFO	0.816	0.171	22.778	0.000**	2.261
CREDIT	-3.885	0.877	19.636	0.000**	0.021
LITERACY	0.181	0.079	5.211	0.022*	1.199
EXP	-0.009	0.055	0.024	0.878	0.992
SIZE	0.141	0.744	0.036	0.849	1.152
PEOPLE	-0.253	0.112	5.108	0.024*	0.776
CLUB	2.191	0.849	6.656	0.010**	1.112
Number of farmers	270				

Source: Field survey 2014
**Significant at 1%   * Significant at 5%

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EFFECT OF CASSAVA-BASED TECHNOLOGIES ON THE WELFARE STATUS OF FARMERS IN IMO STATE, NIGERIA

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ABSTRACT

The study appraised the effect of cassava-based technologies on the socio-economic status of farmers in Imo State, Nigeria. Using the multistage sampling procedure, 144 farmers were randomly selected from two of the agricultural zones in the State, namely, Owerri and Okigwe. Data were collected using the structured interview schedule and analysed with the aid of descriptive statistics like percentages. Results show a high level of awareness for all the technologies except TMS 4(2) 1425. There was, generally, low level of adoption of the technologies. Only TMS 30572, NR 8082 and cassava/maize/melon intercrop had adoption levels of 60% and above. These technologies enabled the farmers feed their households, pay children's school fees, purchase clothes, acquire landed property and pay medical bills. There is, therefore, need to identify and address the factors constraining increased adoption of these technologies by farmers in Imo State.

Keywords: Cassava varieties, technologies and Imo State

INTRODUCTION

The main purpose of developing relevant agricultural technologies is to improve the livelihood of the end-users (Ironkwe, 2011). This necessitates the need to carry out impact studies some years after the technologies have been disseminated to assess the extent this purpose is being achieved. National Root Crops Research Institute (NRCRI), Umudike, has disseminated several technologies on root and tuber crops production. This action is geared towards increasing the productivity and income of the farmers to enhance their standard of living. This study was, therefore, conducted to ascertain the adoption level and assess the effect of the cassava-based technologies on the socio-economic status of the farmers in the South-east agro-ecological zone of Nigeria to whom the technologies were disseminated.

METHODOLOGY

The study was conducted in Imo State, Nigeria. Using the multistage sampling procedure, 144 farmers were randomly selected from two of the agricultural zones in the state, namely; Owerri and Okigwe. Data were collected using the structured interview schedule and analysed with the aid of descriptive statistics like percentages.

RESULTS AND DISCUSSION

Levels of awareness and adoption

As shown in Table 1, all the technologies except TMS 4(2)1425 (29.86%), had high levels of awareness. Cassava variety NR 8082 had the highest (98.61%) level of awareness. This was followed cassava/maize/melon intercrop (95.14%), cassava variety TMS 30572 (93.06%), cassava/maize/cocoyam intercrop (76.34%) and cassava/maize/melon/okro intercrop (73.56%). Others were odorless fufu (69.40%) and cassava flour (61.07%). With regard to adoption; the greatest (93.75%) proportion of the respondents adopted cassava variety NR 8082. Followed by cassava/maize/melon intercrop (79.18%), TMS 30572 (65.99%), TMS 4(2)1425 (65.00%), cassava/maize/cocoyam (53.50%), odorless fufu (53.50%) and cassava flour (50.73%). The least adopted was cassava/maize/melon/okro intercrop (44.48%). This means that high level of awareness does not necessarily entail high level of adoption. TMS 4(2)1425 which had the least (29.86%) level of awareness had adoption level of 65.00%, whereas cassava/maize/melon/okro intercrop with awareness level of 73.56% had the least (44.48%) level of adoption.

Socio-economic benefits

Table 2 revealed that the adoption of cassava-based technologies disseminated to the farmers helped to their socio-economic status in terms of provision of food, money and employment. Most of these technologies provided both food and money; none of them provided solely food or money. Subsequently, TMS 30572 provided food and money to all (100.00%) the respondents who adopted it. NR 8082 provided both food and money to 90.91% of the respondents and cassava/maize/melon intercrop to 73.56%. Similarly, TMS 30572 provided employment to 90.91% of the respondents, NR 8082 to 70.79% and cassava/maize/melon intercrop to 69.40%.

Tangible achievements through the cassava-based technologies

Table 3 showed tangible achievements made by the respondents through the adoption of the technologies. About 90% of the respondents had adequate food for their families through these technologies, 80.60% were able to take care of their children's education, 73.60% purchased clothes while 70.00% were able to acquire new property. The cassava-based technologies were able to help 69.40% of the respondents provide medicare to their families and 56.70% were able to purchase vehicles (cars and motorcycles) while 50.70% were able to purchase radios and televisions.

CONCLUSION

There was high level of awareness in almost all the technologies except in TMS 4(2)1425. However, this high level of awareness could not be translated into corresponding high adoption levels as most of the technologies recorded low rates of adoption. This result is in agreement with Ekwe *et al.* (2009) and Ironkwe *et al.* (2009). The adopted technologies had relatively significant effects on the socio-economic status of the farmers in the study area. It is recommended that increased efforts be made by the extension agency in the zone to enhance adoption of these technologies through intensive promotional campaigns. Other factors limiting adoption of the technologies should be identified and addressed to increase adoption.

Table 1: Distribution of respondents according to levels of awareness and adoption of improved cassava-based technologies

Technologies	Not aware	Aware	Not adopted	Adopted
TMS 30572	6.94	93.06	34.01	65.99
NR 8082	1.40	98.61	6.25	93.75
TMS 4(2)1425	70.14	29.86	35.00	65.00
Ca/Ma/Me	4.86	95.14	20.82	79.18
Ca/Ma/Me/Ok	26.40	73.56	55.52	44.48
Ca/Ma/Co	23.61	76.34	46.50	53.50
Odorless fufu	30.56	69.40	46.50	53.50
Cassava flour	38.90	61.07	49.27	50.73

Table 2: Distribution of respondents according to socio-economic benefits from the technologies

Technologies	Food only	Money only	Food-Money	Employment
TMS 30572	96.50	100.00	75.65	90.91
NR 8082	1.40	0.00	90.91	70.79
TMS 4(2)1425	3.50	0.00	29.37	5.55
Ca/Ma/Me	11.10	2.10	73.56	69.40
Ca/Ma/Me/Ok	4.20	4.90	38.17	12.50
Ca/Ma/Co	5.55	0.70	42.33	15.27
Odorless fufu	3.50	2.80	22.21	13.20
Cassava flour	1.40	1.40	20.82	9.72

Table 3: Distribution of respondents according to tangible achievements made by using the

Variables	Percentage
Provision of food	90.40
Children's education	80.60
Purchase of clothes	73.60
Acquired new property	70.00
Provision of medical care	69.00
Purchase of land	39.86
Purchase of radio/television	50.70
Purchase of motorcycles and bicycles	56.70
Acquired new titles	27.97
Built houses	26.57

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INFLUENCE OF APPRAISAL ON EMPLOYEE PERFORMANCE AMONG AGRIBUSINESS FIRMS IN ABIA STATE, NIGERIA

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ABSTRACT
This study analysis the influence of performance appraisal on employee performance among agribusiness firms in Abia State, Nigeria. Multistage sampling technique was employed in the selection of the locations (Abia, Ohafia, Umuahia Agricultural Zones) and a sample of 120 respondents. Correlation analysis was used to analyze and predict the relationship that exists between performance appraisal exercise and employees performance. The outcome posts a weak and inverse correlation relationship (-0.167) at 10% level of probability. It is an indication that the exercise makes an impact of approximately 17%, with both variables moving in opposite directions, suggesting that performance appraisal has negative effect on employee performance. This could be probably because the appraisal system in use was secret. It is recommended that management should replace secret appraisal system with open approach to show more transparency and also encourage team work through policy reengineering.
Keywords: Appraisal, Performance, Employees and Agribusiness Firms

INTRODUCTION
Organizations are very concerned about the development and orientation of their employees in a bid to enhance their productivity. This concern is hinged upon the realization of the fact that, organizations can only win a competitive advantage through people especially in the face of stifling competition for scarce resources (Obisi, 2011). The implication is that organizations can grow to the extent of quality of skill and knowledge of the people who work in them. In this regard, an organization is expected to encourage shared vision between itself and the employees by continuously reviewing and improving the knowledge and skills of the employees. In the same vein, they should recognize individual efforts and contributions through rewards, incentives and conducive working environment. A shared vision is such that convinces the employees that the success or failure of the organization is same as theirs. According to Zafron et al (2009), it may be possible to get all employees to reconcile personal goal with the organizational goal, thereby increase productivity. Employee performance appraisal is the act of evaluating performance during a given performance period to determine how well an employee has performed relative to agreed objectives or goals. It is a process that examines the record of outcomes of a specific job function or activity within a specified time frame (Bartol et al 1998), as to ascertain the degree at which they accomplished their work requirements (Milkovich and Broudereau, 1999). The essence is to identify employee requirements or needs with the objective to help him perform efficiently and effectively. Organizations may employ open, secret or open/secret appraisal methods. However, the present study showed that majority of the firms used secret evaluation method. Performance appraisal has become popular among organizations and employees of labour. It is considered as an important aspect of human resources management and a part of control process in administration (Kavassishal, 1999). Many organizations spend a lot of resources annually on this exercise with a view to achieve a high organizational culture standard of performance (Cumming, 1972). According to Mirsepassi (1998), the present appraisal system is window-dressing and may not lead to expected result. It wastes the managers' time as a mere formality. Many managers are incapable of managing the appraisal system resulting into even creating more problems in job assignment, promotion, transfers or dismissal, and inability of the appraiser to conduct free and fair appraisal exercise (Zarra zacheh, 1997). Among managers and employees, there is a mistrust of the system as some managers see it as a threat to their position, while many employees do not believe in it (Igwe, 2012). In 2006, Nigeria introduced performance appraisal system into the civil service with a view to enhance productivity of employees. A report on the implementation of staff appraisal in 2008 on the progress made and challenges faced upon introduction of the appraisal system into the state civil service was released. It highlighted the challenges the appraisal system is facing but fails to provide findings on the impact of the exercise on staff performance. Other reports and studies on performance appraisal system provide unclear indication on the impact of performance appraisal system on staff performance. From the forgoing, it is obvious that there is a controversy over the performance of the appraisal system. Available information on the performance of the system shows efforts made on introducing the system, the challenges and benefits of the system. However, little or nothing has been done to empirically verity the impact of performance appraisal system on employees performance. This study therefore investigates if any relationship exists between performance appraisal and employees performance.

METHODOLOGY

The study employed multistage sampling technique to obtain data from respondents within the 3 agricultural zones of Abia State (Aba, Ohafia, Umuahia). From a population of 210 agribusiness firms, 40 were randomly selected irrespective of their investment capacities. This gives a total of 120 respondents. The study employed Spearman's Rank correlation analytical tool for to analyze the stated hypothesis: Performance appraisal has no significant effect on employees performance, while descriptive statistics was used to analyze and determine the type of appraisal system that is in use.

$$r^2 = \frac{\sum 1-6ED^2}{N(n^2 - 1)}$$ where: r^2 = rank correlation efficient

$\sum$ = summation
D = Difference between ranks of corresponding pairs of X and Y
Xi = performance appraisal (confidential = 1, semi-secret = 2, open = 3)
Yi = employee performance proxied by remuneration ranked into low, medium and high incomes.
N = number of respondents.

RESULTS AND DISCUSSION

In addressing the objective on the effects of performance appraisal on employee performance, Spearman's correlation analysis was used and the result is as presented in the Table 1. The result showed a correlation coefficient of -0.167 and significant at 10% level of probability. The coefficient portrays a weak negative correlation; it implies that performance appraisal exacts a negative effect on employee performance. In other words, both variables tend to change together in the opposite directions. The use of confidential evaluation system by the majority of the agribusiness firms is not a healthy trend because it demoralizes the workforce and creates room for feeling of dissatisfaction. This might have contributed immensely to low output and productivity observed in the agribusiness sector. Field work data collating and interpretation shows that majority of the firms adopted the confidential (secret) appraisal system.

CONCLUSION

Open appraisal system is recommended. This gives employees opportunity to assess their performance with their supervisors. Or even comment on their scores for a senior manager to look into. Managers should be transparent, set and maintain a good cultural standard that will instill confidence in the system and create a learning organization within the firms. This is achievable through policy reengineering.

Table 1: Effect of performance appraisal on Employee performance

Performance Appraisal		Employee	Performance
PA	Spearman's correlation	1	-0.167*
	Significance (2-tailed)		0.069
	N	120	120
EP	Spearman's correlation	-0.167*	1
	Significance (2 – tailed)	0.069	
	N	120	120

Source: Field Survey, 2013
*= @ 10% significant level **=@5% significant level ***1% significant level

Table 2: Distribution of appraisal system available in the study area

Appraisal system	Frequency	Percentage (%)
Confidential	60	50.00
Semi-secret	42	35.00
Open	18	15.00
Total	**120**	**100.00**

Source: Field Survey, 2013

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DETERMINANTS OF REPAYMENT PERFORMANCE AMONG WOMEN FARMERS IN BENDE LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

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ABSTRACT
This study investigated the determinants of loan repayment performance among women farmers in Bende local government Area, Abia State, Nigeria. Primary data were collected from 100 women farmers who accessed loan in Institutional credit through purposive and random sampling techniques; tools used for the analysis were descriptive statistics such as mean, percentage, frequency, table and multiple regression analysis. The result of the socio-economic characteristics of women farmers' shows that 93.0% within the age range of 30-60years are energetic and active productive work force, 52.0% of women farmers are married, had a moderately mean household size of 6 persons per household. About 97.0% of the women had formal education and 76.0% had between 11-20years of farming experience. They had small farm sizes (87.0%), low monthly income (50.0%) and without collateral (68.0%). Regression results reveal that the coefficients of loan amount and distance were directly related to loan repayment at 1% level and education and farm income at 5% and 10% level respectively. the coefficient of age had an indirect relationship with loan repayment at 1% level. The study therefore recommends that Government should review policies that will improve the level of Education in the Rural Area thereby enhancing the level of awareness of loan repayment, also the income of farmers should be considered when the giving out credit in order to ensure repayment.
Keywords: Loan Repayment and women farmers

INTRODUCTION
The Nigerian economy is still predominantly agrarian and women are key players in the business of agriculture especially with rural women in agricultural production and processing. Traditionally, capital for investment in agriculture comes from two potential sources, namely personal savings of the farmers and farm credit borrowing. Henri-Ukoha *et al.,* (2011), noted that farmers are expected to pay the principal with the accompanying interest on their basis of their repayment performances. It is important that borrowed funds be invested for productive purpose and the additional income generated, be used to repay loans to have sustainable and viable production processes and credit institutions. However, failure by farmers to repay their loans on time or to repay the loan at all has been a serious problem faced by both agricultural credit institutions and small holders who have limited collateral capabilities. The problem of poor repayment of credit by rural women has been confirmed by various authors. Lawal *et al.,* (2009) noted that poor repayment of farm credit creates set back to productivity of rural women. Nto and Mbanasor (2008) observed that the ability of borrowers to repay amount of loans collected is crucial for the long term subsistence of the credit institutions. The renewed focus on agriculture as holding the key to national development in the face of an uncertain and vulnerable oil economy possess a compelling challenge to the rural farmer especially women farmer's access to institutional facilities and their full participation in sustainable agricultural development. Inadequate repayment capacities of farmers are believed to have significant negative consequences to aggregate technological adoption, agricultural productivity, food security, nutrition and health. Many studies have tried to examine loan repayment performance of many social-economic groups considering the socio-economic and environmental peculiarities across region. It is the therefore necessary to evaluate women loan repayment capacity as such this study seeks to investigate loan repayment performance among women farmers in Bende L.G.A, Abia State, Nigeria.

METHODOLOGY
The study was conducted in Bende Local Government Area of Abia State. The Local Government is purposely selected as a study Area because it is noted for high number of women participation in agriculture. The local Government lies between longitude 7°38'E and $7^0$63'E and latitude $5^0$34'N and$5^0$56'N. They produce food crops like cassava, yam, plantain, pepper, melon and vegetables, cash crop such as goat are reared for subsistence and commercial purposes. A purposive and random sampling technique was used in this work. The list of credit institutions registered and functional in the area include; Statesman microfinance Uzuakoli, Item microfinance Item, First Bank Amaokwe Item and United Bank for Africa (UBA) all in Bende LGA. First stage; The list of women farmers beneficiaries from the four banks in Bende L.G.A were assembled. Second stage; Random sampling of 25 women farmers beneficiaries were selected from each credit institution. Third stage; the 25 women farmer beneficiaries make up a total number of 100 respondents. The study was analyzed using descriptive statistics such as means percentage, frequency and table and multiple regression analysis.

Model **Specification for Repayment**

$Y=b_0+b_1Z_1+b_2Z_2$----b_9Z_9+e …………………………………………………………………..(1)

Where;

Y=Loan repayment (N); Z_1=Age (years); Z_2=Educational level (years); Z_3=Household size; Z_4=Farming experience; Z_5=Loan amount; Z_5=Interest rate; Z_7=Farm Association (dummy; 1=yes, 0=no); Z_8=Farm income (N); Z_9=Distance to loan source (km).

RESULTS AND DISCUSSION

This is an indication that the women in the study area were mostly middle aged farmers. The implication is that they are energetic and within the active productive work force, younger people are more energetic and more likely to combine farm and off-farm projects. The active mean age and years can influence adoption of improved production practices, which invariably requires credit. About 52.0% of the women farmers were married, while 38.0% of them were single. This implies that the married women were more involved in farming and thus credit access in the study. Married women are usually involved in this regards as they how best to utilize credit in farming activities and also because of the need to supplement family means of livelihood. The Table also shows the distribution of the women farmers according to household size. Many (50.0%) of the women farmers had household sizes of between 6-10 members. This result implies that these respondents have moderate family sizes. This has implications on labour supply to the farming business to augment family labour with hired labour. In the absence of well-functioning labor markets, smaller households face higher labor bottlenecks at critical points in their business. The Educational level of the women farmers in Bende Local Government Area of Abia State as shown in Table reveals that many (40.0%) women had secondary school education while 3% of them had no formal education. However, 97% of the women farmers in the study area were literate with diverse formal educational levels ranging from primary school education to tertiary education. Literacy (ability to read and write) would enable the women farmers to better utilize effectively and efficiently available resources in the area especially credit availed to them for farm businesses and curtail frivolous spending. As expected, higher education would enhance improved business ideas, skills, innovation and managerial ability for business sustainability. The table also shows that majority(76.0%) of the respondents had between 11-20 years of farming experience, while 10.0% of them had farming experience of between 21-30 years while only 1.0% of the respondents had farming experience of above 30 years. This could be explained by the fact that active mean age and years of experience can influence adoption of improved production practices, which invariably requires credit. The result also shows that the women farmers in the study area were small scale subsistence farmers as they were operating on 1-2 hectares of land. Nigerian agriculture involves small scale farmers scattered over wide expanse of land area, with small holdings ranging from 0.5-3.0 hectares, and characterized by rudimentary farming systems, low capitalization, and low yield per hectare.

Table 2 showed that Double log functional form was chosen as the lead equation for the analysis based on the conformity with a priori expectation of signs, magnitude of coefficients, overall significance of the functional form (F –ratio) as well as the explanatory power of the variables (Adjusted R^2) included in the model. The result revealed that 5 out of the 9 variables were significant. These were age, education, loan amount, farm income and distance of the respondents to credit institutions. The result also shows that education denoted by the number of years of schooling had a positive sign and is significant at 5.0% level. This implies that the higher the education, the higher the loan repayment. Educated women farmers know the implication of loan default. Loan amount had a positive coefficient and is significant at 1.0% significant level. This suggests that loan repayment increases as the size of the loan increases. This is attributable to the advantages associated with economics of scale which emanates from expansion of productions and purchase of farm inputs. The annual farm income of the women farmers had a positive coefficient and is significant at 10.0% level. This is as expected because as farmers' annual income increases, enough income would be available for prompt repayment of the loan. Coefficient for age was significant at 1.0% and negatively signed, implying that the age of farmers had an inverse relationship with loan repayment. The older one gets, the lesser the repayment of the loan considering the fact that older people don't consider the implications of loan default. This is consistent with the findings of Nto and Mbanasor, (2008).

Table 1.0 shows that 7.0% of the women farmers were within the ages of 21 – 30 years while 38.0%, 42.0 and 13.0% were within the age range of 31-40 years, 41-50 years; and above 50 years respectively.

CONCLUSION

Repayment performance among women farmers in Bende LGA is affected by education level of women, loanable amount, annual farm income, age and distance to credit source. Government policy direction should be geared mainly towards rural female farmer education and secondly an increased loanable funds to ensure good repayment performance by the women farmers.

Table 1: Socio-economic characteristics of women farmers in Bende Local Government Area of Abia State

Variable	Frequency	Percentages
Age		
21 – 30	7	7.0
31 – 40	38	38.0
41 – 50	42	42.0
Above 50	13	13.0
Total	100	100
Marital status		
Single	38	38.0
Married	52	52.0
Widowed	7	7.0
Divorced	3	3.0
Total	100	100
Household size		
1 – 5	41	41.0
6 – 10	50	50.0
Above 10	9	9.0
Total	100	100
Education		
Primary	35	35.0
Secondary	40	40.0
Tertiary	22	22.0
No formal education	3	3.0
Total	100	100
Farming experience		
1 – 10	18	18
11 – 20	76	76
21 – 30	5	5
Above 30	1	1
Total	100	100
Farm Size		
<0.5	9	9.0
0.6 – 1.0	32	32.0
1.1 – 1.5	48	48.0
>1.6	11	11.0
Total	100	100

Source: Field Survey, 2016

Table 2: Estimated determinants of loan repayment/performance

Variables	Linear	Exponential	Double-log+	Semi-log
Constant	6.823	1.626214	-2.316	-4.937
	(0.549)	(3.349)**	(-1.149)	(-0.101)
Age	-0.013211	0.01	-0.966	9.779
	(-2.8925521)	(5.811)***	(5.162)***	(2.151)*
Education	2.332	0.331	0.0598	15.541
	(1.228)	(0.960)	(2.648)**	(2.829)***
Household size	-142.007	0.0045	2.004	-332.564
	(-1.330)	(0.103)	(1.032)	(-0.456)
Farming experience	3.647805	13340.86	0.359	8.657E05
	(3.60214501)	(1.829392)	(1.731)	(1.545)
Loan amount	0.699	2.88E-006	0.694	155.4
	(12.652)***	(4.703)***	(4.822)***	(7.833)***
Interest rate	0.018676	-697.626	-1.139	3.567E05
	(0.014296)	(-0.1059)	(-0.743)	(0.887)
Farming association	-0.61476	4063.548	0.123	-1.361
	(-0.37231)	(1.55707)	(1.128)	(0.026)
Farm income	13.3885	14960.35	0.765	0.0008
	(0.88653)	(1.003325)	(1.806)*	(1.731)*
Distance	66551.02	32105.66	0.845	1.640
	(9.050516)***	(8.418199)***	(7.798)***	(7.246)*
R^2	0.801	0.750	0.815	0.802
Adj. R^2	0.798	0.742	0.801	0.787
F-statistic	59.320***	122.302***	134.796***	54.550***
DW-statistic	2.608	2.260	2.618	2.654

Source: Field Survey, 2016

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RESOURCE USE EFFICIENCY OF CASSAVA FARMERS IN ATIBA LOCAL GOVERNMENT AREA OF OYO STATE

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ABSTRACT

The study assessed resource use efficiency of cassava farmers in Atiba Local Government Area of Oyo State. A two-stage sampling technique was employed to select 102 respondents as population of the study. Structured interview schedule was used to collect needed information from cassava farmers. Descriptive statistic was used to describe the socioeconomic characteristics of cassava farmers, budgetary analysis was used to determine the profit margin and Stochastic Production Frontier was used to ascertain the factors that influence technical efficiency of cassava farmers in Atiba Local Government Area of Oyo State. Budgetary result revealed that cassava production is profitable with Gross Margin of ₦34794.55/ha and labour cost constituted 81 percent of the total variable cost of production. Stochastic Production Function result revealed that hired labour and cost of fertilizer have positive significant influence on cassava output at 1 percent and 5 percent significant level respectively. The study recommended provision of machineries and tractors at a reduce hiring rate so as to serve as labour saving techniques in order to reduce the cost of production and improved cassava farmers' profitability.

Keywords: Efficiency, Resource Use and Cassava Farmers

INTRODUCTION

The world largest producer of cassava is said to be Nigeria with other top producers being Indonesia, Thailand, Democratic Republic of Congo and Angola (FAOSTAT, 2012). The large harvest of cassava in Nigeria is attributed to rapid population growth, internal market demand, availability of high yielding improved varieties of cassava tuber, and increase hectare of farm land allocated to cassava in the country. Broadly speaking, cassava growing belts falls within three agro-ecological zones in Nigeria which includes: southwest, southeast, and the north-central regions. Cassava is regarded as famine reserve crop which requires relatively low amounts of inputs (FAOSTAT, 2012).The crop can withstand stress such as drought as it can stay in the ground for several months (Adeyemo et al, 2010). Cassava is available all year round, thus providing household food security (Ogundari, 2007). Although cassava is cheap to cultivate, it can generate good income for peasant farmers (Amos, 2013). It is widely acknowledged that the scope for agricultural production can be expanded and sustained by peasant farmers within the limits of existing resource base and available technology if farm productivity is raised by efficient use of resources (Udoh, 2005). This exposition therefore, forms the fundamental point why the concept of farm efficiency has remained important economic study especially in developing agricultural economies like Nigeria, where resources are meager and opportunities for developing and adopting better technologies are dwindling. Efficiency analysis in agricultural production is generally associated with the possibility of farms producing a certain level of output from a given bundle of resources or certain level of output at least cost (Girei et al., 2014). Also technical efficiency implies the ability of a firm to obtain maximum output from the given inputs. It is the ratio of output to input and the greater the ratio, the more the magnitude of technical efficiency (Ogundari, 2007). However, Resources are said to be efficiently allocated when the value of marginal product of each resource equals its price (Udoh, 2005). Allocative efficiency of resource use is critical to enhanced productivity and incomes (Amos, 2013**)**. The major goal of any production system is the attainment of an optimally high level of output with a given amount of effort or input. Thus, efficient utilization of resources is also instructive in achieving broad-based economic and agricultural growth. Moreover, the term smallholder usually has embedded in it the connotation of limited land availability (Ogundari, 2007). Others sketch a broader view of 'resource poor' farmers, such as those with limited capital (including animals), fragmented holdings, and limited access to inputs. Govereh (2012) identifies eight major types of risks faced by smallholders including production risks, credit risks, income risks, labour and health risks, nutritional risks, price risks, vulnerability to unethical trading practices, and employment risks. In general, land holding is perhaps the most direct and easily introduced indicator of who smallholders' farmers are. FAO (2007) maintains that agriculture is predominantly on a smallholder basis in Nigeria, and about 90% of farm holdings are less than two hectares in size.

Thus, to assess the resource productivity of cassava farmers in Atiba Local Government of Oyo State is one of the prerequisites for increasing agricultural productivity in the study area. The main objective of the study is to investigate the resource efficiency of cassava farmers in Atiba Local Government Area of Oyo State.

METHODOLOGY

The study was conducted in Atiba local government area of Oyo state, Nigeria. It's headquarter is in town of Ofa-meta, it has an area of 1,757km² with an estimated population of 168,246 (2006 NPC). The study area comprises of ten (10) political and six (6) wards were selected randomly for the course of study. Eighteen (18) farming household were randomly selected from each ward to give a total of 102 respondents as sampling population. Primary data were collected with the aid of interview schedule from rural farming household in the study area. Data collected were summarized using mean, frequency count percentage and stochastic production function

RESULTS AND DISCUSSION

Table 1 show the budgetary result for farming system of cassava farmers in the study area. The total variable cost per hectare (TVC/ha) was estimated at ₦217568.8/ha with labour constituting the larger proportion (81 percent) of Total Variable Cost of production. Furthermore, the Total Revenue (TR), Gross Margin (GM) was estimated at 252563.30/ha and 34794.55/ha respectively in the study area. This implies that cassava farmers perform better in terms of Margin between total revenue and total variable cost. Table 2 revealed the parameter estimates of the production function of cassava farmers. The table showed that hired labour and cost of fertilizer have positive and significant influence on cassava output at 1 percent and 5 percent respectively. This was in line with Oladeebo and Oyetunde (2003) which reported that low levels of production in cassava production is associated with capital, labour, fertilizers usage, farm size, and cost of input. The variance parameter for sigma-square for cassava farmers was estimated at 0.322. The sigma-square attests to the goodness of fit and correctness of the distributional form of the model while the gamma revealed the systematic influences that are unexplained by the production function and the dominant sources of random error. This implies that about 32 percent of the variance in output of cassava farmers in Atiba L.G.A is due to the differences in their technical inefficiency.

CONCLUSION

The Stochastic Production Functions shows that about 32 percent of the variation in output of cassava farmers is due to the differences in their technical inefficiency. The study therefore recommends that government should provide agricultural inputs such as fertilizers, agrochemicals, tractors and labour at a subsidized level as this will equally enhances their production.

Table 1: Cost-Return structure of cassava farmers in the study area

Variables	Value (Naira)	% of Total Variable Cost
Revenue		
Value of cassava	252363.30	
Total Revenue	**252363.30**	
Variable cost items		
Cost of cassava cutting	12765.00	5.867
Cost of basket	1755.42	0.806
Pesticide	6468.75	2.973
Other agrochemical costs	4537.50	2.085
Cost of agro transportation	347.50	0.159
Cost of fertilizer	2262.50	1.039
Cost of harvesting	11432.50	5.254
Cost of cassava transportation	2744.62	1.261
Labour cost	175255.00	80.551
Total Variable Cost	**217568.8**	
Gross Margin	**34794.55**	

Source: Field survey, 2016

Table 2: Stochastic Frontier Production Function result of cassava farmers' productivity

Variables	Coefficient	Standard error	t-value
Constant	4.376069	0.779786	**5.61**
Farm size (X_1)	0.1103594	0.610881	1.81
Total labour cost (X_2)	0.0012380***	0.000932	13.33
Cost of fertilizer (X_3)	0.0000274**	0.000011	2.48
Agrochemical (X_4)	0.0000109	0.0000803	0.14
Planting material/input(X_5)	0.0000068	0.0000698	-0.13
Inefficiency Model			
Constant	28.60411	0.9939683	28.78
Sex (Z_1)	0.3572095	0.508874	0.70
Age (Z_2)	0.0033124	0.0228497	0.14
Education (Z_3)	-0.4853961	0.3041529	-1.60
Household Size (Z_4)	-0.0767725	0.0723489	-1.06
Farm Experience (Z_5)	-0.0143285	0.0401123	-0.36
Marital Status (Z_6)	-0.262717	0.3206662	-0.82
Diagnostic Statistics			
Stigma-square (δ^2)	0.322	0.613	0.53
Gamma (γ)	0.5369	0.3797	6.68
Log Likelihood	-312.34		
Chi Square	28.07***		

*** implies significant at 1 percent, ** implies significant at 5 percent

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ANALYSES OF LEVEL OF TECHNICAL EFFICIENCY AMONG CATFISH FARMERS IN ADAMAWA STATE, NIGERIA

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ABSTRACT
The study was on the effect of socio-economic characteristics on technical efficiency among fish farmers in Adamawa State, Nigeria. The objectives of the study were to: describe the socio-economic characteristics of fish farmers and determine the disparity of technical efficiency among fish farming in Adamawa State. Data were collected using structured questionnaire administered to 150 fish farmers who were sampled using snowball sampling techniques. Data were analysed using descriptive statistics and stochastic frontier production function. The socio-economic result shows that majority of the respondents are married, male civil servants who used their personal savings and were 40 years of age and above, are educated, has less than ten members in their household, provided most of the labour force on their farms and with extension contact more than twice per production circle. The stochastic frontier analysis revealed that the mean technical efficiency is 0.80. The study recommends that; youth and women should be engaged in fish farming, inputs should be supplied at subsidized rate and credits facilities should be provided to fish farmers.
Keywords: Socio-economic, Technical efficiency and Fish farming

INTRODUCTION
Fish farming development at the global level has been viewed as a measure of improving food security and as a means of supplementing income for low income earners. In many countries, particularly in Sub-Sahara Africa, fish farming is almost entirely for subsistence, with little surplus production being sold at farm gate. In Africa; economic analysis in aquaculture is a relatively recent practice and not much work has been reported on its technical, social and economic impacts (FAO, 1996). Meanwhile, various studies as cited by Filli, (2011) confirmed the relative technical efficiency of aquaculture in Nigeria even in the present economic settings. Government investment with demonstration farms has been inconsistent and evidence of inadequate planning and lack of adequate commitment abound in every fish farming business embarked on. It is now left for private sectors and individual farmers to determine the efficiency and potentials of the business (Igun, 1997). Aquaculture is also considered to be a contributor to rural development and poverty reduction as it forms an important component within agriculture and farming systems development through employment, income provision, protein supply, poverty alleviation, food security etc (Asche and Khatun, 2006). Making cultured fish more readily available for Nigerian consumers will give them faster and fresher access to one of the healthiest sources of animal protein. Meanwhile, supplying high-grade fish with strong nutritional content is a challenge for many farmers today. Quality fish requires quality fish feed, which is expensive for farmers to purchase; processing fish to meet diverse market demands depends on farmers having the correct technical and economic knowledge in addition to investment capabilities. Fish culture will not only helps generate jobs and revenue, but also help to meet requirements for food security and improved nutrition; especially for adult population (USAID, 2013). Studies on production efficiency of economic agents have long been of interest to agricultural economist. Much empirical work has centered on imperfect partial measures of productivity, such as yield per hectare or output per unit of labour (Coelli and Battese, 1995). The Parametric Stochastic Frontier Production Function Approach (Meeusen and Van dan Broek, 1977 and Aigner *et al.*, 1997) and the non-parametric mathematical programming approach commonly referred to as Data Envelopment Analysis (DEA). The parametric approach relies on a parametric specification of the production function while the non -parametric approach imposed non-a priori parametric restriction to the underlining technology (Adewuyi and Okunmadewa, 2001). Therefore, the need for research of this nature to verify the profitability of fish farming in relation to efficiency of input-output and to forecast the output scale of fish farming in future.

METHODOLOGY
The study was conducted in Adamawa State, Nigeria. Adamawa State lies between Latitude 7^0 and 11^0 North of the Equator and between Longitude 11^0 and 14^0 E of the GMT. The state has two major seasons (wet and dry) wet season commences in April and ends in late October, while the dry season starts in November and ends in April. The mean annual rainfall of the area is about 1000mm (Adebayo, 1999). The study area falls within the Northern Guinea Savannah Zone of Nigeria with 21 administrative local government areas, land mass of 2,310.05km^2 and a population of 3,178,950 which is projected to be 4,111,704 in the year 2016 at 2.9% yearly growth rate (NPC, 2006). The area is bounded by Taraba State to the south, Gombe State to the west, Borno State to the north and Cameroun Republic to the east respectively. There are a lot of fishing activities in the study area as one of the

major rivers in Nigeria (Benue) links with some major water reserves (Kiri, Njuwa, Chuchill, Yinagu, Chachelek and Gerio) located within the study area, also two large commercial farm (Gessedaddo and Sebore) are located in the state, where fish are harvested on relatively large scale. The peak period of fish harvest from the natural water bodies is in August-October, while in April-May it drops to its minimum harvest in which the dams (restricted fishing areas) occasionally open at such time for its fish capture. Common natural fish species around are Catfish and Tilapia. The wild fish are mostly harvested using fishing gears (nets and hooks). Most homestead fish-farmer harness period of low fish output from the natural (capture) source for their harvest. Data for this study was derived mainly from primary source which was collected with the use of structured questionnaire. Snowball sampling technique, was used to contact150 respondents for this study. The data was collected from across the state, majority collected from the urban and peri-urban areas of Mubi, Michika, Yola, Mayo-Belwa, Numan, Ganye and Guyuk. The analytical tools that were used in this study were Descriptive Statistics and stochastic frontier model.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The variation in the age classifies the active age group that can be easily engaged in the tasking agricultural activities. Table 1 shows the distribution of respondents based on their age. Majority (92.7%) of the respondents were under 60 years of age, while only 7.3% were 60 years and above. This is an indication that fish farming is dominated by working class individuals. The result in Table 1 showed that about 69% of fish farmers in the study area are male, while 31% are female. This implies that fish farming in the study area is usually undertaken by both men and women. This was attributed generally to gender biasness which set women behind men with access to agricultural assets, inputs and services as well as rural employment opportunities in developing countries. About 55% of the respondents are married, 22% single, 15% widows and 8% divorced. This shows that those that are married men are more in fish farming in Adamawa state than those with other marital status. This may be as a result of greater family responsibilities placed on household heads, such as feeding, clothing, healthcare, educating the younger dependents among others, which may not be the same for the non married category. About 75% of the respondents had six members or more in their household, while only 25% of them had less than six members in their household. The implication is that, respondents with large household size were more in fish farming in the study area to earn money to meet up with the regular demands of their household dependants. Table 1 pointed out the educational level of the respondents. It indicates that about 11% of the farmers had no formal education, 15% had primary education, 15% had secondary education and about 59% of the respondents had post-secondary education The, higher the educational level of a fish farmer the more technically efficient the farmer will be. This revealed that fish farming in the study area is mostly practiced by educated people, as almost all (89%) of the respondents had one form of formal education or the other. This also correlates with positive effect of education on fish farmers' technical efficiency. It therefore showed that fish farming requires some basic education to enable them acquire basic skills and training required for fish cultivation.

Experience exposes man's mistakes and suggests correction which increases efficiency and improve productivity and high yield. The more experience the farmer acquires, the more efficient and effective the farmers' activities. Table 1 shows the distribution of respondents based on fish farming experience. The study revealed that few of them (26%) had two years or less of experience in fish farming, while majority (74%) had experience of more than two years. This indicated that despite the fact that fish farming is a relatively new venture in the study area; most of the farmers had more experience. They were becoming conversant with fish farming practice at the time of this research. Their practice and management indicated relatively high efficiency. Occupation explains the time someone has for specific activity as it affects the productivity of every business. Fish farming is expected to compliment the main occupation of the fish farmers where the fish farming is not the primary occupation of the respondent. Table 1 outlined the main occupation of the respondents. It indicated that 54% of the respondents were civil servants, while businessmen were 12%, farmers were 14%, house wives were 11% and students were 9%. These may be due to the fact that most fish farmers in the study area were engaged in one occupation or the other to earn extra-income to aid them augments their salaries which is insufficient to carter for their dependants needs. In addition, the civil servants correlate with those that had higher education level indicating positive relationship between education and civil service. Meanwhile fish farming was not time demanding like other agricultural activities that civil servants can easily engage in. There is economic advantage and disadvantage of having one animal or more in terms of inputs utilization and maintaining output (protein supply). Some farm animals have some common inputs with fish. Table 1 shows the farm animals reared by the respondents, it revealed that majority (81%) of the fish farmers reared one animal or the other or jointly; poultry and livestock in addition to fish. Only 19% of them had no other animals. These suggested the comparative advantage of rearing more than one animal as they share some common resources (inputs) such as water, land, power, fuel etc and also, it sustain consistent in protein supply in the market.

Labour is employed based on quantity in terms of number and quality in terms of skills required for high efficiency and optimum output. Labour could be sourced from family, hired or both; this depends on the family size, as well as the quantity and quality of labour required. Table 1 shows the type of labour employed by the respondents. It shows that majority (67%) of the respondents used family labour, while 29% of them used hired labour for their fish farming. Only four percent (4%) used mixed labour. This is because labour requirement in fish farming was not tasking as compared to other agricultural practices. The most important thing in fish farming was management skills, constant attention and supervision, which most times, the household members were ready to do small scale production. Access to new innovations/technology, skills and modern inputs are linked mostly to extension services and training. The extension service could be through individual contact, group contact, focal persons or workshop. Other sources are through mass media; radio, television, news papers, internet services etc. Table 1 shows how respondents had contact with extension services. About 82% of the respondents had contacts with extension workers more than twice; only about 18% had once or twice contact with extension workers in a production cycle. This indicates that majority of the farmers had chances of adopting new innovations of fish farming skills through proper and formal extension service on fish farming practices as indicated in the result of technical efficiency; that extension services positively improve fish farmers performance. Access to funds gives the financial strength of every business which provides effective implementation of business plan and enhances productivity. Table 1 depicts the sources of capital used in fish farming, 46% of the respondents borrowed money for fish farming, while majority (54%) who are likely civil servants as reflected on the major occupation of fish farmers used personal savings for fish farming business.. However, the civil servant can plan to save a little from their monthly income for investment like this.

Technical Efficiency

In every production, each individual has his/her respective performance depending on personal technical efficiency of an individual which could be attributed to variation in social and economic characteristics. It also provides the mean and mode of the average efficiency in the study area. Table 2 shows the frequency distribution of Adamawa State fish farmers' technical efficiency (TE). It revealed that, 21% of the fish farmers had TE of 0.70 and below, 37% of them were on TE range of 0.71-0.80. The same percentage of fish farmers (37%) were on 0.81-0.90 and only about 5% had their TE 0.91 and above. This showed that majority (74%) of the fish farmers in Adamawa State were operating on 0.71- 0.90 TE. The mean technical efficiency of fish farmers was 0.80 (80%). This implies that the fish farmers were not fully efficient as their observed output was 20% less than the maximum output on average. Their efficiency can be increased by 20% through improved resource allocation and proper management with no additional cost. The arithmetic mode of the technical efficiency was 0.80 (80%) meaning that majority of the farmers had technical efficiency of 80%. The statistical range between the most efficient and the least efficient fish farmer was also large, 0.41 (41%), showing that the least efficient farmer will need 41% improvement to meet up with the most efficient fish farmer in Adamawa State. From these views, the study indicated that most of the fish farmers were 20% below the maximum output as a result of technical inefficiency. Meanwhile, the farmer with 0.98 (98%) efficiency is identified as '*model farmer'* operating at almost the frontier of the production in this study has seven years experience, attained tertiary education, he is fifty years of age, he had six contact with extension worker, he insured his farm and having eight people in his household,. Meanwhile, the farmers had an option of improving on their technical efficiency through experience, education, age, farm insurance and contact with extension worker in Adamawa State as it agreed with the work of Adeogun *et al.,* (2007); Kudi *et al.,* (2008) and Apata, (2012).

CONCLUSION

The study revealed that socio-economic characteristics such as education, age, experience, extension contact affects farmers technical efficiency and farmers had the potential of raising their production efficiency by 20% by improvement in resource allocation. Based on the findings of the study, the following recommendations were made. Farmers should improve on their socio-economic characteristics such as education, age, experience, extension contact so as to improve their technical efficiency. Training on new technology and awareness through cooperative groups on fish farming practice should be geared up, so as to encourage the practice.

Table 1: Socio-Economic Characteristics of Respondents

Item	Frequency	Percentage
Age (Years)		
≤ 30	16	10.7
31 – 40	32	21.3
41 – 50	63	42.0
51 – 60	28	18.7
> 60	11	7.3
Total	150	100.00
Mean Age	39.9	
Gender		
Male	104	69.3
Female	46	30.7
Total	150	100.00
Marital Status		
Married	82	54.7
Single	33	22.0
Divorced	12	8.0
Widowed	23	15.3
Total	150	100.00
Household Size		
1 – 5	38	25.3
6 – 10	91	60.7
11 – 15	13	8.7
Above 15	8	5.3
Total	150	100.00
Mean Household Size	6.87	
Educational Level		
No formal education	17	
Primary school	22	11.3
Secondary school	23	14.7
Post Secondary school	88	15.3
Total	150	58.7
Experience (Years)		100.00
≤ 2	39	
2.1– 4.0	53	26.0
> 4	58	35.3
Total	150	38.7
Mean Farming Experience	3.7	100.00
Labour Source		
Family	101	67.3
Hired	43	28.7
Both	6	4.0
Total	150	100.00
Number of extension visit		
≤ 2	27	18.0
3-4	22	14.7
> 4	101	67.3
Total	150	100.00
Mean Extension service	4.0	
Source of fund		
Saving	81	54.0
Credit	69	46.0
Total	150	100.00

Source: Field Survey, 2013

Table 2: Frequency Distribution of Catfish Farmers by their Technical Efficiency in Adamawa State

Range of TE		No. of Respondents	Percentage
≤ 0.70		32	21.3
0.71 – 0.80		56	37.3
0.81 – 0.90		55	36.7
> 0.90		7	4.7
Total		150	100.00
Minimum (a)	0.57		
Maximum (b)	0.98		
Mean	0.80		
Mode	0.80		
Median	0.78		
Range (b-a)	0.41		

Source: Computer Output from Frontier Analysis, 2013

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ECONOMIC ANALYSES OF IRRIGATED SPINACH PRODUCTION IN LANGTANG NORTH LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA

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ABSTRACT
This study analyzed the economics of irrigated spinach production in Langtang North Local Government Area of Plateau State, Nigeria. The study estimated cost and returns and input and output relationship of spinach farmers in the study area. Spinach farmers were randomly selected and 81 questionnaires were distributed. Results were analyzed using cost and return and production function model. Result on cost and return analysis revealed that gross revenue/ha was (₦93,818/ha) with a total cost/ha of (₦67,246/ha) while a gross margin/ha was (₦26,572/ha). The result from production function revealed that seed and labour had positive coefficient and significant at 1% level of probability while herbicides have negative coefficient and significant at 1% level of probability. The results call for policies aimed at provision of improved seeds to farmers at subsidized rates and efficient utilization of herbicides for increased production.
Keywords: Irrigation, Spinach and Economics

INTRODUCTION

Irrigation has a positive effect on the sustainable agricultural development because it can reduce the amount of land to produce a given amount of food (Ingawa (2005). This is because it leads to rapid agricultural land expansion in the face of scarcity of farm lands with the associated damage of natural soil and wastage of water resources (Ibekwe and Adesope (2010). For Nigeria to increase its staple and export food crops, it has to increase its irrigated area. Nigeria needs to utilize its agricultural and water resources fully to meet domestic food demand while expanding production of export crops. The accomplishments of this means, more irrigation areas and irrigation schemes have to be developed. Vegetable (in this context spinach) are the most important and extensively cultivated food and income generating crops in many part of Africa (Adebisi et al., 2011). According to (Mohammed, 2002), it can give high yield per unit area of land and hence generate high income for the farmers. Growing vegetables is particularly suited for small-scale farmers and their families because of their limited resources (Sabo and Dia, 2009). Spinach (Amaranthus spp) is one of the leading green leafy vegetables in Nigeria. Spinach takes an important place in the population diet because of its affordability and the nutrient it provide. It is often grown and consumed in rural, urban and peri-urban areas in Nigeria. Therefore, the broad objective of this study is to examine the economics of irrigated (Spinach) production in Langatang North Local Government Area.

METHODOLOGY

The study was carried out in Langtang North Local Government Area of Plateau State. It is located at Latitude 9^0 and 8′N, and Longitude 9^0 and 7′E. The area has an annual rainfall of 23mm with average monthly temperature range of 15 - 32°C. The cold, dry and harmattan make the month of December to January averagely cold while the month of March and April record high temperature. The people are predominantly peasant farmers growing various crops such as guinea corn, vegetables, millet, rice, maize etc. A multistage sampling technique was conducted in three (3) districts out of four districts that have highest population of vegetable spinach production in the area .One village was chosen from each of the three (3) districts selected. This is based on the number of population of the farmers cultivating vegetable spinach; the villages include Zamko, Kuffi, and Dadur. Based on the population of the villages 15% of the population was used to determine the number of respondent in order not to be bias. This gave a total of (81) questionnaire which was used in the study area. The primary data used in the study were obtained from 81 spinach producers based on the population within the villages with the use of structured questionnaire. This structured questionnaire was used to collect data from the farmers during 2014/2015 season. Data were analyzed using net farm income and production functions model.

Model specification

Net Farm Income

The farm budget techniques were used in this study, the tool the Net farm income is expressed as follow.
NFI = GF1-TC
Where:
NFI = Net Farm Income, GFI =Gross Farm Income, TC= Total Cost
The variable used include,
Seed (W/kg), Labour (Man per day) ,Fertilizer (₦/kg),Land Rent (₦/ha),Herbicide (₦/Litre)
Fixed Cost

Depreciation on Implement (₦), Pumping machine (₦)

Production Function

This tool was used to know the nature of production of spinach in the study. In implicit form, the model is presented as follows:

$Y = f(Y_1, Y_2, Y_3, Y_4, Y_5) + e$

Explicit form of the mode can be expressed as :

Double log Function:

$Log = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + \log_5 \log X_{5+} e$

Model Specification:

X_1=Seed (kg),X_2 =Labour (Man/day),X_3=Fertilizer (₦/kg),X_4=Herbicide(₦/Lt),X_5=Capital(₦),e=error term or disturbance term

Where:

Y=output, a=Constant, b= regression coefficient, e=error term

RESULTS AND DISCUSSION

Cost and Return analyses for Spinach Production

The total costs of production include the fixed and the variable costs. The total variable costs consist of the labour seed, fertilizer, pesticides, fuel and weeding. While total fixed costs consist of land used value and depreciation non water pumps used. The variable cost stood at (₦ 25746) respectively (₦748) of the total cost while the remaining (₦ 42,248) constituted the fixed cost as in the table. The fertilizer cost constituted the highest fraction of (12.47%) followed by labour cost which stood at (9.09%) while chemical hand the lowest percentage of (2.2%) under dry (irrigation) season production of less weed intensity. The total fixed cost stood at about (₦41, 500).Gross revenue was (₦93, 818), total cost of production was (₦67, 246) and Net farm income was (₦26572) while return per naira invested was (1.39). This implies that production of spinach (irrigated) is profitable in the study area.

Production Function for Spinach

The production function analysis gives the physical or technical relationship between inputs and output in any production scheme or process (Olukosi and Erhabor, 1999). This tool is used to examine the nature of production function in production of spinach in the study area. Double log production function was the lead equation out of the four fitted and was estimate the Coefficient of the inputs utilized by spinach formers. The result in Table 2 shows the coefficient of multiple determination of 0.650 implying that 65% of the variation in spinach output was accounted for by the inputs included in the model. Out of the variables only three variables were significant which includes seeds, family labour and Herbicides. **Seeds:** This variable had positive coefficient (1.539) and significant at 1% level of probability. The implication of this finding is that a unit increase in this input implies a unit increase in output. This agrees with (Goni et al., 2013). **Labour:** This variable has a positive coefficient (32.388) and significant at 1%level of probability. This implies that a unit increase in labour results to an increase in the production output.

Herbicides: This variable has a negative coefficient (- 0.951) and significant at 1% level of probability. This negative sign suggest an inverse relationship with output production. This may be due to the fact that the farmer used a wrong application of input.

CONCLUSION

The results call for policies aimed at provision of improved seeds to farmers at subsidized rates and efficient utilization of herbicides for increased production.

Table 1: Cost and Return Analysis on Spinach Production

Items of Cost/Return	Amount (₦/ha)	Percentage (%)
Variable Cost		
Fertilizer	8,390	13
Labour	6,115	9
Chemical	1,480	2
Seeds	7,013	10
Fuel	2,000	3
Land rent	748	1
Total Variable Cost	**25,746**	
Fixed Cost		
Implement	3,500	5
Pumping Machine	38,000	57
Total Fixed Cost	25746 + 41500	
TC = TVC + TFC	= 67, 246	
Total Return	= 93,818	
NFI (TR - TC)	= 26,572	
Rate of Return ($^{TR}/_{TC}$)	= 1.39	

Source: Field Survey, 2015.

Table 2: Result of Spinach Production in Langtang North LGA

Variables	Regression Coefficient	Standard Error	T – Values
Constant	9.561	3.225	2.96*
Seeds (X_1)	1.54	0.501	3.07*
Labour (X_2)	32.38	12.08	2.67*
Herbicide (X_3)	-0.95	0.27	3.52*
Fertilizer (X_4)	8.70	7.70	1.13^{NS}
Capital (X_5)	20.73	7.71	2.68*

R^2 = 0.650
* = Significant at 1% level of Significant
NS = Not significant
Source: Field Survey, 2015

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BENEFIT-COST ANALYSES OF SAMMAZ 15 MAIZE VARIETY AMONG FARMERS IN RIYOM LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA

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ABSTRACT
The study was carried out in Riyom Local Government Area of Plateau State, Nigeria, on the benefit-cost analysis of Sammaz 15 maize variety. Data was obtained from 70 maize farmers through the use of structured questionnaires. The data collected were analyzed using benefit-cost model. The result of the study shows that benefit – cost ratio is greater than one (1). The major constraints faced by respondents are; inadequate capital, inaccessibility to credit, high cost of inputs, inadequate extension contact, and high cost of labour. It is recommended that cost of inputs should be subsidized and efforts should be made to make credit accessible to farmers. Furthermore, number of extension agents should be increased to introduce Sammaz 15 variety to farmers, and an effective input supply system which would sustain the expansion of maize output by farmers in the study area should be put in place.
Keywords: Benefit-cost, Sammaz 15, Maize production and Plateau state

INTRODUCTION

About 70% of Nigeria's estimated population of 140 million lives in the rural areas. Although Nigeria is Africa's second largest economy (after South Africa) with a GDP of about US $40.0 billion, yet, about two-third of the population live below the national poverty line (FGN 2008). It is an irony indeed that Nigeria, a vast agricultural country "endowed with substantial natural resources" which include: 68 million hectares of arable land; fresh water resources covering about 12 million hectares, 960 kilometers of coastline and an ecological diversity which enables the country to produce a wide variety of crops and livestock, forestry and fisheries products (Shaib, *et. al*., 1997) should find itself in the group of low-income food-deficit countries (LIFDCS) in Africa. It is clear therefore that the country has not been able to harness its vast natural resources for sustainable agricultural development. This has been aptly captured in the National Food Security Program document, which is the most recent and authoritative policy statement by the Federal Government on the state of the nation's agriculture. According to the Government (FGN,2008), although "agriculture remains a key component of the country's economy, currently contributing about 40% of the GDP and employing about 70% of the active population, the sector has significantly underperformed its potential". This has been clearly manifested in the very high food prices nationwide, food insecurity both at the household and national level and malnutrition especially in children. Thus the agricultural production and food situation in the country today is anything but impressive. In spite of the potentials and prospects of producing food for home consumptions and export, achieving a balance between food and population growth is a serious problem in Nigeria today. This problem of production deficit and consequent decrease in per capital availability of food has resulted from the declining ability to produce enough food in the face of increasing consumption capacity. This situation has shown that Nigeria still manifest the typical symptom of a peasant agriculture where the farms are dominated by small scale farmers who are responsible for about 95 percent of total production (Shaib, *et. al.*, 1997).

Increasing agricultural productivity is considered as one of the major solutions to effectively addressing the current Nigeria food crisis. Maize is the most important cereal in Sub-Saharan Africa (SSA) and an important staple food for more than 1.2 billion people in SSA and Latin America. All part of the crop can be used for food and non-food products. In industrialized countries, maize is largely used as livestock feed and a raw material for industrial products. Maize accounts for 30-50% of low income household expenditure in Eastern and Southern Africa. However, heavy reliance on maize in the diet can lead to malnutrition and vitamin deficiency diseases such as night blindness and kwashiorkor (IITA,2013). Maize is also important source of income for smallholder farmers as well as enhancing the food security and reduction in the number of those suffering from hunger, hence the achievement of the MDG's, Maize also plays a key role in ensuring the environmental sustainability of bio-fuel production (NFIC,2013). Maize is one of the major staples in Nigeria. Report of a food consumption survey shows that maize was the most often consumed staples, with 20 per cent of the population eating it at least once a week (IITA, 2013). Current production is about 8 million tonnes and average yield is 1.5 tonnes /Ha. The average yield is low when compared to the world average of 4.3 tonnes /Ha; it is even low when compared to average yield from other African countries like South Africa, Mauritius and Egypt with average of 2.5 tonnes /Ha, 5.8 tonnes /Ha and 7.1 tonnes/Ha respectively (FAO, 2009). Thus, there has been a growing gap between the demand for maize and it supply. Despite the effort by the Nigeria government, to increase production, maize production still remains below demand (Remission, 2005). Also, the performance of maize in Nigeria and other African countries can be attributed to the fact that, bulk of the country's farm, over 90% is dependent on subsistence agriculture (small holder farmers) with rudimentary farming system, low capital and low yield per hectare (Olayemi, 1994 in Ogundari *et al.*, 2006). In Nigeria, like other developing country, food production is closely related to peasant or subsistence nature of agriculture which farmers have practiced for century and which has been handed over to several generations. The old fashioned agricultural system leads to low productivity and food shortage.

METHODOLOGY

The study was conducted in Ryom LGA of Plateau State, Nigeria. The LGA has a total land area of about 807km2 and a population of 131,778(NPC., 2006). Riyom LGA consist of three (3) districts namely Riyom, Bachit and Ganawuri, with two major ethnic groups (Berom and Aten). The LGA has boundaries with Kaduna and Nasarawa. Riyom lies on the Northern Guinea Savannah at longitude 9038'N and Latitude 8046'E. Multistage sampling procedure was used to draw sample for the study area. In the first stage, three (3) districts who are the major sammaz 15 maize producers were purposively selected: Riyom, Bachit and Ganawuri districts. In second stage, two villages were randomly selected from Riyom, and Bachit districts while two villages were randomly selected from Ganawuri district in Riyom LGA, based on the level of maize production. In the second stage, four (4) villages were purposively selected, namely; Atakar, Tse, Dong and Ganawuri these are the major maize producing villages in the study area. The third stage involved random selection of proportionate number of respondents from each of the selected villages in the study area. For all the four (4) villages, a set of seventy (70) questionnaires were administered on respondents.

Gross margin (GM)

i. Gross Margin (GM) Gross margin is the difference between the gross farm income and the total variable cost (Olukosi and Erhabor, 2008).

Therefore; GM = GFI – TVC

Where GM = Gross margin

GFI = Gross farm income

TVC = Total variable cost

Profitability Ratios

Profitability ratio is a class of financial metrics that helps investors assess a business's ability to generate earning compared with its expenses and other relevant costs incurred during a specific period. When these ratios are higher than a competitor's ratio or than the company's ratio from a previous period, this is a sign that the company is doing well (Okwu and Acheneje, 2011). Some examples of profitability ratios are listed and explained below:

ii. Benefit Cost Ratio BCR)

Benefit cost ratio or analysis is the term that either refers to helping to appraise, or assess the case for a project programme or policy proposal and an approach to making economy decision of any kind. From definition, the process involves whether explicitly or implicitly weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option.

Therefore; BCR = TR/TVC

Where TR = Total Revenue

TC = Total cost

Therefore; BCR = TR/TVC

Where

TR = Total Revenue

TVC= Total Variable cost

RESULTS AND DISCUSSION

Table 1 is a summary of the costs, returns and gross margin of sammaz 15 maize productions in the study area. The total cost incurred on fertilizer/Ha is ₦4,760 representing 17% of the total cost of production, the cost of agrochemicals is ₦6, 419/Ha representing 23%, cost of labour is ₦ 13,343/Ha representing 48%, cost of seed is ₦ 2,244/Ha representing 8% and cost packaging and transportation is ₦ 1,123/Ha representing 4%, cost of water is ₦ 4.61/bird representing 0.51%, transportation. The summation of these costs gave a total variable cost of ₦27, 889/Ha. This result shows that sammaz 15 maize farmers were efficient in production in the study area. The gross income obtained from maize production per hectare ₦84, 558/Ha. The gross margin per hectare is ₦ 56,669/Ha representing 67% of the gross income. The implication of this is that farmers involved in sammaz 15 production will survive in the short-run because the resources engaged in its production were efficiently utilized. This findings is consistent with Mukhtar, 2012) findings on the profitability of layer poultry production in Bauchi Local Government area of Bauchi State. The size and the positive value of the gross margin shows that the respondents were able to cover their operating costs with the level of gross margin obtained and had a sizeable proportion as return to management less the depreciation cost. The implication of this is that increasing the scale of sammaz 15 productions in the study area may lead to increased income and the profitability of this enterprise. However, it is important to stress here that income can still be improved upon with appropriate pricing, adoption of proper cultural practices and accessing low cost inputs through bulk purchasing by farmers' cooperatives. The Benefit – Cost ratio is one of the concepts of discount method of project evaluation. As a rule of thumb, any business with benefit cost ratio greater than one, equal to one or less than one indicate profit, break-even or loss respectively (Olagunju *et al*., 2007). The analysis of ratios in table 4 reveals that the Benefit cost ratio (BCR) was greater than one (3.03). It is also in agreement with the work of Emokaro and Ekunwe (2009) who examined the efficiency of resource-use among catfish farmers to be viable. Since the ratio (BCR = 2.90) it implies that sammaz 15 maize variety is profitable in the study area. It is therefore much possible to have higher value of BCR with increase in capitals and skilled labour.

CONCLUSION

From the findings of this study, it is concluded that sammaz 15 variety production in Riyom local government is profitable as indicated by the B-C ratio which is greater than one (1). However, performance of sammaz 15 maize variety can still be improved upon with appropriate pricing, adoption of proper cultural practices and accessing low cost inputs through bulk purchasing by farmers' cooperatives.

Table 2: Benefit-cost analysis of Sammaz 15 maize farmers

Cost	₦/Ha	%
Fertilizer	4,760	17.10
Agrochemicals	6,419	23.02
Labour	13,343	48.00
Seed	2,244	8.05
Packaging and transportation	1,123	4.03
Total Variable Cost(TVC)	**27,889**	
Gross Income	84,558	
Gross Margin (GI-TVC)	56,669	
Benefit Cost Ratio	3.03	

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CONSTRAINTS MILITATING AGAINST YAM PRODUCTION IN NKANU WEST LOCAL GOVERNMENT AREA OF ENUGU STATE NIGERIA

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ABSTRACT
The research was carried out in Nkanu West Local Government Area of Enugu State and it was designed to examine the constraints militating against yam production in the area. A multistage randomised sampling technique was used to select 90 respondents in the study area. Structured questionnaire was used to collect the data on, socio-economic characteristics of the farmers, and constraints to increased yam production in the area. The data was analyzed using descriptive statistics such as averages, percentages, frequency distribution table. It was generally observed that farmers in the study area were constrained by lack of essential infrastructures/amenities, lack of capital, absence of extension agent, use of improved varieties and incidence of pest on their farms. It was recommended that Farmers should be encouraged to form cooperatives, government should ensure that farm inputs such as improved yam varieties, fertilizers, tractors and agro-chemicals are made available to farmers at a highly subsidized rate and extension agents should assist yam to ensure that they use improved varieties
Keywords: Yam, Production, Constraints and Farmers

INTRODUCTION
Yams (Discorea species) are annually root tuber bearing plant with more than 600 species out of which six are socially and economically important in terms of food, cash and medicine (IITA, 2009). Some of its species are water yam (*Dioscorea alata)*, white yam (*Dioscorea rotundata*) and yellow yam (*Dioscorea cayanensis)* (FAO, 1998; Ike and Inoni, 2006; Zaknayiba and Tanko, 2013). Yam as a staple food crop is grown in tropical regions (Thouvenel and Fauquet, 1979) and mostly produced in the savannah region of West Africa, where rainfalls are divided into wet and dry seasons (Etejere and Bhat, 1986; FAO, 1998). Yams are the fifth most harvested crops in Nigeria, following after cassava, maize, guinea corn, and beans/cowpeas. More so, after cassava, yams are the most commonly harvested tuber crops in the country (NBS, 2012). Nigeria is the largest producer of the crop, producing about 38.92 million metric tonnes annually (FAO, 2008). Yam production in Nigeria has more than tripled over the past 45 years from 6.7 million tonnes 1961 to 39.3 million in 2006 (FAO, 2007). This increase in output is attributed more to the large area planted with yam than increase in productivity (Nwosu and Okoli, 2010). However, there has been a general decline in yam production in Nigeria over years. Madukwe *et al.* (2000), Agwu and Alu (2005) and International Institute of Tropical Agricultural [2009] reported that both area under yam cultivation and total yam output were declining. The decline in average yield per hectare has been more drastic, as it dropped from 14.9% in 1986-1990 to 2.5% in 1996-1999 (CBN, 2002, Agbaje *et al*, 2005 and FAO, 2007).In Nigeria, some of the constraints to yam production are unavailability of planting materials, soil degradation, poor handling and storability, pest and disease and other environmental factors (Ibitoye and Attah, 2012). Seed yam for cultivation has continued to be a problem for the farmers. The cost of producing yam is also observed to be higher compared with other tubers in the country. This is largely due to the high cost of seed yam. On the average, about 25% of the annual yam harvest is used as seed yam (Kushwaha and Polycarp, 2001). This situation has caused yam cultivation to suffer a severe setback due to high cost of production. Despite the importance of yams to people and as a source of food security, the attention to yam production is still questionable, as many rural dwellers are still living in hunger in Nigeria. The objective of this study includes to: describe the socio-economic characteristics of yam production in the study area, determine the effect of the socio-economic characteristics on farmers, estimate cost and return in yam production in the study area and to identify the constraints affecting yam farmers in the study area.

METHODOLOGY
The study area was conducted in Nkanu West Local Government Area of Enugu State. Nkanu West is one of the seventeen (17) local government areas that make up Enugu State. Nkanu west is made up of 37 Communities namely Akpugo, Amuri, Agbani, Akegbe, Amodu, Obuofia, Ozall at Obe. It's headquarter is at the town of Agbani. Nkanu West Local Government in Enugu is located in $6^0 18^1$ North, $7^0 33^1$ east greenish meridians; it has an area of 364km^2 (141.5%). It has a population of 146,695 according to the NPC (2006 census. Nkanu West share boundary with Udi LGA. A multistage random sampling procedure was used to select communities, villages and the respondent. In the first stage six communities were randomly selected out of the 37 communities namely

Akpugo, Amuri, Agbani, Akegbe, Ozalla, Obe, In the second stage, three villages were randomly selected from the six communities to make a total of 18 villages., In the final stage, five questionnaires were administered across each of the eighteen Villages to give a total of ninety respondents. Data collected were using descriptive statistics

RESULTS AND DISCUSSION

Socioeconomics Characteristics of Respondents

Table 1.0 show that 54.4 % of the respondents were female while 45.6% were male. This implies that women are very much involved in the yam production than their men counterpart. This is in agreement with Adesimi (1991) who stated that root crops in developing countries are essentially promoted by women.

Table 1.0: Frequency Distribution of Respondents according to Gender

Gender	Frequency	Percentage
Male	41	45.6
Female	49	54.4
Total	90	100

Source: field survey, 2015

Table 1.1 shows that 27.8% of the respondents were between the age of 50-59 years and 8.9 % were aged farmers while 20 and 30% of the respondents were youths in the study area. This shows that yam production enterprises are owned and managed by middle aged and young farmers. This is in agreement with O.E Okelola, (2011).

Table 1.1: Frequency Distribution of Respondents According to Age

Age	Frequency	Percentage
20	10	11.1
20-29	20	22.2
30-49	27	30
50-59	25	27.8
60-70	8	8.9
Total	90	100

Source: Field survey, 2015

Table 1.2 shows 50 % of the respondents have farm size of 1.00-1.99ha; this implies that half of the total respondents have less than 2.00ha of farm. This also implies that majority of the farmers in the study area are small scale farmers due to problem such as land ownership, capital, and absence of extension agents. This tend to affect the yield output on the farm..

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Table 1.2: Frequency Distribution of Respondents According to farm size

Size	Frequency	Percentage
Less than1.00ha	34	37.8
1.00-1.99ha	45	50.0
2.00-2.99ha	8	8.9
3.00-3.99ha	3	3.3
Total	90	100

Source: Field survey, 2015

Table 1.3 shows that 35.6% of the respondents indicated capital/incentives as their major problems, followed by lack of land ownership (13.3%), lack of essential infrastructures (18.9%) This is expected since most of the farmers are poor and lack funds for farming activities. Other constraints are Lack of Use of improved varieties, Land ownership, Incidence of Pests and Absence of extension agents which had 15.6%, 13.3%, 8.9% and 7.8% respectively,

Table 1.3: Frequency Distribution of Respondents According to major constraints

Constraint	Frequency	Percentage (%)
Lack of Use of improved varieties	14	15.6
Lack of essential infrastructure	17	18.9
Lack of capital /incentive	32	35.6
Land ownership	12	13.3
Incidence of Pests	8	8.9
Absence of extension agents	7	7.8
Total	90	100

Source: Field Survey, 2015

CONCLUSION

The result shows that yam production is carried out by women in the study area.. Yam farmers experience series of problems such as land ownership, lack of capital, absence of extension agent, use of improved varieties and incidence of pest on their farms. There is therefore a collaborative need to fight against these problems and make yam farming a more profitable venture in the study area. Based on the Research Findings, the Following Recommendations were drawn:

1. Government should ensure that farm inputs such as improved yam varieties, fertilizers, tractors and agro-chemicals are made available to farmers at a highly subsidized rate.
2. Farmers should be encouraged to form cooperatives. This is to enable them pool their resources together and have advantage of large economics of scale in their production.
3. Agricultural Extension agents should assist yam farmers with relevant documentations necessary to ensure financial assistance from banks or any other credit institution. Agricultural engineers should be encouraged by government to fabricate machines that are efficient, cost effective, available and affordable to farmers..
4. Access road should be provided by the government and through community effort in the rural areas. This would reduce transportation cost and improve buyer-seller relationship. Thereby enabling farmers to make regular sales.
5. Extensions Agents and farmers should visit yam fields regularly so that pests and disease can be controlled before they reach economic threshold.

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CONSUMERS' PREFERENCE FOR CONSUMPTION OF FROZEN FISH IN IBADAN NORTH-EAST LOCAL AREA, OYO STATE, NIGERIA

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ABSTRACT
The study was carried out in Ibadan North-East Local Govt. of Oyo-State in 2010. The objective of the study was to determine consumers' preference for frozen fish. Structured questionnaire was used to elicit the information from the respondents. Systematic sampling technique was used to select a total of 123 household respondents. Data were analyzed using descriptive statistics. The result of the study showed that most (79.0%) of the household were male and 21.0% were female. 62.7% of the household are within the middle age of 25., 85.5% of the respondents have post-secondary education. The result also shows that 22.6% of household consume Titus Fish while 75.8% consume other varieties of frozen fish. The results further revealed that 38.7% of the household consume Titus Fish twice in a week while 34.9% consume it daily. This indicates that majority of household prefer Titus fish to other Species. It was also shown that 53.3% of the household consume below 3kg of Titus Fish, 40.3% consume 3 – 6 kg and 6.4% consume more than 7 kg weekly respectively. About 75% of the sampled household size earned above ₦25,000 income from fish business monthly while 3.3% earned below ₦7500.The results of the study revealed that the respondents have small household size, they are low income earners and they consume an average of 3-6kg of fish weekly. Policy towards improving mass education of nutritional importance of fish and adequate support should be given to fish traders to enhance its production and availability
Keywords: Consumers, Preference, Consumption and Frozen Fish

INTRODUCTION
Nigerian aquaculture industries ranked second in Africa though, yet to reach the country's full production potential in terms of available natural, environmental and socio-economic factors (Ojo *et al*., 2006a). The contribution of aquaculture to total fisheries production rose between 7.38% in 1997 to about 10.11% in 2003 (Ojo et al., 2006b). Although the demand for fish has been rising rapidly as a result of increase in population, per capita income, and high prices of alternative sources of animal protein, Nigerians have to shift to the consumptions of fish which is mostly in fresh and frozen form. It is expected that with increasing aquaculture production and negative acceptability trend of frozen fish, perhaps consumer preference might shift towards the consumption of cultured fish (Ojo and Fagbenro 2004).Fish products are highly diversified in the sense that there are many species of edible fish and each species differs significantly from each other in terms of taste, price, production volume and location. Pieniak *et al*.(2008) reported that fish consumption is mostly affected by tradition and habit and the level of consumption is also enhanced by nutritional awareness. An increase in consumers' taste and preferences for a particular product tends to increase the quantity demanded for that product. Consumer's tastes and preferences affect demand for a given product and in measuring taste and preferences, only the qualitative impact on demand can be evaluated not the quantitative impact. There is a widening gap between production and demand due to inadequate demand information which is capable of hindering optimization of production and marketing in the fish production sub-sector (Ajana, 1999). This study therefore examines consumers' preferences for consumption of frozen fish with a view to developing a guide in the area of fish processing policy in Nigeria.

METHODOLOGY
The study covered the whole of Ibadan North-East Local Government. A total of 123 household respondents was selected using systematic sampling technique. The data for this study was obtained from primary sources. Questionnaire was the main instrument for data collection. It was however complimented with interview schedule. The analytical method for the research work is simply the use of descriptive statistic such as frequency count, percentage, mode and mean in measuring the socio-economic characteristics of the respondents and other variables.

RESULTS AND DISCUSSION
The result in table 1 shows that most (79.0%) of the household are male and 21.0% were female. 62.7% of the household are within the middle age of 25 and 50 years and household above the age of 50 are 28.0%. About 8.8% of the household population in the studied area is less than 25 years. It also shows that 75% of the sampled household size earned above ₦25,000 while 3.3% earned below ₦7500. 85.5% have post-secondary education ed This agrees with Ojo (2004) who stated demand for fish has been rising rapidly as a result of increase in awareness

due to educational background. The result in table 2 shows that 22.6% of household consume Titus Fish while 75.8% consume other varieties of frozen fish which include; stock, Herrings, Horse Mackerel (Kote) etc. The result in table 3 shows that 38.7% of the household consume Titus Fish twice in a week while 34.9% consume it daily. This indicates that majority of household prefer Titus fish to other Species. The result in table 4 shows that 53.3% of the household consume below 3kg of Titus Fish, 40.3% consume 3 – 6 kg and 6.4% consume more than 7 kg weekly respectively .This result is in consonance with Pieniak *et al*. (2008) and Abdullahi *et al*. (2011) who reported that fish consumption is mostly affected income and household size. The results of the study revealed that the respondents preferred to consume Titus species of fish more than other species; this could be attributed to availability of the fish in the area of study

Table 1: Distribution of respondents based on socio economic characteristics

Variable	Frequency	Percentage
Age		
Below 25	10	9.0
26-50	78	63.0
Above 50	36	28.0
Total	**123**	**100**
Sex		
Female	25	21.0
Male	98	79.0
Total	**123**	**100**
Educational attainment		
Adult Literacy Training	1	0.8
Completed Primary Education	1	0.8
Completed Secondary Education	15	12.1
Post-Secondary Education	106	85.5
Total	**123**	**100**
Household Size		
Less Than 5	91	74.2
6 – 10	32	25.8
Income Level		
Less 7, 500	4	3.3
10, 000 – 15, 000	20	16.2
15, 000 – 20, 000	8	6.2
20,000 - 25,000	35	28.3
Above -25000	56	46.0
Total	**123**	**100**

Source: Field survey, 2010

Table 2: Distribution of Respondents based on Household Preference for Frozen fish consumption

Variable SPECIES	Frequency	Percentage
Titus	28	22.6
Cat Fish	1	0.8
Others	94	76.6
TOTAL	123	100

Source: Field survey, 2010

Table 3: Frequency of Consumption of Titus Fish per Week by the Household

Variable	Frequency	Percentage
TIMES		
Daily	43	34.9
Once in a week	30	24.6
Twice in a week	48	38.7
No response	2	1.6
TOTAL	**123**	**100**

Source: Field survey, 2010

Table 4: Quantity of Titus Fish Consumed by the Household

Variable	Frequency	Percentage
INTERVAL (WEEKLY)		
Below 3 kg	65	53.3
3 – 6 kg	50	40.3
Above 7 kg	8	6.4
TOTAL	**123**	**100**

Source: Field survey, 2010

CONCLUSION

The study examined consumers' preference of frozen fish. The results of the study revealed that the respondents have small house hold size, they are average income earners and they consume an average of 3-6kg of fish weekly. Policy towards mass education of nutritional importance of fish is here by advocated.

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EFFECT OF FINANCIAL MOTIVATION ON ORGANIZATIONAL PERFORMANCE IN SELECTED FIRMS IN ABIA STATE, NIGERIA

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ABSTRACT
The study analyzed the need to examine the relative Effect of financial motivation on organizational performance in selected firms in Abia State. It specifically assessed the socio-economic profile of the workers, analyzes the factors that influence worker performance and ascertain the relationship between financial motivation and worker productivity. This profit can only be achieved when the organization produces at the lowest minimum cost. The data for the study were collected from primary and secondary sources. The primary data were obtained through the use of questionnaire, which was designed to collect data on the socio-economic characteristics of the employees of selected firms, their productivity and other relevant data and information while the secondary information sources includes texts, journals and other research publications. In the course of data analysis, descriptive statistics, correlation and multiple regressions were employed.
Keywords: Financial, Motivation and Performance

INTRODUCTION
In contemporary system, industrial harmony is generally taken to be an important element of organizational success. Effective employee performance depends on the level of motivation. This is manifested in workers job satisfaction and improved morale. The fulfillment of workers satisfaction is very important, it does not only help to keep the cost of production low, but also helps to retain skilled manpower in such organization. The goal of the worker is to satisfy his personal needs. Needs which provide the motivating force for work, while the goal of the employer is to maximize profit through high productivity and to remain in business. This profit can only be achieved when the organization produces at the lowest minimum cost. Workers are a vital key to the success of an organization and a productive workplace. The proper communication between managers and employees is the first and best way to keep productivity and satisfaction high and boast a low turnover rate. Research concerning communication between managers and employees has shown how to create a workplace where the employees are productive. Many researchers believe that when management participates and communicates with the employees, positive outcomes are considerable and job satisfaction and productivity are greatly increased (Jackson, 2008; Hoerr, 2009; Peterson and Hillkirk, 2009; Bluestone and Bluestone, 2009; Bernstein, 2009; Sims, 2007).The objective of the study was to determine the effect of financial motivation on organizational performance in selected firms in Abia state, Nigeria.

METHODOLOGY
Abia State is one of the 36 states in Nigeria. The state lies between longitude 04^0 45^1 and 06^0, 07^1 North and latitude 07^000^1 and 08^010^1 East. It is situated in the South-East of Nigeria and is bounded by Imo state at the Western border, Ebonyi/Enugu state at the North, Cross River/Akwa Ibom states at the East and Rivers State at the South. Abia State has a relatively high population density of 580 persons per square kilometer given its population of about 2.883million (NPC, 2006). About seventy percent of the people in Abia state are involved in agribusiness concerns and that accounts for the plethora of such firms in parts of the state. The data for this study were collected from mainly primary sources. The primary data were obtained through the use of questionnaire, which was designed to collect data on the socio-economic characteristics of the employees of selected firms, their productivity and other relevant data and information while the secondary information sources include texts, journals, and other research publications. The study used descriptive statistics, correlation and multiple regression in the analysis of data. Descriptive statistics such as tables, percentages, frequencies were used to assess the socio-economic profile of the worker. However, the correlation analysis was performed to ascertain the relationship between financial motivation and worker productivity while multiple regression was used to analyze the socio-economic factors that influence workers performance

RESULTS AND DISCUSSION
The Relationship between Financial motivation and Productivity
The correlation analysis was used to ascertain the relationship between motivation and productivity. Using the formula, the following result was realized. From Table 1, it could be observed that the rank coefficient for assessing financial motivation/productivity relationship among the workers was 0.711. This implies that there is a positive relationship between them. Thus, the productivity of the workers increases as they are motivated.

Factors Influencing Worker Productivity

To determine factors that influence worker productivity, multiple regression analysis was performed. The four functional forms were tried and the lead equation was selected on the basis of statistical and econometric criteria. The criteria employed include number and magnitude of significant variables, magnitude of R^2 and F-ratio and their conformity with a priori expectation. The R^2 (coefficient of multiple determination) which is 0.700 shows that the model is 70.0% variation in productivity are accounted for by the independent variables included in the model and it indicates goodness of fit. About 30% can be attributable to error and omitted variables in the model. Experience was significant at 1% probability level and positively related to productivity, indicating that as experience increased, productivity increased. Skill level was significant at 1% risk level had a positive coefficient indicating that skill level increased as financial productivity increased. It further implies that any 0.001% increase in skill level would increase productivity at work.. Marital status of the respondents was significant at 1% probability level and had a positive coefficient, implying that male employees outperform their female counterparts. By the implication of the significance of the work environment, it implies that conducive environment enhances worker productivity. In line with a priori, age was negative and thus, indicates that increasing age brings about declining productivity.

CONCLUSION

The complaints of managers, in recent times, about low performance, reduced output and dwindling productivity have been traced to little or no financial motivation of their workers. Lack of financial motivation occurs when the workers perceive non-challance on the part of management in his personal issues which dampens hard work, commitment and to the detriment of the organization. The need to address the issue has necessitated the study. Having found that financial motivation has a positive relationship with worker productivity and factors such as experience, skill level, marital status, work environment and age influence productivity significantly, opportunities exist for improvement. Appropriate mix of the determining variables will bring productivity enhancement.

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Table1: Correlation Coefficient for assessment of Financial Motivation/Productivity Relationship

Variables	Rank Correlation Coefficient
Motivation/productivity	0.711

Source: Computed from Field Survey (2012)

Table 2: Factors Influencing Worker Productivity

VARIABLES	+Linear Function	Exponential Function	Semi-Log Function	Double-log Function
Constant	8.491	2.323	-2.092	-6.101
	(4.031)***	(3.898)***	(-0.125)	(-1.592)*
Education	323.720	188.290	-0.047	-0.315
	(0.358)	(0.736)	(-0.038)	(-1.119)
Experience	0.011	0.976	-1.352	-0.418
	(2.750)***	(-2.882)***	(-4.030)***	(-5.420)***
Remuneration	0.025	-0.007	-0.558	-0.252
	(1.227)	(-1.133)	(-0.954)	(-1.869)**
Skill level	0.001	0.000	-0.579	-0.317
	(2.523)***	(-2.939)***	(1.178)	(-2.805)***
Family size	0.034	3.27E-006	-0.270	-0.047
	(0.672)	(0.062)	(-1.278)	(-0.961)
Marital status	0.098	3.40E-005	2.458	1.179
	(2.954)***	(3.246)	(2.333)**	(4.868)***
Work	0.064	-0.016	-0.331	0.017
Environment	(-2.031)**	(-1.755)*	(-0.634)	(0.141)
Age	-0.163	-0.037	0.306	0.141
	(-2.192)**	(-1.782)	(0.689)	(1.381)
R^2	0.700	0.536	0.646	0.781
F-ratio	42.208	2.742***	11.054***	32.554***

Source: Computed from Field Survey Data, 2013
Figures in parenthesis are t - value
+ = lead equation
*** = Significant at 1% Probability level
** = significant at 5% Probability level
* = significant at 10% Probability level

AGRICULTURAL PROJECTS AND EMPLOYMENT GENERATION: A CASE STUDY FOR FEASIBILITY AND VIABILITY STUDY OF POULTRY EGG (LAYER PRODUCTION) IN KADUNA STATE, NIGERIA

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ABSTRACT
This study examined the agricultural project (poultry egg production project) and employment generation in Kaduna state, Nigeria. The farm proposes to start with about 1100 chicks and with possible expansion to about 2, 000 layers within five years. The objectives are to produce more animal protein and maximize profit. The location of project area is Sabo Gaya, Chikun local government area of Kaduna state, Nigeria. Inputs for poultry egg production have been found to be numerous in the area. Deep litter system will be employed. The fixed inputs involved are land, poultry house, borehole, pick-up van and farm equipment while the variable inputs involved are day old chicks, feeds, vaccination, labour, etc. The proposed total fixed cost in raising about 1,000 layers was ₦5, 496, 650 while the variable will be ₦5, 825, 038. Loan of ₦5, 000, 000 will be collected and to be repaid in four equal instalments. The business was projected for five production cycles in order to determine whether is viable or not. The viability indicators such Net Present Value (NPV), Benefit/Cost Ratio and Internal Rate of Return (IRR) were used to determine the viability, profitable and worthwhile of the project. The calculations, from NPV, B/C ratio at 8% were ₦4, 068, 178 and 1.10 respectively. This showed that the project is profitable, viable and worthwhile; therefore, project should be undertaken at 8% discount factor. The result also revealed that NPV was negative (-₦196, 404) and B/C ratio was also less than 1 (0.9) at 100% discount factor. It means the project should be rejected at 100% discount factor. The result also, indicted that IRR was 62%, which means that investor will be better off, if he collects loan at interest rate less than 62%. Therefore, from the calculations and estimations carried out, the project is viable, profitable and worthwhile. Based on these, the project should be accepted.
Key words: Poultry egg production, project, profitable and viability

INTRODUCTION
A project is any activity on which we will allocate scare resources in expectation of returns and which logically seems to learn itself to planning, financing and implementation as a unit. The various types of agricultural projects include water resources development project, agricultural credit project, agricultural development programmes, agricultural industrial and commercial development. Also, agricultural project are usually classified by types of enterprise such as tree crop projects, arable crop project, macro and micro livestock (poultry, cattle, sheep, goats, rabbit, piggery, snail, grass cutter etc) , fishery project, mixed farming projects etc. Poultry egg enterprise plays a very significant role in providing Nigerians with cheap animal protein. In spite of the great nutritional contribution of eggs, some degrees of discrepancies between its production and consumption persist (World Bank, 1998 and Saliu, 2013). Based on the financial contribution of the poultry industry to local producers, many people are interested in taking to poultry farming as a business or a supportive economic activity. Ali (2002) observed that Nigeria's poultry production is expanding but not keeping pace with rapidly increasing domestic consumption requirements. The domestic supply shortfall is estimated at 25, 000 metric ton per annum. This Scenario implies that egg production have to be increased to a sustainable level. Like many agricultural production economics, the project has the following objectives which includes to produce more animal protein to fill in (partly) the existing gap in protein consumed by households and maximize returns or optimize profits through minimization of costs while goals of the project are to ensure the food security of household and to increase commercial egg production in Kaduna state, Nigeria.

METHODOLOGY
Study Area
The study area is Sabo Gaya, Chikun Local Government Area of Kaduna State. Two hectare of land have been acquired and cleared for the purpose. The piece of land is near a small stream which dries off during the dry season. The farm site is 15km from Kaduna City. Inputs such as labour, water, market have been found to be numerous apart from the availability of concentrate feed ingredient (soybean) which the researcher is carrying research on in order to reduce the overall cost of production. The fixed cost considered include land acquisition and clearing, construction of poultry house, pick-up van, borehole and farm equipment while the variable cost include day old chicks, feed vaccination, drug/medicine, labour, consumable/utilities, maintenance, contingencies and depreciation

As target consumers are mostly retail provision shops, egg rolls makers and five star hotels.

In addition to this, advert to create awareness for consumer of egg and spent hens was sold as at when due.

i. Current price of a crate of egg = ₦ 650
ii. Current price of a spent layer = ₦ 800
iii. Current price of manure = ₦ 300/100Kg bag
iv. Current price of a empty bag ₦ 20

Financial Analysis

It is good to determine the returns expected in the future in order to know whether the project is worthwhile and acceptable. The major viability indicators normally used in determine these are net present value (NPV), benefit/cost ratio (B/C ratio) and internal rate of return (IRR). The calculations and interpretations are as follow.

- Net present value of a project is the value of today of the surplus that the firm makes over and above what it could make by investing as its marginal rate. Mathematically, this is given by this formula.

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t} \quad \text{.............................. (1)}$$

Where
B_t = benefits in each project year.
C_t = costs in each project year.
n = number of years
r = interest (discount) rate.
The project should be undertaken if NPV is positive.

- The Benefit/Cost Ratio is the ratio of discounted costs to discounted revenue and given by the formula:

$$B/C \text{ ratio} = \frac{\sum_{t=1}^{n} \frac{Bt}{(1+r)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}} \quad \text{.............................. (2)}$$

Where;

$\sum_{t=1}^{n} \frac{Bt}{(1+r)^t}$ = Discounted Benefit

$\sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$ = Discounted Cost

The project should be undertaken if benefit/cost ratio is greater than 1. If the benefit/cost ratio is exactly 1, it means that the project just breaks even. That is, it is making neither profit nor loss.

- The Internal Rate of Return (IRR) is the rate of return that is being earned on capital tied up while it is tied up, after allowing for recoupment of the initial capital it is also called the yield of an investment. Mathematically it is given by: $IRR = L + \frac{\mathrm{NPVL(H-L)}}{NPVL+NPVH}$ .... (3)

Where;
IRR = Internal Rate of Return;
L = Lower discounted factor;
H = Higher discounted factor;
NPV_L = Net Present Value at Lower discounted factor;
NPV_H = Net Present Value at Higher discounted factor;

RESULTS AND DISCUSSION

Calculations of NPV and B/C Ratio at 8% for the project:

From Table 1, Net Present Value (NPV) at 8% equal to N4, 062, 174 which is positive. This means that the project is profitable and worthwhile; therefore, the project should be carried out. Also, Benefit/cost ratio at 8% = $\frac{Discounted\ Benefit}{Discounted\ Cost} = \frac{45{,}468{,}842}{41{,}406{,}665}$ = 1.10. The benefit/cost ratio for the project is greater than 1. This means that the production is in stage II which indicated that the producer is making profit; therefore, the project should be accepted.

Calculations of NPV and B/C Ratio at 100% for the project: It could be deduced from the Table 2, the Net Present Value (NPV) at 100% equal to -₦196, 404 which is negative. This implies that the project should not be undertaken at the discount factor of 100 per cent. It further shows that Benefit/cost ratio at 100% = $\frac{Discounted\ Benefit}{Discounted\ Cost} = \frac{9,338,809}{9,846,634}$ = 0.9 which is less than one. It means that the production is at stage III and it implies the project should not be implemented at the discounted factor of 100 per cent.

Estimated cash flow analysis of the project (Internal rate of Return): The analysis of the data from the Table 3 shows that Net Present Value (NPV) at 60% is equal N40, 370 which is positive and small profit still made, project should be undertaken. Also, at 65 per cent Net Present Value (NPV) at 65% = -N72, 931 which is negative, the project should be rejected at 65 per cent. Furthermore, IRR $= L + \frac{\text{NPVL(H−L)}}{NPVL+NPVH} = 60 + \frac{40{,}370(65-60)}{40{,}370+72{,}931}$ = 60+1.78 = 61.78%, therefore IRR = 62%. It means that for every ₦1 that is invested, the investor will receive ₦1:62K. After paying 7kobo on the naira to the lender, he will be better off by 55kobo.

CONCLUSION

The findings and the above estimates, all things being equal, the project is viable, worthwhile and profitable. It is highly recommended for its expected contribution to the development of the community.

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Table 1: Calculations of NPV and B/C Ratio at 8% for the project

Year	Cost (N)	Benefit (N)	Incremental Benefit	Discount factor at 8%	Present Value at 8%	Discounted cost at 8%	Discounted Benefit at 8%
1	11,323, 688	8,272,600	-3, 051, 088	0.926	-2, 825,308	10, 485, 735	7, 660, 428
2	8, 006, 985	9,926,960	1,919,975	0.852	1, 635,819	6, 821, 951	8, 457, 770
3	8, 999, 072	11,490,420	2,491,348	0.794	1, 978,130	7, 145, 263	9, 123, 394
4	9, 694, 885	12,311,270	2,616,385	0.735	1,923,043	7, 125, 741	9, 048, 785
5	14,431, 682	16,414,780	1,983,098	0.681	1, 350, 490	9, 827975	11, 178, 465
Total					4, 062, 174	41, 406, 665	45, 468, 842

Source: Computed from field survey, 2015.

Table 2: Calculations of NPV and B/C Ratio at 100% for the project

Year	Cost (₦)	Benefit (₦)	Incremental Benefit	Discount factor at 100%	Present Value at 100%	Discounted cost at 100%	Discounted Benefit at 100%
1	11,323, 688	8,272,600	-3, 051, 088	0.5	-1,525,544	5,661,844	4, 136, 300
2	8, 006, 985	9,926,960	1,919,975	0.25	479, 994	2,001,746	2, 481, 740
3	8, 999, 072	11,490,420	2,491,348	0.125	311, 419	1,124,884	1, 436,301
4	9, 694, 885	12,311,270	2,616,385	0.063	164,832	610,778	775, 610
5	14,431, 682	16,414,780	1,983,098	0.031	61,476	447,382	508, 858
Total					-196, 404	9,846,634	9,338, 809

Source: Computed from field survey, 2015.

Table 3: Estimated cash flow analysis of the project (Internal rate of Return)

Year	Cost (₦)	Benefit (₦)	Incremental Benefit	Discount factor at 60%	Present Value at 60%	Discount factor at 65%	Present Value at 65%
1	11,323, 688	8,272,600	-3, 051, 088	0.625	-1,906,930	0.606	-1,848,959
2	8, 006, 985	9,926,960	1,919,975	0.391	750, 710	0.367	704,631
3	8, 999, 072	11,490,420	2,491,348	0.244	607,889	0.223	555, 571
4	9, 694, 885	12,311,270	2,616,385	0.153	400,307	0.135	353,212
5	14,431, 682	16,414,780	1,983,098	0.095	188,394	0.082	162,614
Total					40,370		-72,931

Source: Computed from field survey, 2015.

Cash Flow Projections: This refers to the movement of funds in and out of the business within a specified period of time.

Table 4: Cash Flow Projections

Item/Year	Year 1	Year 2	Year 3	Year 4	Year 5
A. Cash Income					
Capital Introduce	6,323,688				
Loss introduce	5,000,000				
Income from output	8,272,600	9,926,960	11,490,420	12,311,270	16,414,780
Total A	19,596,288	9,926,960	11,490,420	12,311,270	16,414,780
B. Cash expenditure					
Loan repayment	-	1,337,500	1,337,500	1,337,500	1,337,500
Total Fixed cost	5,496,650				1,700,000
Total variable cost	5,827,038	6,669,485	7,661,572	8,357,385	11,394,182
Total B	11,323,688	8,006,985	8,999,072	9,694,885	14,431,682
Cash income A	19,596,288	9,926,960	11,490,420	12,311,270	16,414,780
Cash expenses B	11,323,688	8,006,985	8,999,072	9,694,885	14,431,682
Annual Surplus (Shortage	8,272,600	1,919,975	2,491,348	2,616,385	1,983,098
Opening Bank balance	11,323,688	8,272,600	10,192,575	12,683,923	15,300,308
Closing Bank balance	8,272,600	10,192,575	12,683,923	15,300,308	17,283,486

Source: Computed from field survey, 2015.

FAMILY FARMERS' ACCESS TO MICROFINANCE FACILITIES IN IBARAPA CENTRAL LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

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ABSTRACT
The study assessed access of family farmers to microfinance facilities in Ibarapa Central Local Government area, Oyo state. Two-stage sampling technique was used to select 141 family farmers as sample size for the study. Data collected through interview schedule were analyzed using frequency counts, percentages, weighted means score (WMS), rank and mean while Pearson Product Moment Correlation was used to test the relationships that existed between selected socio-economic characteristics and family farmers' access to microfinance facilities. Results revealed the mean age of respondents was 47years and 36.9% of respondents had no formal education. Of all the microfinance facilities accessible to family farmers, thrift and credit collectors ranked 1st; rotational group savings ajo ranked 2nd. Incomplete contributions by some members in the group savings scheme ajo ranked 1st among constraints in accessing microfinance facilities. Results of Pearson Product Moment Correlation analysis showed that age (r = 0.301, p<0.05) and educational status (r = 0.304 p<0.05) have significant relationship with family farmers' access to microfinance facilities. It is hereby recommended that family farmers should organize adult literacy class and, also, improve the structures of their group savings scheme to meet microfinance needs of members.
Keywords: **Family Farmers, Microfinance Facilities, thrift and credit**

INTRODUCTION
Family farming was described by Adewale (2014) as consisting of agricultural forestry, fisheries, pastoral and aquaculture production being managed and operated by a family and relies primarily on labour from the family. It is any agricultural activity involving fishing, poultry, rearing and cultivation of crops owned by group of people who are related by blood or marriage. Family farming could be for subsistence or commercial, or for both. In developing countries, family farmers are usually small-scale farmers or food producers who are at the forefront of eradicating hunger. Incidentally, they are usually resource-poor farmers who hardly have access to fund or wherewithal to carry out their farming activities. Financing family farming activities depend mostly on microfinance sources. Wikipedia viewed microfinance as a source of financial services for entrepreneurs and small businesses lacking access to real banking and related formal services www.enwikipedia.org/wiki/microfinance.Jaffari, *et al. (*2011) defined microfinance as the provision of financial services to the poor who are traditionally not served by the conventional banks. The distinguishing features of microfinance are the smallness of loans advanced and savings collected, near absence of assets-based collateral as well as simplicity of operation (Iorchir, 2011). This kind of financial services give family farmers the opportunity to access finance and this affords the opportunity to sustain their family enterprises more efficiently and effectively, thereby providing investment opportunities for better economic returns (Amao and Kolawole, 2015). In Nigeria, microfinance institutions were established by successive governments in order to make credits available to non-formal sector, especially people in the rural areas, where family farming dominates. Such institutions include rural banking scheme, Peoples Bank, Family Economic Advancement Programme, Nigerian Agricultural Cooperative and Rural Development Bank, Community Bank, and currently Microfinance Banks (Acha, 2012). While microfinance operates by providing credit and other financial services to economically active but low income households and businesses (Acha, 2012) including family farmers and their farms, studies have shown that family farmers have constrained access to microfinance facilities and this continue to reduce their production potentials. Arising from this problem, this study assessed access of family farmers to microfinance facilities in Ibarapa Central Local Government Area of Oyo State. The specific objectives of the study were to:

1. identify socio-economic characteristics of family farmers in the study area
2. determine family farmers' means of accessing microfinance facilities in the study area
3. identify constraints being faced by family farmers in accessing microfinance facilities. The study also tested the hypothesis that – there is no significant relationship between selected socioeconomic characteristics of family farmers and their access to microfinance facilities.

METHODOLOGY
The study was conducted in Ibarapa Central Local Government area of Oyo state. The population of the study comprised all family farmers in the study area. Snowball technique was used to select 141 farmers as sample

frame and all the family farmers were sampled purposively. Data were collected through a well-structured interview schedule. Data were analyzed with descriptive statistics and correlation model

RESULTS AND DISCUSSION

Respondents' socioeconomic characteristics

The results in Table 1 showed that majority 31.3% of the respondents fell between 41-50 years, while the mean age was 46 years. This implies that most family farmers in the study area were adults and have agility to pursue farming activities. It is also revealed that majority of the respondents (48.2%) had family size of range 6 – 10 while the mean household size was 7 members. This implies that family farmers in the study area have large family size who are likely to be involved in family farming activities. Table 1 also revealed that many respondents (36.9%) had no formal education. This implies that literacy level is relatively poor among family farmers in the study area and this may limit them from accessing microfinance facilities as being illiterate may hinder them from filling cumbersome documents required to access loan.

Facilities through which family farmers' access microfinance in the study area

Data from Table 2 showed that thrift and credit collectors ranked 1st as the most common microfinance facility accessible to respondents. This implies that thrift and credit collector offers the greatest opportunity for family farmers to access microfinance facility because the finance does not usually interest-free. Since thrift and credit collection arose from farmers' savings, it means that personal savings is the commonest and most assured means of accessing finance for family farming. Microfinance banks that was least accessed may be due to the fact that farmers who could not meet the banks' stringent conditions or are not literate enough to interact with banking bureaucracy could not access fund through microfinance banks.

Constraints faced by family farmers in accessing microfinance facilities in the study area.

Table 3 revealed that incomplete contribution of money by some group savings *ajo* members especially those who have benefitted from the contributions (1st), is the commonest constraint that the respondents faced in accessing microfinance facilities, little amount of money is the 2nd, partiality in issuing loan 3rd and condition for obtaining loan is cumbersome also ranked 3rd, delay/postponement of loan payment to applicants ranked 4th. This implies that accessing loan from microfinance facilities is always bedeviled by constraints which hamper family farmers from accessing loan

Test of hypotheses

Ho1- There is no significant relationship between selected socioeconomic characteristics of family farmers and their accessibility to microfinance facilities in the study area.

Pearson Product Moment Correlation (PPMC) results in Table 4 revealed that there is significant relationship between age ($r = 0.301$, $p< 0.05$), educational status ($r = 0.304$, $p < 0.05$) and family farmers' access to microfinance facilities. This implies that the older the farmer, the more such farmer has access to microfinance facility. This is because age is perceived to command integrity and loan-worthiness. Also, the more literate a farmer is, the more he or she has access to microfinance facility.

CONCLUSION

Based on the findings of the study, it concluded that the bulk of microfinance facilities accessible to family farmers revolves round their personal savings. It is hereby recommended that family farmers should form or improve the structures of their group savings scheme *ajo* to meet microfinance needs of members. Also, family farmers should organise adult literacy class designed to create awareness on available microfinance opportunities.

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Table 1: Distribution of respondents by socio-economic characteristics (n=141)

Socioeconomic characteristics		Frequency	Percentage
Age (in years)	≥30	12	8.5
	31- 40	29	20.5
	41 – 50	44	31.3
	51 – 60	38	27.0
	≤61	18	12.7
	Mean	**46**	
Family size	1 – 5	53	37.5
	6 – 10	68	48.3
	11 – 15	20	14.2
	Mean	**7**	
Educational status			
Non-formal education		52	36.9
Secondary		38	27.0
Tertiary		33	23.4
Primary		18	12.8
Gender Male		106	75.1
Female		35	24.8

Source: Field Survey, 2015

Table 2: Distribution of respondents' accessibility to microfinance facilities in the study area (n=141)

Microfinance facilities	WMS	Rank
Thrift and credit collectors	2.6	1st
Rotational group savings (ajo)	2.4	2nd
Personal savings	2.4	2nd
Friends' assistance	1.9	2nd
Cooperative society	1.8	3rd
Microfinance banks	1.1	4th
WMS = Weighted Mean Score, Midpoint score = 1.5		

Source: Field Survey, 2015

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Table 3: Distribution of constraints face in accessing microfinance facilities

Constraint of Microfinance Facilities	WMS	Rank
Incomplete contribution by group savings beneficiaries	2.8	1st
Little amount of money could only be accessed at a time	2.5	2nd
Partiality in issuing loan	2.4	3rd
Conditions for obtaining loan is cumbersome	2.4	3rd
Delay/postponement of loan payment to applicants	2.3	4th

WMS = Weighted Mean Score, Midpoint score = 1.5

Source: Field Survey, 2015

Table 4: Results of Pearson Product Moment Correlation (PPMC), shows the relationship between selected socio-economic characteristics of the respondents and accessibility to microfinance facilities

Socio-economic characteristics	r-value	p-value	Decision
Age	0.301	0.000	Significant
Years spent schooling	0.304	0.000	Significant
Household size	0.062*	0.474	Not significant

Source: Field Survey, 2015

FACTORS AFFECTING ACCESSIBILITY OF CREDIT FROM BANK OF AGRICULTURE (BOA) AMONGST FARMERS IN ABIA STATE, NIGERIA

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ABSTRACT
The study was conducted in the three zones of Abia State. Multi-stage random sampling technique was employed in selecting the blocks, circles and respondents in the study area. Structured questionnaire was used to elicit information from 120 respondents on socio-economic characteristics, level and factors influencing the use of credit and constraints to Bank of Agriculture (BOA) credit. Data collected were analyzed using descriptive statistics (percentage and frequency,) and inferential statistics (Probit Model analysis). The result of the study revealed that majority (35%) of farmers fell within the ages of 51 – 60 years, mostly (78.3%) males, highly educated (44.2%), greatly married (93.1%) with moderately (37.5%) household size of 4 – 6 persons, mainly (67.5%) part-time, and 80 percent belonged to cooperative society. However, farmer's gender, household size, awareness of credit, cooperative society and access to loan were significant at 1.0% and 10.0% levels of probability while farm size was negatively significant. Based on the above, Abia ADP should create awareness of the importance of BOA credit by encouraging and assisting farmers in the formation of cooperative society for easy access and use of credit. Also Federal government should reduce the lending interest rate and intervene on the late payment of BOA credit for timely accessibility.
Key words: Credit, Bank of Agriculture, Farmers, Interest, Accessibility and Institution

INTRODUCTION

Agricultural production engages about 80 percent of the Nigerian population, majority are rural small-scale farmers producing food with traditional technologies because of lack of financial accessibility to acquire the necessary tools and materials (Onunka, 2011). Accordingly, most farmers in the developing countries such as Nigeria, purchase farm inputs and pay for production services with self-sourced capital (personal savings) without accessibility to credit .Most rural Nigerian farmers earn little income and save less since much of their earnings are used to fund consumable goods. Hence, their marginal propensity to save and invest on productive ventures such as agricultural production tends to zero (Afolabi, 2010). Savings and investment are dependable on level of income of individual earners. Some Nigerians falls under low income category, they try to save in unorthodox ways. For instance cases abound where savers save idle funds under their pillows, or in ditches, with such funds being stolen or destroyed by termites. The problem of accessibility to credit for agricultural production has triggered to a greater extent that their decisions to demand for credit to finance agricultural investment are high. This has resulted also to low productivity, low income, low savings and mass poverty. The increasing need for credit in agricultural production becomes more obvious as the society responds to adoption of improved technologies of farming so as to produce enough food for the teeming growing population. Credit is a vital component of agricultural support service to be generated from the agro-service system. Credit also plays a crucial role in agricultural production and rural development as it enables farmers reap economics of scale, venture into new fields of production, employ new technologies and empower them to provide utilities for a widening market. The increasing need for credit in agricultural production becomes more obvious as the society responds to the campaign for monogamy, birth control, mass literacy and use of improved methods of agricultural production so as produce more food for the teeming growing population. As a matter of necessity, Nigerian government in sponsoring credit institution for agricultural production created specialized credit institution called Bank of Agriculture (BOA), to carter for the credit needs in the agricultural sector, thereby alleviating poverty of the small-scale farmers in the country (Oladebo and Oladebo, 2008). BOA was formally called Nigerian Agricultural Bank (NAB) in 1973 and 1978, which was changed to Nigerian Agricultural and Cooperative Bank (NACB) in 1990s and subsequently known as Nigerian Agricultural Cooperative and Rural Development Bank (NACRDB) in 2000. In an attempt to reposition the nation's financial institution in meeting the credit needs of the average farmer, and effectively sustain the national agriculture, led to the establishment of Bank of Agriculture (BOA) in 2010. BOA has its branches in all the states of the country including Abuja with its credit functions of direct lending, on-lending, collaboration and monitory of credits to agriculture and non-agricultural small businesses.

In addition, government policies and objectives towards this direction are to enhance the farmers' opportunity of becoming self-sufficient, increase yields/productivity, increase income and better their living standard by improving their farm operations and technologies in the form of credit with little or no interest rate. However, this can be achieved through creating awareness, access and availability of the small-scale or average farmers to have full information about the latest or existence of the new development so as to take decision on the use.Considering the importance of credit as production power in agricultural business, it is therefore, expedient to examine the use of credit from Bank of Agriculture (BOA) by farmers in the study area.

METHODOLOGY

The study was conducted in Abia State which is one of the state in the south East region of Nigeria. It lies within approximately latitude 4^o. 49^1 N and $6^o.47^1$N and longitudes 7^oE and 8^oE of the Greenwich meridian with its capital at Umuahia. Multi-stage sampling technique was employed to select the respondents according to the zone, block and circle. Six (6) blocks were selected from the 3 zones and 2 circles from the each block, making it 12 circles randomly selected. Ten (10) farmers (respondents) were selected and interviewed using structured questionnaires from each circle, making it a total of 120 farmers as sample size. Data collected was analysed using descriptive statistics (tables, percentages, frequencies) and inferential statistics (probit model estimate).
Probit model estimate is specified explicit in the form below:

Pi [Y1] = [Fzi] … (1)

Where

$Zi = \beta0 + \beta1X1 + e$

$Yi = \beta1 + \beta2X2i + \ldots\ldots.. + \beta kXki + e$ … (3)

Yi* is unobserved but Yi = 0 if Yi* < 0,1 if Yi* >0

P (Yi = 1) = P (Yi* >0)

P (μ i ≥ -β1 + β2X2i ………………. -βk X kL …(5)

Where i = 1,2 ……………120

Where Yi = Accessibility (Accessible = 1, Not accessible = 0)

β=A factor of unknown coefficients.

[βo] = Intercept

[β1] = Regression Coefficients

ei = Error term

X_1 = Gender (Male = 1, Female = 0)

X_2 = Age of respondents (years)

X_3 = Marital status (married = 1, non-married = 0)

X_4 = Educational status (years)

X_5 = Household size (in number)

X_6 = Type of farmer (full-time = 1, part-time = 0)

X_7 = Farming experience (years)

X_8 = Awareness Credit(Yes = 1 No = 0)

X_9 = Access to Bank of Agriculture(Yes = 1, No = 0)

X_{10} = Extension contact (Yes = 1, No = 0)

X_{11} = Utilization of Agric loan (Yes = 1, No = 0)

X_{12} = Farm size (ha) X_{14} = Farmers' income (₦)

RESULTS AND DISCUSSION

The socio-economic characteristics of the respondents are presented in Table 1. It shows that majority (35%) of farmers fall within the ages of 51 – 60 years which might explain that credit/loan requires responsible and matured minds. Most of the respondents (78.3%) are males, probably because of collateral involved, well read (44.2%) and married (93.1%). The average household size is 4 – 6 persons (37.5%), mainly part-time (67.5%) farmers and majority (80%) belong to cooperative society. Table 2 show the Tobit analysis on the factors influencing adoption of credit from BOA. It reveals that five (5) independent variables (gender, household size, awareness, cooperative society and access to loan) are significant at 1% and 10% levels, in explaining the important of use of credit from BOA in the study area while farm size is negatively significant. The x^2 value (131.33*) is significant at 10% level of probability. Gender has a strong positive significant relationship (1% level) with the farmers in the use of BOA credit. The result is in agreement with the outcome of Onunka (2005) that gender mediates access, and control of resources and decisions to adopt new techniques. Also, household size increases the use of credit because increased household leads to increased farm lands, awareness and utilization of credit. Membership of cooperative society indicates positive relationship, implying the more the farmers join cooperative groups, the more they use credit from BOA. This might be that Banks easily gives credit to cooperatives more than individual farmers for the fear of defaulting. Access to loan is positively significant with the use of credit, indicating the importance of collateral in financial institutions, while farm size is of no significant and relationship to the use of credit from BOA in the study area. Table 3 shows the major constraints to BOA credit use by farmers such as lack of collateral (1st), high interest rate (2nd) and late approvals/payment (3rd), in the study area. This result is in agreement with *aprio ri* expectation observation that small-scale farmers have difficulties in their transactions with the institutions due to the inaccessibility of the funds as a result of high interest rate and the bureaucratic procedures.

CONCLUSION

The results of the study have brought to bear the determinants of use of credit from BOA in the study area. It is obvious that socio-economic characteristics of respondents shows that the majority (35%) fall within the ages of 51 – 60 years, mostly males which are highly educated, married with moderately household size, mainly part-time farmers and members of cooperative society. Independent variables such as gender, household size, awareness, cooperative society and access to loan are significant at 1% and 10% levels and farm size is negatively significant. The respondents have major constraints – lack of collateral, high interest rate and late payment of credit from BOA in the study area. Considering the need for credit to small-scale farmers, the Abia ADP should create awareness of the importance of BOA, assist and encourage the farmers in forming cooperative society for credit accessibility. Further, federal government should reduce the lending interest rate and emphasis on the early payment of BOA credit to farmers for more investment.

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Table 1: Socio-economic characteristics of the respondents

Age	**Freq.**	**Percentage (%)**
21 – 30	4	3.3
31 – 40	19	15.8
41 – 50	27	22.5
51 – 60	42	35.0
61 and above	28	23.3
Gender		
Male	94	78.3
Female	26	21.7
Educational status		
No. formal education	1	0.8
Primary	2	1.7
Secondary	42	35.0
NCE/ND	22	18.3
Others	53	44.2
Marital status		
Single	8	6.9
Married	112	93.1
Household size		
1 – 3	40	33.3
4 – 6	45	37.5
7 – 10	9	7.5
10 and above	26	21.7
Farming type		
Full-time	39	32.5
Part –time	81	67.5
Membership of Cooperative		
Yes	96	80
No	24	20
Total	**120**	**100**

Source: Field Survey data, 2015

Table 2: Tobit analysis on the factors affecting use of credit from Bank of Agriculture in the study area

Variables	Parameters	Coefficient
Constants	B_o	-21.1251 (-4.21***)
Gender	X_1	4.65144 (6.40***)
Age	X_2	0.07547 (1.28)
Marital status	X_3	0.8385557 (0.89)
Education	X_4	0.0229219 (0.04)
Household size	X_5	3.894792 (2.15***)
Farming type	X_6	1.021441 (1.01)
Farm experience	X_7	-0.1753019 (-1.47)
Awareness of BOA	X_8	1.832154 (3.77***)
Membership to Cooperative	X_9	2.491514 (1.91*)
Farm size	X_{10}	-0.19846 (-5.01***)
Access to loan/credit	X_{11}	2.95583 (1.81*)
Extension contact	X_{12}	0.0054098 (0.997)
SE		1.75347
X^2	131.33**	
Number of observation	120	
Pseudo R^2	0.3277	
Log likelihood	-126.80877	

*Source: Field survey data, 2015 *Figures in bracket = t = value, * significant at 1% (percent) and 10% (percent) levels of probability.*

Table 3: Constraints to BOA credit Use by farmers

Constraints	Percentage	Ranking
High interest rate	50.3	2nd
Far from the reach of the farmer	9.5	6th
Bureaucratic bottlenecks	19.8	5th
Late approvals/payment	30.0	3rd
Guarantors	8.0	7th
Lack of bank account	20.1	4th
Lack of collateral	52.5	11th
Lack of awareness	6.6	8th

Source: Field survey data, 2015

COST AND RETURN ANALYSIS OF YAM PRODUCTION IN IKWUANO LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA

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ABSTRACT

The study was carried out to assess the cost and return of yam production in Ikwuano Local Government Area of Abia State. Structured questionnaire was used to elicit information from the farmers. Multi-stage Random Sampling method was used in the study. Two clans were randomly selected out of four clans in Ikwuano, they are Oboro and Ibere. Two communities from each of the selected clans were randomly selected, making it four communities and they are Umuariaga Oboro, Ndioru Oboro, Amuro Ibere and Itunta Ibere. 30 farmers from each of the four Communities were randomly selected for the study. In all 120 respondents were used as the sample size. List of farmers collected from the community head served as the sample frame. Data were analyzed using descriptive statistics. Results showed that majority of the farmers (46.7%) are between 41-50 years and 27.5% (31-40) years. This showed that yam production requires able bodied men for its cultivation and production. The result also revealed that yam farming is profitable with the net income of ₦352,906.85 realized within a production season. This result establishes the fact that yam production is profitable in Ikwuano LGA of Abia State. The result also revealed that about 64.2% of the respondents have no extension agents' contact within the period under review. There is therefore, the need for the government to reactivate extension system by giving them necessary support as to enable them disseminate proper information to yam farmers in Ikwuano for food security and improved livelihood. Also, farmers' in Ikwuano area should get involved in yam production for food security and improved livelihood since it is a lucrative enterprise.
Keywords: Cost, returns, yam production and economics

INTRODUCTION

Yam (*Dioscorea* species) is an annual tuber-bearing plants with more than 600 species out of which six are socially and economically important in terms of food, cash and medicine (IITA, 2009). Some of its species are water yam (*Dioscorea alata)*, white yam (*Dioscorea rotundata*) and yellow yam (*Dioscorea cayanensis)* (FAO, 1998). In Nigeria, yams contribute significantly to the national economy and income by providing employment to many rural dwellers (Asumugha *et al*., 2010) and cheap carbohydrate staple food for over 80 percent of the populace (Nwachukwu, 2008). It plays significant roles in the social-cultural and economic wellbeing of thousands of people in Nigeria. The yam peel may also have economic values; it can be recycled and used as feedstuffs for livestock, since it is highly rich in carbohydrate (Oladeebo and Okanlawon, 2010). Yam production in Nigeria has more than tripled over the past 40 years from 6.7 million tonnes per annum in 1961 to 27 million tonnes per annum in 2001 (FAO, 1999). This increase is however attributed to larger hectares of land planted to yam than to increased productivity as a food crop, the place of yam in the diet of the people in Nigeria cannot be overemphasized. It contribute more than 200 dietary calorie per capital daily for more than 150 million people in west Africa while serving as an important source of income to the people (Babaleye, 2003). Yam production is regarded as a source food security and employer of labour in many areas where it is cultivated. Despite the importance of yam in food availability, income and employment generation, its production has not been given the utmost attention in Ikwuano Local Government area. The objective of the work is to describe the socio-economic characteristics of the farmers and assess costs and returns of yam production in the study area.

METHODOLOGY

The study was carried out in Ikwuano North LGA of Abia State. Structured questionnaire was used to elicit information from the respondents (farmers). Multi- stage Random Sampling method was used to select two clans out of four clans in Ikwuano Local Government Area, they are Oboro and Ibere. Two communities from each of the selected clans were randomly selected, making it four communities and they are Umuariaga Oboro, Ndioru Oboro, Amuro Ibere and Itunta Ibere. 30 farmers from each of four Communities were randomly selected for the study. In all 120 respondents were used as the sample size. Data were analyzed using descriptive statistics. To determine the cost and return of yam production in Ikwuano Local Government Area, it was analyzed using the formula below.
The cost and return of yam production was analyzed thus:
TR = P*Q ------------------------------------ (i)

TC = TVC +TFC ------------------------------ (ii)
GM = TR – TVC ----------------------------- (iii)
NI = GM- TFC -------------------------------- (iv)
Where TC = Total Cost
TVC = Total Variable Cost
TFC = Total Fixed Cost
TR = Total Revenue
P = Price per kg of yam produced
Q = Quantity of yam produced
GM = Gross Margin
NI = Net Income

RESULTS AND DISCUSSION

Results in Table 1 shows that majority of the farmers (46.7 %) falls between 41-50 and 27.5% of the farmers falls between 31-40 years. This showed that yam production requires able bodied men for its cultivation and production. The results also showed that majority of the farmers constituting 96.7% possess formal education. Education makes farmers receptive to new ideas and techniques (Anyaegbunam *et al*., 2006). The result in table 1 also revealed that most of the farmers (72.5%) are male while about (27.5) % are female. Traditionally, it is believed that women in Igbo land are not meant to cultivate yam and it requires a lot of energy for its production. According to Ironkwe and Ewuziem (2010), traditionally yam is regarded as ''Man's crop''. Results in table 1 also show that 60.0% of the respondents were married, while the remaining 22.5% were single. According to the married people, farming is a necessary condition for them to lift their households out of poverty and ensure hunger free situation in their homes. For these reasons, they are more engaged in agriculture than unmarried people in the area. The results also indicate that the majority (50.0%) of the respondents have between 5 and 9 household members. This implies that the birth rate in the area is still high. Traditionally, yam production is a labour intensive enterprise, family size was a necessity for the size of the farm and increase production of yam in the area. It was also revealed in the table 1 that 90% of the farmers got labour source from both their families and hired labour while only 10% of the farmers do their farm work by themselves. This implies that yam production is labour intensive.

Costs and Returns

Table 2 shows the result of the analysis of costs and returns accrued to yam farmers in the study area in the year 2016. The result indicates that the farmers invested about ₦4,858,964.15 in the production of yam, these includes cost of labour, seed yams, implements, agro-chemicals and other necessities. Cost of seed yam acquisition (97.20%) ranked first in the list of items for yam production. This implies that cost of planting material (seed yams) is the major cost item associated with yam production. Cost of labour ranked second, accounting for 1.86% of total cost. This showed that yam production requires much labour while Agro-chemicals and Transportation ranked third and fourth accounting for 0.20% and 0.05% of total cost of yam production respectively. Cost on depreciation constituted 0.39% while land charges as rent had 0.32%. The total variable cost items showed ₦4,824,375.4 while the fixed cost had ₦34,588.75. The table further revealed that the total revenue of ₦5,211,871 was earned by the farmers during the period and that the farmers made net income of ₦352,906.85 in the production season. The result obtained here agrees with Oladeebo and Okanlawon (2010).

CONCLUSION

The result revealed that the farmers made net income of ₦352,906.85 in the production season. This establishes the fact that yam production is profitable in Ikwuano LGA of Abia State. It was revealed that about 64.2% of the respondents have no extension agents' contact in their farming season Therefore, government should reactivate extension system and give them necessary support to enable them disseminate proper information to yam farmers in Ikwuano for increased yam production and more profit. Also, farmers' in Ikwuano area should get involved in yam production for food security and improved livelihood since it is a lucrative enterprise.

Table 1: Distribution of respondents based on socio economic characteristic of farmers

Variable	frequency	percentage
Age		
20-30	2	1.7
31-40	33	27.5
41-50	56	46.6
51-60	15	12.5
61 and above	14	11.6
Total	**120**	**100**
Gender		
Male	87	72.5
Female	33	27.5
Total	**120**	**100**
Educational attainment		
Non-formal	4	3.3
Primary school	20	16.7
Secondary school	56	46.7
Tertiary education	40	33.3
Total	**120**	**100**
Marital status		
Single	27	22.5
Married	72	60.0
Widow	21	17.5
Total	**120**	**100**
House Hold size		
1-4	13	10.8
5-9	60	50.0
10-14	30	25.0
15-19	17	14.2
Total	**120**	**100**
Farming experience		
1-9	45	37.5
10-19	27	22.5
20-29	28	23.3
30-39	11	9.2
40and above	9	7.5
Total	**120**	**100**
Labour source		
Own labour	12	10.0
Family	35	29.2
Hired	25	20.8
Family and hired	48	40.0
Total	**120**	**100**
Extension Contact		
Yes	43	35.8
No	77	64.2
Total	**120**	**100**
Access to Improved Input		
Yes	57	47.5
No	63	52.5
Total	**120**	**100**

Source: Field survey, 2016

Table 2: Cost and Return Analysis of Yam Production in Ikwuano LGA.

Item	Value	Percentage	Rank
Total Revenue (TR)	**5,211,871**		
Variable Cost			
Seed yam	4,722,997.9	97.20	1st
labour	89,512.5	1.86	2nd
Agro-chemicals	9,688	0.20	3rd
Transportation	2,177	0.05	4th
Total Variable Cost (TVC)	**4,824,375.40**		
Gross Margin (GM) = TR-TVC	**387,495.6**		
Fixed Costs			
Depreciation on implements	19,188.75	0.39	
Land charges (rent)	15,400	0.32	
Total Fixed Costs	**34,588.75**		
Total Cost of Production (TC)	**4,858,964.15**		
Net Income (NI) = TR – TC	**352,906.85**		

Source: Field survey, 2016.

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FACTORS INFLUENCING THE GROWTH OF CASSAVA VALUE CHAIN IN ANAMBRA AND IMO STATES, NIGERIA

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ABSTRACT

The study analyzed the cassava value chain in South Eastern Nigeria Specifically, it sought to identify the actors, roles and interrelationship across the chain, map the value chain, ascertain the benefit cost ratio of cassava processing, identify factors affecting growth and competitiveness of various channels, and then potential business solutions that will address constraints. The study was purposively carried out in Anambra and Imo States based on the intensity of cassava production, two local government areas (LGAs), and 30 respondents were selected from each of the LGAs, making it a total of 120 respondents comprising of producers, processors and marketers. Information was elicited from the respondents by means of focused Group Discussion (FGD), interview schedule and structured questionnaire. Data were analyzed with descriptive statistics. The results also show that the most important constraint militating against growth and competitiveness of the channels was unavailability of credit (85.00%) which ranked highest, followed by high cost of transformation (76.67%) high labour cost (69.17%) and high cost of processing (62.25%) which ranked second, third and fourth respectively. Potential business solution that will address constraints identified were access to credit (87.5%) which ranked first; this was followed by construction and rehabilitation of rural and feeder roads (81.67%), provision of storage facilities (76.67%) which ranked second and third respectively among other factors.It is advocated that policies regarding these identified potential solutions should be put in place and the resultant effect will be development and maintenance of a well-functioning market for Nigerian cassava and its products that will be able to compete favourably with products from other countries. Cassava value chains can also be enhanced through farmers cooperatives organized under a public private partnership strategy.

Keywords: value chain, cassava, growth and Nigeria

INTRODUCTION

Nigeria is the largest producer of cassava in the world with an estimated annual production of about 54 million metric tones (FAOSTAT, 2013). About 90% of this is however consumed as food in form of gari, abacha and fufu and also 70% of cassava produced in Nigeria is processed into gari (Onabalu, 1997).Across the country, cassava production has witnessed a tremendous increase for different reasons mainly due to introduction of high-yielding and disease-resistant varieties among other factors This increase in production between 2004 and 2006 came about as a result of the interventions of the Nigerian Government and some developmental agencies. The Nigerian Government facilitated the development of new disease-resistant cassava varieties by the joint efforts of International Institute of Tropical Agriculture (IITA), National Root Crops Research Institute (NRCRI), Root and Tuber Expansion Program (RTEP), and the Federal Ministry of Agriculture, in conjunction with State Agricultural Development Programs and cassava farmers. (Sanni *et al*, 2009) The Presidential Initiative on Cassava, launched in Nigeria in 2003, brought cassava and its potential to the national limelight (Sanogo and Adetunji 2008). The Initiative had as its goal the promotion of cassava as a viable foreign exchange earner and also the development of the production system to sustain the national demand. The Presidential Initiative focused its intervention on the development of production, processing, and marketing of the processed products.The cassava market in Nigeria can be classified into two broad categories based on the nature of demand namely: the traditional food-oriented market and the industrial market. The former refers to the demand for food consumption by individuals and households while the latter is the demand for cassava for industrial purposes (Knipscheer, et al, 2007).There is increasing demand for cassava product due to rapid population increase, high rate of urbanization and increased use of cassava products in the livestock, confectionery and starch industries.A value chain process involves all the activities that are undertaken in transforming raw materials into a product that is sold and consumed (Vermeuleu *et al.*, 2008).More so Value chain analysis (VCA) can be defined as a method of accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users Value chain activities include direct functions of primary production, collection, processing, wholesaling and retailing as well as the support functions. In value chain system, value is added at each point in the chain.Ananmbra and Imo states produce cassava in large quantity. In -depth value chain study in the states is scanty; the study investigated factors affecting growth and competitiveness of the various channels and the potential business solution that will address constraints and tap the opportunities.

METHODOLOGY

A purposive multistage sampling technique was used in selecting states and respondents. Two states, Anambra and Imo states were chosen from the five states in south eastern Nigeria based on intensity of cassava production. Two Local Government Areas were selected from each state, Awka North and Oyi for Anambra state, Ohaji Egbema and Owerri North for Imo State respectively.30 respondents were selected from each LGA making a total of 120 respondents comprising producers, processors and marketers. Information was elicited from the respondents by means of focused group discussion, interview schedule and structured questionnaire. Information gathered bordered on cassava production, processing and marketing. Data were analyzed using descriptive statistics

RESULTS AND DISCUSSION

Constraints militating against growth and competitiveness of the various channels

The results in Table 1 show the frequency distribution of respondents according to constraints militating against growth and competitiveness of the various channels . The results show that the most important constraint militating against growth and competitiveness of the channels was unavailability of credit (85.00%) which ranked highest, followed by high cost of transformation (76.67%) high labour cost (69.17%) and high cost of processing (62.25%) which ranked second, third and fourth respectively.

Others were; inadequate storage facilities (60.00%), unstable prices (53.33%), seasonality of product (47.50%) and use of crude facilities in processing (40.83%) which ranked fifth, sixth, seventh and eight respectively. Among the least constraints were; poor demand (34.17%), inadequate market information (30.00%), high market charges (23.33%) and unstable government policies (18.33%) which ranked ninth, tenth, eleventh and twelfth respectively.

Potential business solutions that will address constraints

The results in Table 2 show the frequency distribution of respondents according to potential business solutions that will address constraints. The results reveal that the most important potential business solution that will address constraints militating against growth was access to credit (87.5%) which ranked first; this was followed by construction and rehabilitative of rural and feeding roads (81.67%), provision of storage facilities (76.67%) which ranked second and third respectively. Others include; prices (68.33%), traditional wholesale and retail outlets (59.17%), National trade policies (51.67%), specialized wholesalers (50.33%) which ranked fourth, fifth, sixth and seventh respectively. Among the least solutions were, preferred suppliers (48.33%), information technology (45.33%), penetration into lower economic market segments (44.16%), centralized procurement (39.117%), domestic regulations (33.33%), market concentration (29.17%) and competition among retailers which ranked eighth, ninth, tenth, eleventh, twelfth, thirteenth and fourteenth respectively.

CONCLUSION

The study revealed that a lot of constraints militate against the growth and competitiveness of the value chain process; these include unavailability of credit, high cost of transportation, high labour costs, high cost of processing, inadequate storage facilities and unstable prices among others. Potential business solutions that will address the constraints identified were access to credit, construction and rehabilitation of rural feeder roads, provision of storage facilities, stable prices, traditional wholesale and retail outlets and specialized wholesalers among others. It is advocated that policies regarding these solutions and adequate strategies should be put in place and the resultant effect will be development and maintenance of a well-functioning market for Nigerian cassava and its products that will be able to compete favourably with products from other countries.

Table 1: Frequency distribution of Constraints militating against growth and competitiveness of the various channels

Constraints	*Frequency	Percentage	Rank
High market charges	28	23.33	11
Poor demand	41	34.17	9
Unstable prices	61	53.33	6
High labour cost	83	69.17	3
Unavailability of credit	102	85.00	1
High cost of processing	75	62.25	4
High cost of transportation	92	76.67	2
Use of crude facilities	49	40.83	8
Seasonality of product	57	47.50	7
Inadequate storage facilities	72	60.00	5
Inadequate market information	36	30.00	10
Unstable government policies	22	18.33	12

* = Multiple Response

Source: Field Survey, 2014.

Table 2: Frequency distribution of respondents according to potential business solutions that will address constraints

Potential solution	*Frequency	Percent	Rank
Specialized wholesalers	70	50.33	7
Preferred suppliers	58	48.33	8
Stable prices	82	68.33	4
Penetration into lower-economic market segments	53	44.16	10
Centralized procurement	47	39.17	11
Market concentration	35	29.17	13
Competition among retailers	18	15.00	14
National trade policies	62	51.67	6
Domestic regulations	40	33.33	12
Traditional wholesale and retail outlets	71	59.17	5
Information technology	55	45.83	9
Access to credit	105	87.50	1
Construction and rehabilitation of rural and feeder roads	98	81.67	2
Provision of storage facilities	92	76.67	3

* Multiple Responses
Source: Field Survey, 2014.

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ECONOMIC ANALYSIS OF GARI PROCESSING IN IBARAPA CENTRAL LOCAL GOVERNMENT, OYO STATE, NIGERIA

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ABSTRACT
This research work focuses the economic analysis of Gari processing in Ibarapa Central Local Government Area of Oyo State. It described the socio-economic characteristics of Gari processors, identified the processing methods available in the study area, identified the constraint encountered by the processors and determined its profitability among local producers. Farmers' use of indigenous knowledge in the processing of cassava into Gari for immediate economic returns and continuous revenue generation calls for critical evaluation. A multistage sampling technique was employed with a sample size of 120 processors. Descriptive and budgetary analysis were used and major findings revealed that only female were involved in cassava processing into gari with mean age being 40 years. Total fixed cost accounted 19.4% of total cost incurred in cassava processing. Therefore, the business can easily be set-up. Benefit Cost Ratio (BCR) is 1.90 which implies that every ₦1.00 invested in cassava processing into Gari, will yield ₦1.90. This shows that cassava processing into gari is profitable and sustainable with little capital. Lack of capital and market price fluctuation were the major constraints facing cassava processing into gari in the area.
Keywords: Gari, processing, economic analysis and Nigeria

INTRODUCTION
Cassava (*Manihot esculenta*) is an important staple food and cash crop in several tropical Africa country especially Nigeria where it play a principal role in the food economy. Nigeria is the largest cassava producing country in the world with an annual estimate of 49 million metric ton (Odedina and Adebayo, 2012). Among the starchy staples, cassava provides high carbohydrate production which is about 40.0 percent higher than rice and 25.0 percent more than maize. According to (Nweke *et al.*, 2002; Nweke, 2004), 80.0 percent of Nigeria in the rural areas eat cassava meal at least once a day, hence it plays a major role in the country food security. According to (Odedina and Adeboye, 2012), no Continent depends as much as on root and tuber crop in feeding the population as does Africa. In humid and sub-humid areas of tropical Africa, it is either a primary staple food or secondary co-staple. In 2002, cassava gained prominence in Nigeria following the pronouncement initiative on the crop. Cassava roots are used for human food and animal feed in a large number of different products. Various processing methods are used to produce different food products, depending on locally available processing resources, local customs and preferences. Cassava processing improves palatability, increases shelf-life, facilitates transport and, most importantly, detoxifies cassava roots by removing cyanogens (Westby, 2002).
A combined process of grating (shredding) and fermentation of cassava roots is important in the processing of roots for many West African products, including roasted granules (*Garri*), steamed granules (*Iattieke*) from Côte d'Ivoire and some of the fermented pastes (*Agbelina* and *placali* from Ghana and Côte d'Ivoire respectively) (Westby, 2002; Obilie *et al*., 2004). Furthermore, cassava generates income for its producers, processors, transporters and marketers and it serves as raw material in industries such as bakery, textile, paper, plywood and confectioneries (Anaekwe, 2012; FAO, 2003). In view of the benefits of cassava processing into Gari highlighted as aforementioned, efforts are being intensified towards increasing cassava processing into Gari in the country to the level of self sufficiency. One of such commitments was the pronouncement and investment of the Obasanjo administration to increase cassava processing into Gari to a level that it serves as the nucleus of much industrial production in Nigeria (Fakayode, 2008). However, farmers' use of indigenous knowledge in the processing of cassava into Gari for immediate economic returns and continuous revenue generation calls for critical evaluation. Hence, the focus of this study is to analyse the economics of cassava processing into Gari by describing the socio-economic characteristics of Gari processors, identifying the processing methods available in the study area, identifying the constraint encountered by the processors and determining its profitability among local producers, in Ibarapa central local government of Oyo State, it is generally observed that there is low level of investment in small scale cassava processing into Gari. This is evident in the preponderance of women most of whom are resource poor in cassava processing into Gari enterprises. Inadequate empirical data on value addition to cassava processing into Gari might be the bane of the inability of the enterprise to attract the necessary attention of private entrepreneurs in the sector. This therefore portends negative consequences for the food security and employment generation situations in Ibarapa central local government area in particular and Nigeria in general. Considering the intensified effort of research so far to maximize the use of various method of processing Gari, hence, this study becomes essential to bring in productivity into Gari processing and great income for Gari processors and cassava planting farmers thereby making them to be food secured.

MATERIALS AND METHODS

Oyo State is divided into administrative or agricultural zones: these are the Ibadan-Ibarapa, Oyo- Iseyin, Saki and Ogbomosho. Ibarapa zone is composed of three local governments which are Ibarapa North, Ibarapa East and Ibarapa Central. The study was carried out in Ibarapa central Local Government Area of Oyo State. Primary data were obtained through the administration of well-structured questionnaires which were used to obtain information from 120 Gari processors with the use of a multistage random sampling technique. Information such as age, sex, marital status, education, household size, religion, cost and return quantity and expenditure, revenue among others were obtained. Descriptive statistic (such as frequency count, percentage, mean), gross margin and regression analysis were used for the analysis. Gross margin was used to determine the cost and returns while regression analysis was used to determine the effect of socio-economic characteristic on the profitability level of the processor. Analysis of variance was used to test the hypothesis. The gross margin is specified as;

GM = TR – TVC

Where;

GM = Gross margin, TR = Total revenue, TVC = Total variable cos, TFC= Total fixed cost

GM – TFC = profit

In line with the use of ordinary least square multiple regression (OLSR) analysis; four functional forms were fitted into the data. The equation that gave the best fit was then selected as the lead equation based on conformity with a priori expectations (expected signs of the estimators, the magnitude of the coefficient of multitude determination (R^2) and the statistical significance of the parameter estimate). The explicit forms of the function are given as;

Y = b0 + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 + b8X8 + b9X9 + e

Exponential = lnY = b0 + b1X1 + b2X2 + b3X3 + b4X4 +b5X5 + b6X6 + b7X7 + b8X8 + b9X9+ e

Semi log = Y= b0 + b1lnX1 +b2lnX2 +b3lnX3 + b4lnX4 + b5lnX5 + b6lnX6+ b7lnX7 + b8lnX8 + b9lnX9+e

Double log= lnY = b0 +b1lnX1+b2lnX2 +b3lnX3 + b4lnX4+ b5lnX5+ b6lnX6+ b7lnX7+ b8lnX8 +b9lnX9+e

Where;

Y= profit (N), X_1 = Quantity of cassava tuber, X_2 = Amount spend on transport of product, X_3 = Equipment cost, X_4 = Amount spend on labour, X_5 = Amount spend on firewood, X_6 = Amount spend on basket, X_7 = Amount spend on broom, X_8 = Grating cost, X_9 = Market charges, e = error term.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

Table 1 shows that all the respondents were women which implies that only women were involved in Gari processing while men believed that Gari processing is women's job and therefore preferred involving in production rather than processing. A good number of the processors were in their active age with 39.68 years as the mean age with 7 years as average year of experience. Majority of the gari processors had no formal education which implies that gari processing in the study area cannot accept new innovation and modern technology easily since most of them were not educated. Majority of them were not members of Gari processing association/society, they believed that joining association/society required an entry cost which they were not ready to part with. Almost all of them had farming as primary occupation with mean household size of 4 persons per household. Above average of them used both hired and family labour for production. This implies that they have available family labour, though not enough with 4 persons per household size of household. It was also revealed that all of the processors adopted manual gari processing method with the opinion that the cost of modern processing machines are high and could not afford them. Almost all of them do not have more than one processing unit.

Major Constraints: Lack of capital and market price fluctuation were reported to be the most serious constraints facing gari processing in the area.

Costs and Returns

Table 2 shows that total fixed cost accounted 19.4% of total cost incurred in gari processing. Therefore, the business can easily be set-up. Benefit Cost Ratio (BCR) was 1.90. The BCR value shows that cassava processing into gari is profitable in the study area. The value means that for every (₦1.00) invested in cassava processing into Gari will yield ₦1.90k.

Regression Analysis

Regression result of which linear functional form was chosen as the lead equation shows F-value to be 65.638*** and R^2 to be 84.3% which implies that 84.3% factors that determine the revenue of cassava processors in the study area were explained by explanatory variables while the remaining 15.7% has been captured by the stochastic Error term. Note, independent variable with *, **, and *** is significant at 10%, 5% and 1% respectively.

$$\mathbf{Y = 4000.491 + 1.403 InX_1 + 10.964X_2 + 0.398X_3 + 1.338X_4 + 0.916X_5 + 3.623X_6 - 1.250X_7 + 5.729X_8 + 2.322X_9}$$

(4557.902)	(0.081)***	(3.455)	(0.422)	(5.241)	(0.257)***	(2.048)*	(-6.861)	(6.861)	(0.841)***

The above regression equation implies that if the ages of the respondents (X_1) are increased by three (3) units, then the output on quantity of cassava tuber monthly would be increased by 1.403 units. If the level of education (X_5) of the respondents is increased by three (3) units, then the amount spend on fire wood would be increased by 0.916 units. If the household size (X_6) of the respondents is increased by one (1) units, then the amount spend on basket would be increased by 3.623 units. Also, if the cost spent on transporting cassava is increased by three (3) units, then the market charges would be increased by 2.322 units. There would be an increase as a result of positive correlation between these variables X_1, X_5, X_6, X_9 and the output of cassava processing.

CONCLUSION

Although, cassava processing in the study area did not achieved absolute efficiency in the use of variable inputs, however, the study concluded that cassava processing into gari is profitable and sustainable with little capital. Based on the major findings, the study recommend that gari processors should use modern processing machines to improve their output, gari processors should be encouraged to join cooperatives societies so that the respondents will be able to increase their income and also there is need for adequate market with good stable prices for the respondents' products.

Table 1: Distribution of the Respondents According to the Socio-Economic Characteristics of the respondents in the Study Area

Variable	Frequency	Percentage (%)	Mean
Gender			
Women	120	100	2.00
Age			
21-30	28	23.3	39.68
31-40	31	25.85	
41-50	44	36.67	
51-60	16	13.33	
61-70	1	0.8	
Marital Status			
Single	4	3.3	
Married	114	95	
Divorced	1	0.8	
Widow	1	0.8	
Religion			
Christianity	62	51.7	
Islam	57	47.5	
Traditional	1	0.8	
Level of Education			
Non-Formal Education	87	72.5	
Formal Education	33	27.5	
Years of Experience			
1-5	72		7.34
6-10	28		
11-15	17		
16-20	3		
Society/Association			
Yes	45	37.5	
No	75	62.5	
Primary occupation			
Artisan	1	0.8	
Farming	119	99.2	
Household size			
0-5	104	86.6	
6-10	16	13.3	

Source: Field Survey, 2014

Table 2: Cost and Return

Cost and Return	Value (₦)
Total Revenue (TR)	3936624
Average Total Revenue (ATR)	32805.2
Total Cost (TC)	206100
Average Total Cost (ATC)	17242.5
Total Fixed Cost (TFC)	763950
Average Total Fixed Cost (ATFC)	6366.25
Total Variable Cost (TVC)	1305150
Average Total Variable Cost (ATVC)	10876.25
Gross Margin (GM)	21928.95
Profit (π)	15562.7
Expenses Structure Ratio (ESR)	0.194 = 19.4%

Source: Data Analysis, 2014

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MARKETING OF FLUTED PUMPKIN AMONG WHOLESALERS AND RETAILERS IN ESAN WEST LOCAL GOVERNMENT AREA OF EDO STATE

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ABSTRACT

Marketing of fluted pumpkin in Ekpoma Esan West local Government Area of Edo State, Nigeria was studied using eighty marketers (forty retailers and forty wholesalers) drawn from two markets using simple random sampling technique. Data for the study were captured from primary and secondary sources. Percentage response, marketing margin and marketing efficiency were used to address the objectives. The results of the study showed that the marketers were inefficient in their marketing margin as their values were less than 1, while both were efficient in their marketing efficiency. The major constraints to fluted pumpkin marketing were commission agent, poor access to credit facilities and poor storage facilities. Provision of improved storage facilities, reconstruction of rural roads, improved marketers' access to credit and stabilization of price were recommended.

Keywords: Marketing, fluted pumpkin, Wholesalers and Retailers

INTRODUCTION

Fluted pumpkin belongs to the family cucurbitaceae and supplies essential micronutrients in human nutrition, source of income and offer employment opportunities to the populace, especially women who formed the substantial producers in Southern Nigeria (Adaigbo, 2010).The leaf extracted from fluted pumpkin is used as blood tonic, the fruit case and pulp can be used for livestock feedstock, the pectin content of the pulp is used in the production of marmalade and the protein extracted from the leaf of fluted pumpkin can be used to feed farm poultry in form of protein concentrates (Obasi and Kalu, 2010). Marketing occupies a significant position in an exchange economy especially in areas where there is increasing commercial activities and high rate at urbanization exist (Iheme, 2008). It aids in addition of place, form and time utilities to a commodity as it moves from production to point of consumption (Nwaru, 2004). Marketing of fluted pumpkin products cover the services involved in moving fluted pumpkin product from the farm to the final consumer (Iheke, 2009). In developing countries such as Nigeria, marketing of cropsis faced with lots of problem which include seasonal price variations, transportation of harvest produce, storage and processing, grading, communication and credit facilities. These problems have negative influence on the efficiency of the marketing system of most agricultural commodities such as fluted pumpkin (Irene, 2002). Despite all the marketing problems of the vegetable which affect its supply and price, the demand of fluted pumpkin in the study area continue to be high. This necessitates the need for the study of marketing of fluted pumpkin so as to make appropriate recommendations on the efficient marketing of the vegetable in order to improve on the people's food security status as well to enhance the marketing employment potential of the crop especially to women that formed the substantial marketers. Specifically, the objectives are to determine the socio-economic characteristics of the marketers, assess the marketing margin of the marketers, appraise the marketing efficiency of the marketers and identify the problems encountered by the marketers (retailer and wholesalers).

MATERIALS AND METHODS

This study was carried out in Esan west of Edo State. Edo Esan West lies between longitude 060 04'E and 060 43'E and latitude 050 44'N. The markets in Esan west are Ekee by Ekee, idefas and new market. Questionnaire was used to collect the relevant data for the study. Eighty marketers (forty retailers and forty wholesalers) were selected using multi stage random sampling technique. The objectives of the study were analysed using percentage, marketing margin and marketing efficiency.

Wholesaler marketing margin = Selling price - purchase price

$$\text{Retailer marketing margin} = \text{Selling price} - \frac{\text{purchase price}}{\text{Selling price}}$$

The objective (iii) was captured using marketing efficiency.

$$\text{Wholesaler marketing efficiency} = \frac{\text{Marketing benefit X 100}}{\text{Marketing cost}}$$

$$\text{Retailer marketing efficiency} = \frac{\text{Marketing benefit X 100}}{\text{Marketing cost}}$$

RESULTS AND DISCUSSION

Table 1 show that female marketers dominated fluted pumpkin marketing for both wholesalers (70%) and retailers (75%) in the study area females are better hagglers of price than male counterpart. Large proportion (55%) of the wholesalers and retailers (50%) fell within age range of 21-41 years respectively, while the least 5% of wholesalers and 17.5% retailers' fells with age range of 42-62 years respectively. Youth marketers have the tendency of withstanding stress associated with marketing than aged ones (Obasi and Kalu, 2010). Forty percent (40%) of the wholesalers and forty two doth five percent (40.5%) of retailers were married, while 57.5% and 50% of wholesalers and retailers were single respectively. Also, 2.5% and 7.5% of the wholesalers and retailers respectively were widowed. Married people are likely to be assisted in the business by their household members. The Table 2 showed that wholesalers had selling price of ₦93, 600 and the retailer had ₦78, 400. The purchasing price of the wholesalers and retailers were ₦69, 900 and ₦58, 900 respectively. The wholesalers and retailers had marketing margin of 0.25 each. This implies that both wholesalers and retailers were inefficient since the values were less than one (Iheme, 2008).

Marketing efficiency is marketing benefit divided by the marketing cost multiple by 100. The marketing benefit is selling price, minus purchasing price which is equal to ₦23, 700 and ₦19, 500 for wholesalers and retailers respectively. Marketing cost items are specified in the Table 3. Table 3 showed that the total marketing costs were ₦71, 490 for wholesalers and ₦13, 880 for retailers. The cost items considered among the wholesalers; transportation (43.57%) was the highest. This finding is in line with (Iwena, 2009) who reported that high transportation cost could be associated with poor road network in most rural areas. However, marketing efficiency of 331.5% for wholesalers and 109.66% for retailers were indicated in table 4. This implies that both wholesalers and retailers of fluted pumpkin marketing were efficient in the marketing of fluted pumpkin in the study area.

Table 4 showed that 80% and 70% of wholesalers and retailers respectively reported on poor access to credit, Credit is needed to offset marketing cost and pays laborers involves in the business (Ume *et al*., 2009). More so, 60% of the wholesalers and 45% of the retailers encounter the problem of high cost of transportation .Transport, help for easy evacuation of the goods from points of production to final consumers at reduce cost, unfortunately, most rural roads are not accessible especially during rainy season (Arene, 2002). The other problems were poor storage facilities (60% of the wholesalers and 37.5% of the retailers), high perishability of commodity (77.5% and 75% of the wholesaler and retailers respectively), and problem of commission (60% of the wholesalers and 50% of the retailers).

CONCLUSION

The marketers were inefficient in their marketing margin, while efficient in their marketing efficiency of fluted pumpkin. Poor access to credit, poor/high cost of transportation and lack of storage facilities were the major constraints to fluted pumpkin marketing. The study recommended the need to rehabilitate rural roads, improves marketer's access to credit and improved storage facilities to reduce rate of spoilage of the vegetable.

Table I: Distribution of Respondents according to Socio-economic characteristics

Variable	Wholesalers		Retailers	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	12	30	10	25
Female	28	70	30	75
Age				
1-20	6	15	5	12.5
21-41	22	55	20	50
42-62	10	25	8	20
62 and above	2	5	7	17.5
Marital Status				
Married	16	40	17	42.5
Single	23	57.5	20	50
Divorced	0	0	0	0
Window	1	2.5	3	7.5

Source: Field Survey, 2015

Table 2: Distribution of Respondent According to Marketing Margin

Items	Wholesalers Value (₦)	Retailers Value (₦)
Selling Price	93, 600	78,400
Purchasing Price	68,900	56,900
Marketing Margin	0.25 %	0.25 %

Source: Field Survey, 2015

Table 3: Distribution of Respondents According to Marketing Cost

Items	Wholesalers		Retailers	
	Value (₦)	Percentage (%)	Value (₦)	Percentage (%)
Transportation	31,150	43.57	1,330	9.58
Loading	6,050	8.46	0	0
Off loading	5,040	7.04	0	0
Communication	6,400	8.93	600	4.32
Commission agent	3,000	4.19	900	6.48
Sanitation	1,650	2.30	850	6.12
Cost of grading	1,950	2.30	0	0
Security	3,400	4.75	200	1.44
Material Cost	2,850	17.97	8,000	57.63
Total	71,490	100	13,880	100

Source: Field Survey; 2015

Table 4: Constraints to Fluted Pumpkin Marketing

Constraint	Wholesalers		Retailers	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Poor access to credit	32	80	28	70
High cost of transportation	24	60	18	45
Seasonality of Supply	30	75	32	80
Poor storage Facilities	2	60	3	37.5

Source: Field Survey, 2015

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ASSESSMENT OF MAIZE GRAIN MARKET STRUCTURE IN SAMINAKA TOWN OF LERE L.G.A., KADUNA STATE, NIGERIA

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ABSTRACT
The study was carried out to examine the maize grain market structure in Saminaka town which is noted for marketing of maize grain. Single stage sampling was adopted for the purpose of this study. A total of fifty maize grain marketers (twenty wholesalers and thirty retailers were randomly selected at the central market) were chosen as respondents. Data were collected by the help of structured questionnaire and interview schedule. Analyses of data were done using descriptive statistics and Gini Coefficient. Product differentiation existed and there were little barriers to entry into the maize grain market. The Gini Coefficient values of 0.1987 (wholesalers) and 0.09275 (retailers) were recorded, indicating an existence of some degree of sellers' concentration in the wholesalers side. Government policies should be directed towards reducing transportation costs, rent charges by the local government authority and provision of micro-credit for the traders to expand their purchases.
Key Words: Assessment, maize grain, market structure and Gini coefficient

INTRODUCTION
Marketing is the sum total of all business activities performed in the movement of commodities from the point of initial production until the commodities are in the hands of the ultimate consumer (Adekanye, 1998). Market structure refers to the number and size distribution of buyers and sellers, product differentiation and presence or absence of barriers to entry into the market (Anuebunwa, 2002; Okereke *et al.,* 1988). The origin of maize is not yet fully known but many Authors claimed that maize is native of tropical America where it is cultivated for thousands of years ago. It was said to be introduced to America few years after the discovery of America in 1492. The source of introduction to Africa was not quite certain. The plant might have been introduced through the first European contact with the West Africa Coast (Adegbola *et al.*, 1976). Maize is scientifically called *Zea Mays*. It is a cereal crop. With the rapid expansion of livestock industries in the country and the higher food demand by the ever-increasing population, the need to increase and improve on maize production is imperative. Given the critical roles of adequate food and nutrition in the development process and in supporting world peace and stability, greater attention has been paid to food and nutrition issues at the levels of national government especially in the less developed countries as well as by the international community (World Bank, 1986). Maize production is an appropriate system to supply the fast growing human population with dietary deficiencies among households. It also has the capacity to produce additional income to the generally resource-poor families especially women which in the long run contributes significantly to food security and poverty alleviation (Gue'ye, 2002). The high risks and uncertainties, price fluctuations, transportation cost, inadequate market information and facilities had been identified as responsible for the high marketing cost in food marketing (Anuebunwa, 2007; Anuhihe and Eze, 2002). This study therefore was designed to assess the market structure of maize grain in Saminaka town of Kaduna state, Nigeria which is known to produce large quantity of maize in the state and the country at large.

METHODOLOGY
The study was purposively carried out in Saminaka town which is noted for production and marketing of maize grain. Single stage sampling was adopted for the purpose of this study. The Saminaka central market is selected which is noted for its marketing of maize grain. A total of fifty marketers (twenty wholesalers and thirty retailers were randomly selected in the market) were chosen as respondents. Data were collected by the help of structured questionnaire and interview schedule. Analyses of data were done using descriptive statistics such as percentages, frequencies, means and tables and Gini Coefficient. The Gini Coefficient (G) was used to determine the structure of the maize grain market.
The model is stated in line with Anuebunwa (2008) as:

$$G = 1 - \sum_{I=1}^{K} X_i Y_i$$

Where,

X_i = percentage of maize grain traders in the ith class of traders
Y_i = cumulative percentage of maize grain traders in the ith class of traders

k = number of class

The Gini coefficient varies from 0 to 1, where 0 implies perfect equality in the distribution (perfect market) and 1 implies perfect inequality (imperfect market, high level of seller concentration) (Okereke and Anthonio, 1988).

RESULTS AND DISCUSSION

Socio-economic characteristics of the Respondents

Table 1 shows the socio-economic characteristics of the marketers in the study area. The table shows that gender wise, male poultry chicken marketers constituted 68% while females are 32 percent. This implies that there are more male maize grain marketers than females in the study area. The table further revealed that majority (56%) of the marketers fall within the age range of 31-50 years while 34% of the marketers are above 50 years. This implies that the marketers are still in their productive age. It is expected that respondents in these age brackets can take risks and initiatives which are expected factors marketing activities as they have the strength to move from one location to another. Moreover, majority (94%) of the marketers are married and most (94%) of the marketers have one form of education or the other. The table shows that 28% of the marketers have less than 10 years of experience in local maize grain marketing while majority (68%) have 11- 30 years marketing experience. A similar study by Okereke and Anthonio (1988) established a significant relationship between marketing experience and volume of sales in the wholesale and retail trades. The table also revealed that 72% belong to the local maize grain traders association, while 28% do not. This implies that prices for the crop most times are determined by the association. According to Anuebunwa (2008), membership in traders association offers opportunity for the creation of implicit barriers to entry and exit into the trade. This influenced the nature of the market. Table 2 shows the distribution of maize grain wholesalers by monetary value of monthly sales. The table reveals that the wholesaler's average monthly sales were ₦2,401,700. Majority of the wholesalers (80%) sold maize grain worth of ₦47,500,000 representing 98.9% of the total value of monthly sales whereas 15% of the wholesalers sold maize worth of ₦259,000 monthly. The distribution gave a Gini coefficient of 0.6294. A Gini coefficient of 0.1987 implies inequality in the distribution showing the market to be an imperfect market. The result is in consonance with previous works by Anyaegbunam (2012); Okereke and Anthonio (1988) and Anuebunwa (2002; 2007) respectively who reported an imperfect competitive markets for staple food items. Similarly, at the retailers' level. Table 3 shows the distribution of maize grain retailers by monetary value of monthly sales. The table reveals that the retailer's average monthly sales were ₦263,050. Thirty percent (30%) of the retailers sold maize valued ₦4,500,000 representing 57.1% of the total value of monthly sales whereas 6.7% of the retailers sold maize worth ₦1,790,000 representing 22.7% of the total value of monthly sales. The distribution gave a Gini coefficient of 0.09275 which implies inequality in the distribution showing the market to be an imperfect. Many varieties of maize grain were displayed for sale but they differ in terms of size, colour and weight. There are little barriers to entry into the maize grain marketing business. At the wholesalers' level, prospective marketers have to register with the cooperatives for quicker sales of their products while most of the retailers do not necessarily need to register with marketers association. Results of the study indicated that there existed some degree of market concentration in the wholesalers' side. The gini coefficient of 0.2 (wholesalers) and 0.1 (retailers) confirmed the finding.

CONCLUSION

The study examined the maize grain market structure in Saminaka town of Kaduna state. The Gini coefficient analysis showed that maize grain marketing system is an imperfect competitive market as shown by the results of the Gini coefficient. Government policies should be directed towards reducing transportation costs, rent charges by the local government authority and provision of micro-credit for the traders to expand their purchases.

Table 1: Distribution of Respondents according to Socio-economic Characteristics

Variable	Frequency	Percentage
Gender		
Men	34	68
Women	16	32
Total	50	100
Age		
10-20	1	2
21-30	4	8
31-40	12	24
41-50	16	32
>50	17	34
Total	50	100
Marital Status		
Married	47	94
Single	3	6
Total	50	100
Educational Attainment		
No. Education	3	6
Adult Education	5	10
Primary Education	11	22
Secondary Education	20	40
Quranic Education	8	16
Tertiary Education	3	6
Total	50	100
Trading Experience (Years)		
<10	14	28
11-20	26	52
21-30	8	16
31-40	2	4
>40	0	0
Total	50	100
Traders Association		
Yes	36	72
No	14	28
Total	50	100

Source: Field Survey, 2016

Table 2: Distribution of maize grain Wholesalers by average size and total value of monthly sales in Saminaka area of Kaduna State

Sales class in ₦	Frequency	% of Wholesalers (Xi)	Cumulative %	Total value of monthly sales (₦)	% Total value of monthly sales	Cumulative % Yi	XiYi
<100000	3	15	15	259000	0.54	0.54	0.00081
100000-200000	-	-	-	-	-	-	
201000-300000	1	5	20	275000	0.57	1.11	0.00051
301000-400000	-	-	-	-	-	-	
401000-500000	-	-	-	-	-	-	
>500000	16	80	100	47,500 000	98.9	100	0.8
Total	20	100		48,034,000			0.80132
Mean				2,401,700			
Gini coefficient							0.1987

Source: Field Survey, 2016

Table 3: Distribution of maize grain Retailers by average size and total value of monthly sales in Saminaka area of Kaduna State

Sales class in ₦	Frequency	% of Retailers (Xi)	Cumulative %	Total value of monthly sales (₦)	% Total value of monthly sales	Cumulative % Yi	XiYi
<10000	-	-	-	-	-	-	-
10000-20000	2	6.7	6.7	178,000	2.3	2.3	0.00154
21000-30000	6	20	26.7	467,500	5.9	8.2	0.0164
31000-40000	11	36.7	63.4	956,000	12.1	20.3	0.7464
41000-50000	2	6.7	70	1,790,000	22.7	42.4	0.02841
>50000	9	30	100	4,500 000	57.1	100	0.3
Total	30	100		7,891,500			1.09275
Mean				263,050			
Gini coefficient							0.09275

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DETERMINANTS OF PRODUCTIVITY AMONG ARABLE CROP FARMERS IN IMO STATE, NIGERIA

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ABSTRACT
The study evaluated the factors affecting productivity of arable crop farmers in Imo State. Convenience sampling technique was used in selecting the three agricultural zones in Imo State. Simple random sampling techniques were used in selecting 3 L.G.As in each zone. Mbaitolu, Ngor-Okpala and Mbaise L.G.As were chosen from Owerri agricultural zone whereas Obowo, Okiqwe and Ehime-Mbano L.G.As were from Okiqwe agricultural zone and Orsu, Ideato-south and Nwangele L.G.As were from Orlu agricultural zone. One community was randomly selected from each L.G.A., from which 10 farmers were randomly selected, thus bringing sample size to 90. Data were analyzed using frequencies, means and the Ordinary Least Squares method of multiple regression analysis. The result shows that the most common cropping system practiced by arable farmers in the study area is mixed cropping and cassava is the most common crop planted by all the farmers interviewed., 92.22% of the crop combinations which was highest had cassava, yam, maize, okra, melon, vegetables and cocoyam. The co-efficient of extension contact (X_6) and Planting material (X_7) were highly significant and positively related to the gross value of output which suggests that if extension services to farmers and improved planting material are increased this will lead to increase productivity. However, basic amenities, finance, high cost of labour resources and others are the problems militating against increased productivity of farmers. It is recommended that soft loan and subsidized improved varieties of crops should be provided by government including tractors to substitute declining labour resource.
Keywords: Farmers, Extension, Arable, Crop and Productivity

INTRODUCTION

Food remains the most essential need of man (Okon *et al.,* 2005). Agriculture provides over 80% of the food needs, contributes more than 30% of the total gross domestic product, employs about 70% of the non – oil export of Nigeria (Adegboye, 2004). In recent times, low production and productivity have characterized this sector and in effect cannot effectively perform these roles. This has mostly manifested as food insecurity (Eze *et al*., 2012). Food insecurity indicated according to FAO (2012) include reduction in both capacity and attitude to work, poverty, corruption, low life expectancy, infant mortality and malnutrition among others. Small holder farmers produce on subsistence level and are not involved in commercial agriculture (Oladeebo, 2004). To ensure food availability, accessibility and affordability (food security), agricultural production needs to be increased by 2.3% annually over the next decade in order to meet the population growth of 2.1% (Onyenweaku *et al.,* 2010). The apparent disparity between the rates of food production and food demand led to massive food importation and high food prices in the country (Eze *et al.,* 2012). Food shortage is attributed to inefficiency in production and small scale operation by farmers (Ibeawuchi *et al.,* 2007). The crucial issue in the Nigeria agriculture is that of low productivity (Bamidele *et al.,* 2006). Despite all human and material resources devoted to agriculture, the productive efficiency for most crops still fall below 60% (FACU, 1992; FDA, 1993; FDA, 1995). The inefficiency problem is attributed to factors such as use of low input technologies, lack of knowledge of available high input techniques or inadequate management (due to lack of skills, motivation etc), use of poor crop varieties, cropping pattern practiced, lack of poor extension services, unavailability and affordability of input such as fertilizer, improved seeds and seedlings. This aims at evaluating the cropping system produced by arable crop farmers. A study of this nature is expected to serve as a useful guide to policy makers, extension agents and farmers on possible measures that could facilitate increased arable crop production in the study area.

MATERIALS AND METHODS

The study was carried out in Imo State of Nigeria. Imo State is located in the south-eastern part of Nigeria with a total land mass of 7480 square kilometers and a population of 3,932,899 million people (NPC, 2006). The State lies between latitude 40 41S and 6041E. The State is divided into three agricultural zones namely Okigwe, Owerri and Orlu agricultural zones. The study evaluated the factors affecting productivity of arable crop farmers in Imo State. Convenience sampling technique was used in selecting the three agricultural zones in Imo State. Then simple random sampling techniques were used in selecting 3 L.G.As in each zone. Mbaitolu, Ngor-Okpala and Mbaise L.G.As were selected from Owerri agricultural zone while Obowo, Okiqwe and Ehime-Mbano L.G.As were selected from Okiqwe agricultural zone and Orsu, Ideato-south and Nwangele L.G.As were selected from Orlu agricultural zone. One community was randomly selected from each L.G.A. From each community, 10 farmers were randomly selected thus bringing the sample size to 90. The farmers were classified according to types of farm enterprises they are practicing. The sampling frame comprised the list of all registered arable crop farmers obtained from the Imo State Agricultural Development Programme (ADP). The primary data used for the study were collected from the field using well structured questionnaire. Data collected were analyzed using descriptive statistics and the ordinary least square method of multiple regression analysis. In line with the use of ordinary least square multiple regression (OLSR) analysis; four functional forms were fitted into the data. The equation that gave the best fit was then selected as the lead equation based on conformity with a priori expectations (expected signs of the estimators, the magnitude of the coefficient of multitude determination (R^2) and the statistical significance of the parameter estimate). The explicit forms of the function are given as;

Linear function= $Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$

Exponential = $\ln Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$

Semi log = $Y = b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + e$

Double log = $\ln Y = b_0 + b_1\ln X_1 + b_2\ln X_2 + b_3\ln X_3 + b_4\ln X_4 + b_5\ln X_5 + b_6\ln X_6 + e$

Where;

Y = gross value of output (Naira), X_1 = age of farmers (years), X_2 = educational level (years), X_3 = farm size (hectares), X_4 = farming experience (years), X_5 = household size (number of persons), X_6 = extension contact (number of visits by extension agents), X_7 = Expenditure on planting material (Naira), X_8 = labour input (man-days) and e = error term.

RESULTS AND DISCUSSION

Socio-Economic Characteristic of Arable Farmers

Results of socio-economic characteristic of arable farmers' shows that those between 41-50 years of age constituted the highest (37.78%) followed by those between 51- 60 years of age constituting 26.67%. This implies that there were more aged farmers than younger ones and this would affect the productivity of farmers as farming activities requires strength and bending work like planting, weeding, heaping and carrying objects. Educational level shows that those who spent between 7-12 years in school constituted 37.78% as highest followed by those who spent between 0 - 6 years in school constituting 26.67%. Caswell *et al.*, (2001) remarked that education is thought to create a favorable mental attitude for the acceptance of new practices especially information on improved crop varieties and better management methods. The number of years spent in farming shows that those who have spent 6-11 years in farming constituted 58.33% as highest while those who had farming experience of more than 12 years and above followed with 36.67%. This gives an indication of practical knowledge acquired on how the farmer can overcome certain inherent problems associated with that farming business (Nwaru, 2006). Those with farm size of 0.10 to 1.9 hectares constituted highest with 44.44% followed by those having 0.0 to 0.10 hectares constituting 30.00%. Farm size has negative impact on productivity if the farmer does not use mechanized methods in the light of large farm size. Majority of the farmer's household size have 5 - 8 persons constituting 48.89%, followed by farmers having more than 9 persons constituting 34.44%. Large household size if properly used could reduce cost for the farmer and increase productivity of the farm. This is necessary as households count more on household members for labour than hired labour in their farms. This finding is synonymous with Iheke, (2010). About 86.67% of the farmers are married while 13.33% are single which shows that farming is a serious business. Based on gender, women represent 56.67% of the farmers while 43.33% are men which agree with Okoye and Onyenweaku, (2007) who reported that women dominated in farming activities. Result further shows that 53.33% of the farmers have farming as their main occupation as engagement in other non-farm activities causes them to have divided attention.

Cropping System

Table 1 shows the frequency of farmers according to crop mixture. It showed that the most common cropping system practiced by arable farmers in the study area is mixed cropping and cassava is the most common crop planted by all the farmers interviewed., 92.22% of the crop combinations being highest had cassava, yam, maize, okra, melon, vegetables and cocoyam. According to Ibeawuchi *et al.*, (2007), these crops dominate most crop combinations because of the position they occupy in the daily life of people of the state. This could be attributed to the relative importance of the crops involved. Cassava is a major source of cheap calories and can be processed and consumed in various forms. Its usage as a source of ethanol for fuel, energy in animal feeds and starch for industry is increasing. Vegetable is a good source of minerals and vitamins. Melon which is used to prepare delicious soup is a good source of vegetable oil and contains some levels of protein. Maize is a source of carbohydrate and protein. It also serves as feed for animals. Yam is a good source of carbohydrate while 13.33% as the least had cassava, vegetables, melon, and maize and okra. Which is similar to the one above?

Table 2 shows the result of the ordinary least square multiple regression estimate on the determinant of value of output of arable farmers. Four functional forms (linear, double-log, semi-log, exponential) were fitted to the data and based on the magnitude of the co-efficient of multiple determinations (R^2), the model with the highest number of significant explanatory variables in conformity with the priori expectation and the model with best fit were chosen. Semi-log was chosen as the lead equation based on the values of the multiple determinations (R^2) and it is the model with the highest number of significant explanatory variables in conformity with the priori expectation and also the model with best fit. The coefficient of multiple determinations (R^2) of 0.62 implies that 62% of the variation in the value of value of gross margin can be explained by the joint action of the included explanatory variables. The table shows that the co-efficient of extension contact (X_6) and Planting material (X_7) were highly significant and positively related to the gross value of output. This suggests that total factor productivity will increase significantly if extension services to farmers and improved planting material are increased above their present levels of use. It is expected that productivity will increase if more experienced and educated farmers cultivate hectares of farm land while Age (X_1) is inversely related to productivity. This suggests that if these factors are increased above their present levels, productivity will decrease significantly. This is expected if aged and weak farmers are involved in agricultural production, it decline productivity as they would be too old and weak to farm.

Farming Constraints

Under this circumstance of farming constraints, majority of the respondents lacked basic amenities as represented by 92.22% of the respondents. This can be attributed to lack of good roads, storage facilities, markets for goods produced and lack of power faced by the farmers. It was followed by finance which was represented by 82.22% of the respondents. This could be attributed to high interest rate from financial institutions, making access to finance impossible for farmers and there is no financial help from government such as soft loan or subsidized farm inputs for farmers to increase their productivity. Another major problem revealed by the respondents was declining labour resource which indicated 48.89%. Scarcity of labour force could be attributed to urbanization where youths are looking for much gainful employment or white collar jobs in the urban centers.

CONCLUSION

Based on the result of the study which showed that the resource inputs were not efficiently utilized, allocated and managed by the arable farmers and in order to attain optimality in the use of farm resource inputs factors such extension agents should encouraged and increase in number to educate farmers on innovation in agriculture increase their productivity and to make available better improved planting materials needed by farmers to increase production. Based on the findings and discoveries from the study, it is recommended that basic amenities required by farmers to cultivate and transport their produce should be provided by government, soft loan and improved subsidized new varieties of crops, tractors to substitute declining labour resource, extension departments in ministries, good road network to and from farmers farm and government agencies like ADP, Fadama should be empowered to enlighten and empower farmers to increase their production level. Modern facilities should be provided to attract and encourage younger farmers and men.

Table 1: Frequency Distribution of Farmers According to Crop Mixture

Crop mixture	Frequency	Percentage	Crop mixture	frequency	percentage
C/Y/M/OK/ML/V/CY	83	92.22	ML/M/V/C/OK	54	60
M/C/V/CY	82	91.11	C/ML/M/V	40	44.44
C/M/V/CY/Y	80	88.89	V/M/Y/C/OK	38	42.22
M/C/V/OK/Y/ML/CY	75	83.33	C/M/Y	35	38.88
M/C	71	78.89	CY/M/C/V/Y/OK	30	33.33
Y/ML/C	68	75.56	C/ML/Y/V/OK	27	30.00
CY/M/V/Y/C/OK	63	70.00	M/C/Y/CY	22	24.44
Ok/V/CY/ML/C	60	66.67	M/C/OK	21	23.33
M/Y/CY/V/C	55	61.11	Y/M/V/C	15	16.67
C/M	54	60.00	C/V/ML/M	12	13.33

Note: M – Maize, Y – Yam, C- Cassava, OK – Okra, V – Vegetable, ML – Melon, CY – Cocoyam

Source: Field Survey, 2013

Table 2: Result of Multiple Regression Analysis on the Factors Influencing Honey Production

Explanatory Variable	Linear	Double log	Semi log	Exponential
Constant	121.50	83.10	4.24	97.42
	(0.00)	(0.14)	(20.33)	(0.01)
Age (X1)	-0.12	-0.58	-0.19***	6.40
	(-1.10)	(-0.35)	(-1.95)	(1.74)
Educational level (X2)	-0.10	-0.06	0.01	0.05
	(-0.10)	(-0.40)	(0.17)	(0.73)
Farm size (X3)	0.06	0.02	0.89	-0.02
	(0.60)	(0.21)	(1.01)	(-0.39)
Farming experience (X4)	-0.01	0.04	-0.00	-0.06
	(-0.16)	(0.30)	(-0.09)	(-0.76)
Household size (X5)	0.12	-0.18	0.05	0.02
	(1.32)	(-1.08)	(0.68)	(0.31)
Extension contact (X6)	0.54*	0.68*	0.59*	0.68*
	(4.69)	(4.38)	(5.65)	(8.47)
Planting material (X7)	0.18	-0.17	0.29**	-6.46
	(1.30)	(-0.01)	(2.25)	(-1.76)
Labour input (X8)	0.06	-0.10	0.14	0.14
	(0.65)	(-0.61)	(1.67)	(1.72)
R^2	0.53	0.49	0.62	0.60
F ratio	9.57	3.66	13.97	13.39
N	90	90	90	90

Source: Field Survey, 2013

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PRODUCTIVITY ENHANCING FARM PRACTICES AND INFLUENCE ON FARMERS' INCOME IN THE SAVANNA REGION OF NIGERIA

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ABSTRACT
This study examined the productivity enhancing farm practices' effect on farmers' income in the Nigerian savanna belt of Northern Guinea Savanna and Sahel Savanna. By the use of structured questionnaires, data for the study were obtained from 170 farmers. Descriptive statistics and multiple regression analysis were used to analyze data obtained. The result presented average age of farmers to be 42 years as the household size mean value was found to be 13.4 ranging between 3-29 people. About 41.8% of the farmers are not learned in English language while also, about 56% have between weekly to monthly contact with extension services. The productivity enhancing farm practices like usage of chemicals, fertilizers, improved seeds, credit facilities, animal traction, tractor facilities, crop rotation practice, technical labor, storage practice and crop processing were assessed. The influence of these improved farm practices was found to be positive and significantly related to the farmers' income. Recommendations were made for farmers to adopt these farm practices and for improvement in extension linkages to sensitize small-scale farmers on the need for the adoption of improved farm practices.
Keywords: Productivity enhancing farm practices, farmers income, Savanna region and Nigeria

INTRODUCTION

The Northern and Southern Guinea Savannas, (Sub humid zone) and the Sudan Savanna, (higher rainfall part of the semi-arid zone) have the highest potential for crop–livestock farming in the whole of West Africa (Winrock 1992). The Savannah region of Nigeria is a region where the people mostly are dependent on agriculture and stock raising for their livelihood, and as a rough estimate, it is propounded that 3 out of 4 people in this zone are engaged in these activities (FAO, 1974). The agricultural production of the staple crops in Nigeria is however largely from this region. The national estimated cereals production for the year 2010 shows that the savannah region alone produced between 94-100% total cereal productions for the year. Kano and Kaduna states alone produced 21.2%, 16.3%, 15.8% and 13.38% of the estimated total national output of sorghum, maize, rice and millet respectively (NAERLS & NPAFS, 2010). Cowpea, which is another household staple in the country, the Savanna alone produced over 98% of the total national production, while Kano and Kaduna states altogether produced 6.81% of the sum. The national agricultural production data for vegetable crops are similar in this regard (NAERLS & NPAFS, 2010). Gallup and Sachs (2000) have however estimated that wet tropical countries have 27% and dry tropics 42% lower productivity than temperate regions. The Nigerian Savannah of course falls within the 42% lower productivity in comparison to the temperate region. In Nigeria, agriculture is predominated by small-holder farming. Up to 90% of total agricultural production is directly linked to small-holder farmers, which cultivate about 2 hectares of land on average (Government of the FRN, 2006). These farmers are illiterates and their mode of cultivation is rudimentary. Traditional agriculture is widely practiced, with the use of hoes and low usage of productivity enhancing farm inputs like the improved seeds, credit facilities, fertilizers and chemicals, are widespread. Agriculture in the country is therefore plagued with low productivity per hectare and consequently, farmers are poor. These problems have led the government to embark on policies which are capable of developing the agricultural sector. In this regard, a series of agricultural development programmes have been instituted while a number of research institutes and universities founded in other to enhance growth in agricultural sector through the generation of adaptive research and extension linkages for farmers to adopt improved agricultural farm practices in the country. These research institutes and universities are established to develop new technologies and improve on the existing ones through basic and applied researches and disseminating their findings to farmers all over the country to help improve the food producing sector of the country's economy. Noteworthy, however is the fact that literatures on the usage of productivity enhancing farm practices, so introduced to farmers over the years from these adaptive researches, are few, and the influence of the adoption of improved practices on the farmers income, as a measure of farmers livelihood, are not well researched. This study is aimed at bridging the research gap, as the results will indicate the influence of usage of these farm practices as the anticipated findings will be useful to the extension outfits, local and international research institutes, and undoubtedly, the farmers who will begin to see the potential possibilities of intensifying production, increase their farm output and returns to agricultural production.

MATERIALS AND METHODS

This study was carried out in Kaduna and Kano states in the northern part of Nigeria, covering two agro ecological zones—the Northern Guinea and the Sudan Savannah regions of the country. These zones lie between latitude 8^0 and 13.5^0N, and longitude 3^0 and 15^0E. Agriculture is the main occupation of the largely Hausa-Fulani tribes-men of the region. The regions are marked with dissimilar and remarkable differences in farming practices as shown in Figure 1. For example, the Northern Guinea Savanna is the moist-semi-arid zone and the largely cultivated food crop is Maize and with movement further drier north, Sorghum becomes the more essentially cultivated food crop towards the dry semi-arid; Sorghum and Millet are the two major cereals cultivated in mixed cropping. In the Sahel Savanna however, Millet takes higher importance with increasing aridity (FAO, 1980). A three level multistage random sampling method was use for this study. At the first stage, a random sample of 11 and 6 local governments areas in Kano and Kaduna states, which are made uo of 44 and 23 local government areas were respectively, representing a 25% sample frame, was done. At the second stage, a random selection of two villages within the local governments where done. At the last state, 5 farmers were further sampled per village, meaning that in each local government area, ten farmers were administered questionnaires. Altogether, 170 farmers were sampled. The tool of analysis for this study included descriptive statistics, used mainly to express the socio-economic characteristics of the farmers and identify the adopted improved farm practices of the farmers. Furthermore, regression analysis was used to determine the effect of adopted productivity enhancing farm practices on farmers' income.

The model is implicitly specified thus:

$$\mathrm{Yi} = \alpha \mathrm{Xi} + \mathrm{Ui}$$

Y_i = Farmer's total revenue in naira
X_1= Total land area in hectares
X_2= Total cost of labour in naira
X_3 = Total cost of improved seed in naira
X_4= Total cost of fertilizer in naira
X_5= Total cost of chemicals in naira
X_6= Total cost of traction in naira
X_7 = Adopted improved farm practices, scored
α = Coefficients of variables specified
U = Error term

RESULTS AND DISCUSSION

Table 1 shows the result of the findings made from the observation of the socio-economic characteristics of the farmers; that 63.3% of the respondents are observed to be in the age range of 31-50 years which is noted to be the virile age range where farmers can do a lot of farm work. The average age of the farmers was found to be 42 years. The farming population is essentially a young one. Furthermore, it was revealed that 82.4% of the farmers have been farming with the experience of more than 10 years. This represents a sizeable percentage of farmers in the sampled area. It is to be expected that with growing numbers of years of farming, farmers tend to gain better understanding in the art of farming to the advantage of acquiring experience and increasing productivity. This also helps to identify farmers who have perhaps lived all or most of their lives farming (Ojeleye, *et al.*, 2014). The mean figure for farming experience in years was found to be 22.7 years. Table 1 also shows that 51.8% of the farmers have household sizes between the ranges of 11-20 people per household, while 3.5% of the sampled farmers have household sizes greater than 20 people. The mean household size was however found to be 13.4. Our study also shows that about 6.5% of the farmers had no formal education. 35.3% of the respondents had Quranic education while 9.4% have had adult education. For primary, secondary and post-secondary educations, about 32.9%, 11.7% and 4.1% of the respondents, respectively have acquired these forms of education. Education allows for better judgment of farmers, aiding them to adopt new innovations, and improved farm practices that are vital for increased productivity. The frequency of extension contact is also captured in Table 1, as about 56% of the sampled respondents had between weekly to monthly contact with extension services. Only 12.4% of the respondents have no contact at all with extension services, while 8.8% had between once to twice in a year contact. Regular and frequent contact with extension agents, extension services and platforms, are expected to facilitate the adoption of improved farm practices.

Usage of Productivity Enhancing Farm Practices

Farmers' use of productivity enhancing farm practices is shown in Table 2. The use of chemicals in the form of pesticides and herbicides is widespread, 78.2% of the farmers, showed a high level of awareness and usage. This will undoubtedly bring about increased productivity, particularly, if the usage of these chemicals follows recommended practices. Fertilizer use among the farmers was of 92.9% of the sampled farmers. The widespread and high frequency of observation of the use of these chemicals is a good indicator for higher productivity. The response of farmers to the use of improved seeds was also captures by this study. Animal traction usage received a wide coverage among the sampled respondents. It was observed that 75.3% and 81.2% of the respondents are aware and use improved seeds and seedlings, and animal traction respectively, for their farm operations. The access to and usage of farm credit was only about 10% of the respondents. It simply means that 90% did not gain any form of access or usage of farm credit. Tractor use and access to heavy machineries like crushers, seed drill, threshers, which are modern farm machineries mostly tractor mounted, in effect substitute human drudgery on the farm, thereby permitting increased cultivation, production and productivity. The presentation in Table 2 shows that only 24.7% of the sampled respondents patronize tractor facilities. The access to technical labour, that has to do with skill labour required for modern and sophisticated machineries, which the farmers can not readily operate, is connected to this. It is shown in Table 2 that 60.6% of respondents responded to the access of technical know-how personnel, only 50.5% of these respondents patronized these skilled, technical men. In other words, 49.5% of those that responded to knowing about technical labour do not patronize them (Table 2). Farming system adapted for traditional agriculture in the country included crop rotation. It is made to order for the management of soil fertility, the control of erosion, pests and weeds. Only about 69% of the respondents are in the know of the usefulness of this practice, and equally responded to regularly put to use, this farm practice for their farm operations. Use of cottage storage facilities for farm products and processing of produce, that is, adding value to raw agricultural commodities were also captured in our study. These influence production and productivity and consequently on the livelihood of farmers. Storing farm products is the holding of goods from the time of production until when they are needed while processing entails conversion of a commodity from its raw state to a form more acceptable to the buyers (consumers) or to the next stage in the distribution chain (Ojeleye, *et al.*, 2014). Ojeleye *et al.* (2014) further state that storage and processing can be traditional, intermediate or of improved or advance technology, but essentially, they enhance farmers' productivity and income. It was however observed that 62.9% of respondents sampled responded to using one form of storage facilities or the other as indicated in Table 2. Also, just 28.2% of the respondents undertake the processing of their products. This is not unconnected with the fact that processing generally involves the use of expensive and sometimes sophisticated machines. Markets provide both opportunities and pressures for farmers. Engagement in them may lead to higher living standards or more diverse consumption, but at the same time, it exposes them to the possibility of ruin either from adverse price trends or from the exercise of unequal market power. In other words, good market accessibility and participation can mar or enhance farmers' production intensification and efficiency. About 82% of the sampled farmers do have access to some certain markets.

Effect of Productivity Enhancing Farm Practices on Farmers' Income

A linear regression model was chosen to determine the effect and relationship of selected independent variables and the score from adaptation of improved farm practices used (Yi) as related to their influence on total revenue from the farmers output. Table 3, shows that total money value, that is, the cost of improved seeds and seedlings, and fertilizer were significant at 1%, while total land cultivated and the cost of chemicals (herbicide and pesticides) were significant at 5% level of significance. It was also noted that the score of adopted improved farm practices, X, which was included to show the influence of usage, was significant at 1% level to the total revenue of the respondents (Table 3). This implies is that, if the farmers will adopt the use of these farm practices identified, it will improve their standard of living, because of the significant, positive relationship this has on their income. The coefficient of cost of labour was negatively related to the total revenue function and this might explained the effect that hired labour has on the farmers' income. It may be noted, that some farmers who undertake farming as a secondary occupation, for instance, do not have or make for adequate time for farm operations and so employ the services of hired labour with little or no supervision, and thereby hindering optimum use of resources. This resulted in lower productivity of resources. The estimated, R square from the multiple regression model was 51%, meaning that the independent variable included in the equation considerably explained the dependent variables. A very high F-value, significant at 1% was also noted. Five (5) of the seven (7) variables were noted to be significant and their signs fit *a priori* expectations.

CONCLUSION

An inference is therefore drawn from this study particularly on the relationship of the adoption of improved farm practices with the income of farmers. It has been found that increasing income of farmers which essentially means increasing standard of living relates directly and positively to increasing adoption of recommended farm practices. Transformation of traditional farming system for increased food production calls for adoption of these improved farm practices. In the light of this, it is recommended that farmers adopt these practices in order to improve their standard of living by the increase of their level of income. The study also recommends improved extension linkages to sensitize small-scale farmers on the need to adopt these improved farm practices.

Table 1: Socio-economic characteristics of the sampled farmers in the study area

Variables	Frequency	Percentage
Age		
< 30	34	20
31-50	108	63.3
> 50	28	16.5
Farming experience		
< 10	30	17.6
10-20	56	32.9
> 20	84	49.5
Gender		
Male	140	82.4
Female	30	17.6
Marital Status		
Single	17	10
Married	149	87.6
Widow	4	2.4
Household size		
< 10	76	44.7
11-20	88	51.8
> 20	6	3.5
Education		
No Formal Educ.	11	6.5
Quranic education	60	35.3
Adult education	16	9.4
Primary education	56	32.9
Secondary education	20	11.8
Post Sec. Education	7	4.1
Extension Contact		
No Contact	21	12.4
Weekly	45	26.5
Monthly	50	29.4
Bi-Monthly	17	10.0
Quarterly	22	12.9
Once/Twice a year	15	8.8
Total	**170**	**100**

Table 2: Distribution of respondents according to adopted productivity enhancing practices

Productivity Enhancing Farm Practices	Frequency	Percentage
Chemicals Use	133	**78.2**
Fertilizers Use	158	**92.9**
Improved Seeds Use	128	**75.3**
Use of Credit Facilities	17	**10.0**
Animal Traction	138	**81.2**
Tractor Facilities	42	**24.7**
Crop Rotation Practice	117	**68.8**
Technical Labor Awareness	103	**60.6**
Technical Labor Patronage*	52*	**50.5**
Storage Practice	107	**62.9**
Crop Processing	48	**28.2**
Market Accessibility	140	**82.4**
Class Total	**170**	**100**

Table 3: The regression result of respondents' revenue function

Variables	Stand. Error	Coefficient
Total land Area (ha) X_1	1500.380 [2.183]**	3275.470
Total Cost of Labour (₦) X_2	17967.37 [-0.145]	-2605.525
Total Cost of Improved Seed (₦) X_3	3.043022 [3.437]*	10.457
Total Cost of Fertilizer (₦) X_4	0.443306 [3.748]*	1.661
Total Cost of Chemicals (₦)X_5	3.521561 [1.949]**	6.863
Total Cost of Traction (₦) X_6	1.101533 [1.517]	1.671
Productivity Enhancing Practices Usage X_7	15.45389 [5.807]*	89.741
Constant	36312.09 [0.442]	16038.982
Multiple R = 0.71295, R Square = 0.50830,	**Adjusted R Square = 0.48705,**	**F Value = 23.92405***

Note: *, **, = Significance at 1% and 5% respectively.

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SOCIO-ECONOMIC DETERMINANTS OF AGRICULTURAL OUTPUT, AMONG COOPERATIVE FARMERS IN ABIA STATE, NIGERIA

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ABSTRACT
The study the socio-economic determinants of agricultural output, among cooperative farmers in Abia State were carried out to examine the socio-economic determinants of agricultural output, among cooperative farmers in Abia State. Structured questionnaire was used to collect data from the members of farmers' cooperative. Ninety (90) agricultural cooperative members were randomly selected from fifteen (15) registered agricultural cooperatives in the three agricultural zones to fill-in the questionnaire. The data collected were analyzed, using descriptive statistical tools, such as frequencies, means and percentages. The socio-economic determinants of agricultural output were analyzed using multiple regression analysis. The result from the descriptive statistics indicated that majority of the cooperative farmers were relatively young people, with mean age of 39.7 years, and dominated by males represented by 67.8 percent. About 70 percent of the respondents were married with mean household size of 4 persons. Also, majority of the respondents were literate, and 50 percent had farming experience of between 11 – 20 years. The regression result identified the significant socio-economic determinants of agricultural output to include age, level of education, years of farming experience, income, farm size, and bank credit. The study recommendations that the younger farmers, should be adequately sensitize on the benefits of cooperatives to join farmers' cooperative. Extension services should be made available and accessible to the farmers and also Farmers' cooperatives access to credit should be made easier and at a reduced cost.
Keywords: Cooperatives, farmers, agricultural output and socio-economics

INTRODUCTION
Nigeria does not produce enough food for its large and growing population. The rise of the oil sector to a position of economic preeminence in the early 1970s resulted in the neglect of the agricultural sector. Consequently, Nigeria began to experience a shortfall in domestic production that transformed the country from food sufficient net exporter of food products, to a net importer of many different agricultural products including palm oil, rice, wheat and maize (Ogen, 2007). The primary objective of forming group farming cooperative is to increase agricultural outputs, according to Zarafshani et al., (2010). Agricultural cooperative acquire some incentives from the government to enhance the effectiveness of their production and marketing of the items, with the hope of increasing agricultural output and benefit to members economically. Some of these incentives received by the cooperatives were outlined by Ogieva, (2003) included: access to loans, farm inputs such as fertilizers, agricultural extension services, farm equipment, mobilization of savings, management of credit and attraction of government's supports. International Cooperative Alliance, ICA (2015), defined cooperative as an autonomous association of persons unified voluntarily to meet their common economic, social and cultural needs through a jointly owned and democratically controlled enterprise. It is a business voluntarily owned and controlled by its member patrons and operates for them and by them, on a non- profit basis. There is no uniform classification of agricultural cooperative. Enikanselu *et al*., (2005) gave the following classifications of agricultural cooperatives as farmers' multipurpose cooperatives, produce marketing cooperatives, food crop production and marketing cooperatives, livestock cooperatives, fisheries cooperatives, agro-industrial cooperatives. Many authors including Alexandratos, (2005); Enikanselu *et al*., (2005); Erebor, (2003) and Ogieva. (2003) had variously stated the benefits of farmers' cooperatives that influences their agricultural output though from different perspectives were summarized to include; promotion of farm labour efficiency, promotion of environmental friendly farm practices through Sustainable Agricultural and Rural Development (SARD); applying environmental friendly technologies such as Integrated Pest Management (IPM). Furthermore, dissemination to the members of the agricultural cooperatives on appropriate technology through extension services to increase their agricultural sustainability, development of the rural economies, provision of social services such as education, transportation, provision of rural infrastructure through government machinery for rural poverty alleviation and development. Despite the incentives to agricultural cooperatives to increase agricultural output in Nigeria, food production has not been able to keep pace with the increasing population. According to Ibe, (2002), it was reported that at the introduction of formal cooperatives in Nigeria, over seven years ago, cooperatives was used as a plat form for improving agricultural production and farmers' income. Following the current trend in food insecurity in the country, the study therefore examines the socio-economic determinants of agricultural output among cooperative farmers, in Abia State, Nigeria.

METHODOLOGY

The study area was Abia State. Abia State is located in the South Eastern Nigeria. The state has three agricultural zones namely: Aba, Umuahia and Ohafia, and seventeen (17) Local Government Areas. Abia state has a total population of about 2,845, 380 (NPC, 2006). Majority of the population in the state engage in agricultural production at different scales as their predominant occupation. There are also various agricultural cooperatives societies in the study area. Primary data were used for the study. Structured questionnaire were used to collect data from the respondents with the assistance of extension agents from ADP, Umuahia. Multi-stage, stratified sampling technique was used in sample selection. In the first stage the three agricultural zones namely: Aba, Umuahia and Ohafia were selected with the assistance of Agricultural Development Programme (ADP) in the State, using lists of the registered and functional farmers' cooperatives. In the second stage, five (5) agricultural cooperatives were randomly selected from each of the three zones which giving a total of fifteen (15) farmers' cooperatives. And in the third stage, from each of the 15 farmers' cooperative, six (6) respondents were also randomly selected for the giving a total of ninety (90) respondents for the study. Data collected were analyzed using descriptive statistical tools such as frequencies, means and percentages. Furthermore, the socio-economic determinants of agricultural output among cooperative farmers were analyzed using multiple regression model. The implicit form of the regression model was specified as;

$Y = f(X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9,e_i)$

Where;

Y = Agricultural output (Naira)
X_1 = Age (years)
X_2 = Gender (male = 1, female = 0)
X_3 = Marital status (married = 1, single = 0)
X_4 = Household size (number of persons)
X_5 = Level of education (years)
X_6 = Farming experience (years)
X_7 = Farm income (naira)
X_8 = Farm size (hectare)
X_9 = Bank credit (naira)
e_i = error term

Four functional forms of the regression model namely: the linear, semi log, cobb-douglas and exponential forms were used to analyze the data. The equation that formed the best fit was chosen as the lead equation based on the basis of the multiple determination (R^2) and the number of significant variables and its conformity to a priori expectations.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The socio-economic characteristics of the respondents was summarized and presented in Table 1. It shows that the cooperative farmers had mean age of 39.7 years, this indicates that the majority of the cooperative farmers were relatively young people. Farmers' cooperative in the study area was dominated by males as 67.8 percent were represented by males. The marital status of the respondents revealed that 70 percent of them were married with mean household size of 4 persons. Majority of the respondents were literate since 80 percent represented those that attained either secondary or tertiary education respectively. Half of the respondents (50 %), had farming experience of between 11 – 20 years. Table 1 shows that the cooperative farmers had mean age of 39.7 years, this indicates that the majority of the cooperative farmers were relatively young people. Farmers' cooperative in the study area was dominated by males as 67.8 percent were represented by males. The marital status of the respondents revealed that 70 percent of them were married with mean household size of 4 persons. Majority of the respondents were literate since 80 percent represented those that attained either secondary or tertiary education respectively. Half of the respondents (50 %), had farming experience of between 11 – 20 years.

Socio- economic determinants of agricultural output among cooperative farmers

The socio – economic variables that have significant influence on agricultural output is shown in Table 2. The table contains the result obtained with semi – log functional form of the regression analysis which gave the best fit. The R^2 value was 0.89 which implied that 89 % of the total variations in the dependent variable were accounted for by the independent variables. F- Statistic was significant at 1%, indicating the fitness of the model. The result shows that six variables namely age, level of education, years of farming experience, income, farm size and bank credit significantly affect the agricultural output among cooperative farmers. Age was negatively related to output and significant in determining output among the farmers. The inverse relationship implies that as the age of the farmers increase, their output decreases. The result is in agreement with a related study by Olagunju and Ajiboye, (2010) that most or nearly all agricultural activities are believed to be tedious, energy draining and farmers are expected to be physically active to ensure higher output from farm. Level of education attained by the farmer was significant at 1% level and positively related to output. The implication is that the higher the level of education attained by the farmer the higher the expected output. This is in conformity with a prior expectation that the level of education of the farmers enhances productivity. Years of farming experience was positively related to output and significant at 5 % level. The result implies that the longer in the number of years a farmer is in the farming business, the higher the output. This result is consistence with that of Nwaobiala and Onumadu (2010), that farming experience has shown to enhance the participation and adoption of improved techniques by farmers thereby increasing agricultural output. The effect of income in determining agricultural output was significant at 1 % level and positively related to output. This implies increase in the farmers' income leads to a corresponding increase in their farm output. This may be attributed to the fact that an increase in income enables the farmer expand the farm business and also purchase farm input as required. Farm size was significant at 10% and positively related to output. This implies that a unit increase in farm size resulted in proportionate increase in output. Access to credit was positively related to agricultural output at 10%. Access to credit has been positively linked to agricultural productivity in several studies in Nigeria (Abu, *et al.*, 2010 and Ugbaja, 211).

Table 1: Summary of the socio-economic characteristics of the respondents

Variable	Frequency	Percentage
Sex		
Male	61	67.8
Female	29	32.2
Total	**90**	**100**
Age		
20 – 30	25	27.8
31 – 40	41	45.6
41 – 50	9	10.0
51 – 60	8	10
Above 60	7	8.9
Total	**90**	**100**
Mean	**39.7**	
Marital status		
Married	63	70
Single	27	30
Total	**90**	**100**
Household size		
1 – 3	9	10
4 – 6	44	48.9
7 – 9	28	31.1
Above 10	9	10
Total	**90**	**100**
Mean	**4.1**	
Level of education		
No formal education	6	6.7
Primary school	12	13.3
Secondary school	49	54.4
Tertiary	23	25.6
Total	**90**	**100**
Years of farming experience		
1 -10	22	24.4
11 – 20	45	50
21 – 30	15	16.7
Above 30	8	8.9
Total	**90**	**100**
Mean	**12.5**	

Source: Field survey, 2015

Table 2: Regression estimates of socio-economic determinants of agricultural output

Variables	Beta coefficient	T-value
Constant	1.292E6	5.446***
Age	-93237.12	-2.914***
Sex	21777.12	0.644
Marital status	-33766.83	-1.203
Household size	-22358.07	-1.090
Education	1613.22	7.055***
Farming experience	38490.31	2.284**
Income	164878.71	9.803***
Farm size	31148.830	1.998*
Bank credit	14938.37	2.005*
R^2 = 0.890		
F – ratio = 18.967* **		

Source: Field survey, 2015

Note:* significant at 10%, ** significant at 5%, *** significant at 1%.

CONCLUSION

Regression result identified the significant socio-economic determinants of agricultural output to include age, level of education, years of farming experience, income, and farm size and bank credit. Recommendations were that the younger farmers through adequate sensitization on the benefits of farmers' cooperative should be encouraged to join the cooperative in order to attain higher output. Extension agents should avail their services to the farmers to enable them acquire the necessary improved agricultural technologies that increases farm output. Farmers' cooperatives access to credit should be made easier and at a reduced cost, this can encourage farmers to expand size of farm operations, have adequate cash to meet up farm capital needs to attain higher output and income.

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LAND REFORM SYSTEM AND ITS IMPLICATIONS ON AGRICULTURAL PRODUCTION IN NIGERIA

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ABSTRACT

This study is focused on assessing the implications of land reforms system on agricultural production in Nigeria. The study set three major objectives which include to; provide an overview of land reforms, examine the problems of land reforms and finally, consider the implication of land reforms on agricultural production in Nigeria. Land reform is usually linked with agricultural and rural development. This is so because the bulk of the population especially those involved in primary production depend on the availability of land in whatever form it may be required. Land must be available to persons and/or groups of people who are ready to put it to productive use. It is the farmers' most important asset and it plays an essential role in sustaining agricultural production. However, ownership of land often interferes with its use as an agricultural asset. The employment of land use reform is therefore needed to ensure equitable allocation, availability and distribution of land to ready users both in rural and urban areas of the country. The Nigeria Land Use Act need be revisited to make room for easy and efficient land access to individuals, corporate institution and their likes that would be ready to use land for productive purposes.

Keywords: Agriculture, agricultural production, land reform, land tenure and land use act

INTRODUCTION

In Nigeria, land is considered to underpin all social, economic and political development of a person or a household. Therefore, access to land also defines one's inclusion (or exclusion) in social, economic and political processes. There has been a plethora of literature on the nexus between land ownership and access to opportunities in social, political and economic spheres. Lack of access to land is linked to social exclusion (Chikaire, et. al., 2014). In the agrarian economy, land is central to income and livelihood. Lack of income and livelihood opportunities and continuous work on low wages have made landless people not able to take part in the social and political processes within the community or at larger levels. Access to land is also essential to enable rural poor to have equal opportunities created by market. Their access to land will make them able to take some of these opportunities created by the market. Land and the institutions that govern its ownership and use greatly affect economic growth. Lack of access to land and inefficient or corrupt systems of land administration have a negative impact on agriculture especially in a developing country like Nigeria. Access to even small plots of land to grow crops can also greatly improve food security and quality. Policies that foster lease markets for land can also contribute to the emergence of a vibrant non-farm economy (Chikaire, et. al. 2014). Improving land administration may also contribute to broader public service reform and provide a basis for wider reforms. Tenure rights to resources play a fundamental role in governing the patterns of natural resource management, as well as in the welfare of individuals and communities dependent on those resources (Chikaire, et. al., 2014). In the words of the World Bank, land reform is "concerned with changing the institutional structure governing man's relationship with the land, involving intervention in the prevailing pattern of land ownership, control and usage in order to change the structure of holdings, improve land productivity and broaden the distribution of benefits" (World Bank, 1996). Parsons (1996) defines land reform as the aggregate of ideas and courses of action designed to resolve tenure problems. His viewpoint is generally in line with the one expressed by the World Bank. It may consist of government initiated or government backed approach to property redistribution of land or as in the case of Nigeria, an outright transfer of ownership of land from the citizens to the state. The common characteristic of land reform is usually the modification or replacement of existing institutional arrangement governing possession, use and title. Thus, while land reform may be radical in nature such as large scale confiscation and transfers of land from one party to another or to the state, it can also be less drastic and conciliatory in nature such as regulatory reforms aimed at improving land administration (Dale, 2007). The land use pattern in Nigeria estimated arable land to be about 33% of the total land area, permanent pastures cover 44%, permanent crops cover 3%, forests and woodlands 12% and others 8%. Thus land is still the main asset of rural Nigerians where over 80% are peasant farmers; however this asset has not been fully utilized for agricultural production (Atilola, 2010). Public investments in agriculture have been extremely low (less than 2% of total federal expenditure between 2001 and 2005), and corruption has been identified in areas where the federal and state governments have played a role (e.g., fertilizer distribution). The general objective of this study is to assess the implication of land reform system on agricultural production in Nigeria. The specific objectives are to provide an overview on land reforms in

Nigeria; examine the problems of land reforms in Nigeria and consider the implications of land reforms on agricultural production in the country.

The Nigeria land use act

The current law guiding land administration in Nigeria is the Land Use Act, Cap L5, 2004, originally promulgated in 1978 (Chikaire et. al., 2014). It has however generated a lot of clamour for its review to make it more relevant to the needs of the present day. Until the introduction of the Land Use Act in 1978, the Crown Lands Law was adopted for the management and administration of land in the then Western, Mid-Western and Eastern Regions (when the country had Regional Governments). The provisions of the variants of the Crown Lands Act were substantially similar though it did not cover the administration of freeholds lands in those regions. They however differed significantly from the law governing the management of lands comprised in the then Northern Region, where the Colonial Administration nationalized land, divesting the Emirs who held the land in trust for the citizens (Chikaire et. al., 2014). The nationalization was consolidated by the Land and Native Rights Proclamation of 1914, which was later replaced with the land Tenure Law of 1962 (Chikaire et al., 2014). Thus, while the State Land Law of the Southern regions applied only to State lands, the Land Tenure Law of 1962 applied to all lands in the Northern region. The major difference between the laws in the South and North was the fact that freehold was possible in the South while only leasehold applied in the North. However, the land registration law applied equally to the Regions. The unfortunate implication was that different laws governed tenurial system to Nigeria while a single law governed land registration. Furthermore, the laws, especially with regards to the North, were not quite in accord with the original culture and tradition of the people. Like experienced by other African countries in the hands of their colonial masters, they created new land rights over the existing rights of the indigenous population. The Land Use Act was an effort at solving the multiple land tenure system that existed in the country. The expectation was that it would make land acquisition easier so that a larger number of citizens would have access to land. The Act which essentially adopted the Land Tenure Law of Northern Nigeria to nationalize all land in Nigeria vested all lands comprised within the territory of a state in the Governor of that state (except lands vested in the Federal Government). By transferring the radical title of non-state land to the Governor, the Act sought to introduce a uniform land tenure system throughout the country. The controversy that has trailed the Act explains how poorly it has addressed the land administration problems in Nigeria. There is a persistent clamour for its review and indeed it has not been reviewed for the nearly forty years that it has operated. One major factor hindering its review is the fact that it is entrenched in the 1999 constitution of the country making it difficult to isolate for review (Ukaejiofo, 2008). The Land Use Act has never been fully implemented. Most citizens, especially most rural citizens, are unaware of the Act and few have applied for certificates of occupancy. In many areas, the Land Allocation Advisory Committees are reportedly not functioning, and the rural populations continue to look to their chiefs and emirs on matters relating to land. The chieftaincy or emirate (in northern Islamic states) is responsible for managing the community land, making allotments to individuals and households, establishing the areas of communal land (e.g., washing areas, grazing land, market sites), setting rules regarding communal land and its resources (and in some circumstances, the use of land allotted to individuals), and adjudicating land disputes (Blench, et al., 2006). Even in urban areas, where the majority of the population lives in informal settlements, customary and Sharia' law govern rights and obligations relating to land (Olayiwola and Adeleye, 2006).

Problems of the land use act

Although the decree has made it easy for governments to acquire land for public purposes, drastically minimised the burden of land compensation and considerably reduced court litigations over land, it has since its inception created a new genre of serious problems for land management in the country (Mabogunje, 2002). Most of the problems with the Land Use Act border more on the implementation procedure rather than the provisions themselves; however the following problems with the provisions are pertinent. The lack of prerequisite maps for determining who owns what land; the non-explicit demarcation of urban and rural areas, and the assumption that the prerequisite national cadastre and geospatial data infrastructure, which are very essential for any land tenure reform, were available (Atilola, 2010). The exclusion by the decree of the rights of families or individuals to develop private lay-outs has led to the emergence of a disjointed, uncoordinated and incoherent system of physical planning in Nigerian cities and a declining rate of housing provision and even agricultural production in the country. Each succeeding Federal Government since the promulgation of the Act had exhibited lack of political will to implement various provisions of the Act to make it succeed. The Act made allowance for transitional provisions for the orderly assimilation of the land tenure systems it hoped to replace, but 30 years, after these other land tenure systems are still being operated (Atilola, 2010). Many state governments failed to establish the Land Use and Allocation committee in their states for many years. This has hampered the steady and continuous delivery of land for building purposes.

The operation of the land Use Act by its "trustees" – the State Governors and local government Chairmen had been characterized by its use as political weapon, lack of transparency, arbitrary and selective administration of its provisions (Atilola, 2010). The power of governors and local government chairmen to revoke any right of occupancy over land 'for overriding public interest' has been used arbitrarily in the past and helps to underscore the fragility of the rights conferred by the certificate. In consequence, there is increasing reluctance by both the courts and the banks to accept the Statutory Certificate of Occupancy neither as a conclusive evidence of the title of the holder to the land nor as adequate security in an application for loan. Equally serious is the fact that some governors use the provision requiring their consent for assignments or mortgaging as a means of raising revenue for their states through imposition of heavy charges for granting such consent. Thereby making the process of obtaining title to land is expensive and tedious. It is antithesis to a dynamic market land economy. Also many governors do not give the urgent attention needed to their responsibility of granting consent for land assignments thereby impeding the development of an efficient land market and housing. The inconveniences and delays in securing Statutory certificates of occupancy have induced many land transactions among Nigerians to move to the informal market or be falsely dated as having been concluded before March 28, 1978; the operative date for the Land Use Decree. Consequently, 30 years after its operation less than 3% of land in the country, mainly in the urban areas, is covered by title deeds (Olayiwola and Adeleye, 2006; Dada 2010; Butler 2009, Atilola, 2010). The Act has not succeeded in removing the uncertainties in title to land; instead, it seems to accentuate it. It does not protect small scale peasant farmers who continually lose their farm lands through acquisition for urban expansion and large-scale acquisition of land for commercial agriculture, most of which are speculative, without paying adequate compensation (Atilola, 2010). As of 2006, roughly 2 million people had lost their homes and land to compulsory land acquisitions (USAID, n.d.). The government's use of its acquisition power is subject to increasing challenge – both by residents resisting eviction and by organizations questioning the ―public purpose in taking land from one set of private parties to give to another set (Nuhu, 2007). The philosophy of the Act, that all land belongs to the state; all undeveloped land has no value and hence has no market value; and that there is no freehold of land deterred the development of market land economy in Nigeria. The decree as it stands represents an abrogation of the right of ownership of land hitherto enjoyed by Nigerians, at least in the southern half of the country, and its nationalization by the government is inconsistent with democratic practices and the operations of a free market economic system. The Act abolished the existing freehold title to land and limits the title that can be granted under it to leasehold interests not exceeding 99 years (Atilola, 2010). Thus under the act all allottees of state land and owners of properties covered by a Certificate of Occupancy became tenants of the State.

Need for land reform in Nigeria

The inadequacies of the current land tenure system as embodied in the Land Use Act, informed the agitation for its review by many stakeholders. Apart from the need to overhaul the land tenure system, government was made to realise that there could be no true development without the economic empowerment of the rural dwellers through the conversion of their natural asset, land, to capital by granting them titles to their land holding and creating an open land market economy (Atilola, 2010). According to Mabogunje (2007), the importance of the State taking a firm hand with respect to land reform can thus not be underestimated. Defined land ownership whether of a leasehold or freehold type is crucial for promoting the capabilities of rural producers, enhancing their access to credit, enabling them to invest in farm infrastructure and improved input, and generally improving their productivity. Without it all talks of poverty eradication and hunger alleviation especially at the rural end is at best no more than fighting the symptoms rather than causes of poverty (Mabogunje, 2007). Thus land is a natural asset of the common man which government should help in converting to capital and means of empowerment. At present this natural asset of majority of rural Nigerians is locked up as "dead capital" as various interests in them does not possess titles to raise capital. Only about 3% of the land in Nigeria is covered by title deeds (Chikaire, et. al., 2014). It is this low level of land titling that accounts for the high level of poverty in the land as it is not possible to harness the potentials in land without title deeds. The philosophy of the Land Use Act that all land belongs to the state and should be held in trust by the governor for the people., and that undeveloped land has no value, constitute a great obstacle to the development of a dynamic market land economy. Therefore, needs a surgical review for the current initiatives of unlocking the commercial potentials of land in Nigeria to be realised. It is the current dysfunctional nature of land administration dynamics in Nigeria, and concerns arising from its unproductive nature, that informed the need to provide a better strategy that will make Land Administration work and also provide benefits to all citizens of Nigeria. The other problems are operational and bureaucratic issues, including lack of institutional, administrative, infrastructural and professional expertise for the operations, which negatively affect the effectiveness of the law.

Furthermore, a minimum limit could also be fixed and farmers encouraged and assisted to cultivate enough land to meet the subsistence and non-farm needs of their families and provide a sellable surplus to meet the needs of urban population. To makes this possible, it may be important to undertake a cadastral survey and to explore the possibilities of colonizing unused arable land for the benefit of needy farmers. Experiences in other parts of the world demonstrate that you cannot guarantee equality of opportunity or prevent invidious class differentiation on in the farm sector, if you do not sufficiently restricts the size of individual holdings. Another fundamental problem with the Land Use Act lies in the fact that it has not taken the farm structure and landholding patterns and their implications for productivity and economic security into serious consideration. Its emphasis is on formal tenure, i.e. on the definition of the types of rights individuals and groups have relative to the state. It failed to address the problem of 'Lilliputian and fragmented holdings' which is prevalent in our farming system and the question of measures that can be taken to assist farmers to increase their resources base improve their productivity and incomes (Chikaire, et. al., 2014). This is a key problem because the question of what use is made of the land is as significant as that of ownership. You cannot guarantee ownership of the land by the poor by merely preventing absolute individual ownership. For any land reform to become an important instrument for equalizing access to land, it must contain policies that can raise productivity and income of farmers (Chikaire, et. al., 2014). For example, a fragmented and marginal holding which cannot provide adequate income or full time employment for farmers exposes them to the possibility of being forced to become landless and jobless. The existence of a free market in land and differentiation on the basis of wealth and social and economic power clearly indicates there is a strong possibility for greater disparity in landholding, welfare and performance and points to the enormity of the real and potential insecurity for the poor farmers. This will happen as farmers land get increasingly fragmented; if they continue to lack ability to produce enough from their land, and as they are exposed to increasing population pressure and greater commercialization of interests in land made possible largely by urban capital.

The results of this development could be very devastating as there seems to be a growing investment in agriculture on the part of those who get substantial income from the non-farm sector, more so as the majority of our farmers are caught in a cycle of poverty arising mostly from technical deficiencies, shortage of working capital and lack of access to improved technology that could make their effort profitable. Thus, by ignoring to plan simultaneously to tackle the problem of land use, the Act has indirectly exposed marginal farmers to the possibility of losing their only means for economic survival (Chikaire, et. al., 2014). This is most likely because of a dismal shortage and mal-distribution of the supportive services that could make farming more profitable and secure. According to USAID (n.d.), differing views as to the most effective methods of land tenure reform have been expressed. While some believe smallholder farmers should be allowed to expand in adjacent plots and otherwise consolidate their holdings to encourage mechanization and economies of scale, others solicit for the preservation of smallholdings and provision of smallholder farmers with appropriate technologies. Some have also expressed the need for tax landholdings to obligate farmers to increase their efficient utilization and bring large tracts of underutilized land into production or that lands that have been acquired in dubious fashion should be redistributed. Still others maintain that markets should replace the administrative allocation processes enshrined in the Land Use Act. In 2007, Nigeria's past administration introduced a 7-Point Agenda, which included land reforms that optimized economic growth through the release of state land for commercialized farming and other large-scale businesses operated by the private sector, (USAID, n.d.). In any case, in it was stated that National Assembly rejected bill to establish a National Land Reform Commission for the restructuring of land matters across the country (USAID, n.d.) by the then government in 2010. Following this development, a Presidential Technical Committee on Land Reform was formed to advise the government on the creation of a national cadastre, a plan for registration of landholdings, and the development of mechanisms for land valuation and conflict resolution. The land reform committee in Nigeria is aimed towards enabling the state to be effective managers of land. It is aimed to provide a systematic cadastral survey of land in the entire federation the term of reference makes it an essential body to assist both states and local government to carry out cadastre survey and codify the possessory right of the majority of the people access to land and landowners. The term of reference necessitate the body to collaborate and provide technical assistance to the states and local governments in undertaking cadastral survey and to ensure the demarcation of land boundaries and title holdings in such a way that communities, hamlets, villages and towns are recognized it was also saddled with the responsibility of encouraging state and local governments to establish adjudication mechanism for land ownership, conflict resolution and to make recommendation for mechanism for valuation in both rural and urban areas.

CONCLUSION

Land is the farmers' most important asset and it plays an essential role in agricultural production. Ownership of land however, often interferes with its use as an agricultural asset. The employment of land reform is therefore needed to ensure equitable allocation, availability and distribution. The Land Use Act was promulgated in 1978 with the objective of making land accessible to all Nigerians. However, it can be said that this objective has not been realised probably as a result of the numerous problems associated with the Act. For any land reform to be effective, it must contain policies that can raise the productivity and income of farmers. The inadequacies of the current land reform system as embodied in the Land Use Act have called for its review by stakeholders. Land is important to the life of man. Land is wealth, prestige and power. It is important for poverty reduction and food security. Its availability ensures economic development and growth. For agriculture to develop; land must be readily available – reform is one vehicle that ensures availability and access to land. Land tenure reform measures taken by the state empowers its citizens to realize their potentials in the development process. After careful observation of the current situation of the country's land reform system, this study recommends that; the masses should be educated about the reform objectives, laws and procedures and the relationship between the state and local governments and the farmers should be further strengthened to increase the access to land for agricultural purposes. The possibilities of colonizing unused arable land for the benefit of needy farmers should be explored.

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FUND SECURITY ANALYSIS AMONG SMALL-HOLDER PIGGERY OPERATORS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT
The idea of this research work focused on the fund security status of piggery operators in Akwa Ibom state, Nigeria. The major aim of the microfinance movement is to provide funds for investment in micro businesses, thus lifting people out of poverty and promoting economic growth. Multistage sampling technique was adopted in selecting 90 (ninety) piggery operators. Simple descriptive statistics such as means, frequencies, percentages as well as Tobit model were used for the analysis. The results of this study showed that piggery operators' fund security was positively related to years of education, farming experience and stock size and negatively related to the age of operators, household size, total annual expenditure, value of inputs and interest rate. By this, government is encouraged to provide credits to the operators at low interest rates so as to give a quantum leap to the crawling productivity level previously experienced by these operators. Piggery operators can also form viable cooperative societies to provide mutual assistance to her members so as to assess bank loans with minimal restrictions in terms of collateral.
Keywords: Fund security, small-holder and pig operation

INTRODUCTION
The swine industry in Nigeria has not gotten developed like the ruminants and poultry because pigs are not generally used for meat purposes by majority of the population (Adebosin and Malion, 1986 in Banta *et al.*, 2012). This is based on the culture and religion which makes it a taboo for pigs to be eaten by some people. In Nigeria, pigs account for 4.5% of the total meat supply of the country (Adebambo, 1982 in Banta *et al.*, 2012). Pork is a source of meat which has high nutritional value particularly in the supply of fat that is rich in energy. The piggery industry also provides employment opportunities for the populace, thereby serving as a source of income to the Nigerian people because of the high profile nature of pigs. One of the advantages of the piggery industry is that feed materials are often industrial wastes which are easily obtained at low cost. The industry faced challenges ranging from religion to poor financing. Further, Onwumere (2008) identified some of the constraints to piggery operators output to include operators' education level, total cost of production and access to research and extension services. Efforts to deliver formal credit and financial services to the rural poor in developing countries have failed over the years (Adams, 2009). Commercial banks generally do not serve the needs of the rural poor because of the perceived high risk and the high transaction costs associated with small loans and savings deposits. To fill the void, many governments have tried to deliver formal credit to rural areas by setting up special agricultural banks or directing commercial banks to loan to rural borrowers. However, these programs have almost failed because of the political difficulty for governments to enforce loan repayment and because the relatively wealthy and powerful, rather than the poor, received most of the loans (Adams *et al.*, 1984, Adams and Vogel, 1986). In Nigeria, credit has been recognized as an essential tool for promoting Small and Micro Enterprises (SMEs) (Morduch, 1999; Olaitan, 2001). About 70 percent of the population is engaged in the informal sector or in agricultural production, piggery inclusive. The federal and state governments in Nigeria have recognized that for sustainable growth and development to occur the financial empowerment of the rural areas is vital, being the repository of the predominantly poor in the society and in particular the SMEs (CBN, 2005; Akinbogun, 2008; Atanda and Adeyemi, 2011). If this growth strategy is adopted and the latent entrepreneurial capabilities of this large segment of the people is sufficiently stimulated and sustained, then positive multiplier effects will be felt in the economy. To give effect to these aspirations, various policies have been instituted over time by the Federal Government to improve agricultural production capabilities, positively channel the potential of SMEs to enhance people standard of living and to put the sector in the front burner of Government's development strategy (Olaitan, 2001; Akinbogun, 2008; Ayanda and Adeyemi, 2011). Serious quantitative studies showing the actual fund security status of livestock operators especially piggery operators have not been done reasonably, thus this study seeks to ascertain the various determinants of microfinance assessed among piggery operators as well as their fund security position in a bid to improve their productivity.

METHODOLOGY
The study area of this research is Akwa Ibom state. The multistage sampling technique was adopted in this study. The survey sample includes 90 (ninety) respondents. 30 (thirty) small-scale piggery operators were selected from each of the three local government areas purposely selected from three agricultural zones (Essien Udin, Abak and

Ikot-ekpene) selected out of the six agricultural zones in the study area based on their relatively high livestock activities. The data for this study was from primary sources which involved administering well-structured questionnaires to the piggery operators. Simple descriptive statistics such as means, frequencies, percentages as well as the tobit model were used for the analysis.The tobit model is stated below:

Following McDonald and Moffit (1980) as adopted by Adesina and Baidu-Forson (1995), Akanni (2007) and Idowu *et al.* (2011), the Tobit regression model is explicitly specified as:

Mfi = Bi Xi + e_i

Where:

Mfi = Probability of adequate micro-financing or volume of financing (Fund Security Index), for Gi ^ Z; Mfi is continuous if Mfi > Mfo; Mfi = 0 if Mfi < Mfo; Mfo = The non-observable threshold level. Xi = Vector of explanatory variables; p_i = Vector of respective parameters; e_i = independently distributed error term.

MF = Volume of financing/funding (Naira)

Z = Fund insecurity line

Gi = Intensity of micro-financing which is defined as: (Wi - Yi) / Wi and

Wi = Optimum funding level (Naira)

Yi = Mean Piggery farm per capital expenditure (₦)

The set of explanatory variables which describe the effect of the use of micro-finance on the output of piggery operators are;

X_1 = Operator's age (years)

X_2 = Educational Status (years)

X_3 = Piggery Farming Experience (years)

X_4 = Household Size (number of dependents)

X_5 = Number of Pigs (stock size)

X_6 = Total Annual Expenditure (₦)

X_7 = Gender of Piggery Operators (1 for male and 0 if otherwise)

X_8 = Value of Inputs (₦)

X_9 = Interest rate (%)

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

Majority of the piggery operators were between ages 30 and 39 accounted by 39% of the sample size. The implication of this finding is that youths participated actively in piggery operation in the study area. The result showed that males accounted for 58% against the 42% occupied by the females. 61% of the respondents were married, 28% were single while only 10% were widowed or divorced. However, it is known that married operators are more efficient since family members may assist in the farm operations. Further, 43%, 32%, 15% and 10% of the piggery operators possessed maximum of secondary, tertiary, primary and no form of education respectively. Operators whose household sizes were between 4 and 6 were in the majority given by 70%. Operators with 7-9 household sizes had 18% while the least was among household sizes of 1 to 3 and 10 to 12 with only 6%. Personal savings showed the highest at 57%. 48% of the operators had experience of 1 to 3 years. This represented majority of the respondents.

Fund Security Status of the Piggery Operators

The result of the fund security status of the piggery operators indicates that less than half of the operators were fund secure given by only 43%. The implication of this high fund insecurity status among the piggery operators is that they would not be able to procure the necessary inputs needed to expand output. Other challenges like inadequate and irregular services of skilled labor would abound. These will compound to reduce effectiveness as well as reduce the operators' profitability.

Determinants of Fund Security of Piggery Operators

Age, household size, total annual expenditure, value of inputs and interest rate reduced the probability of the operators to be fund secure at 5%, 1%, 1%, 5% and 1% respectively while years of education, years of experience and stock size reduced the probability to be fund secure at 5%, 10% and 1% respectively.

CONCLUSION

The results of this study showed that piggery operators' fund security was positively related to years of education, farming experience and stock size and negatively to age of operators, household size, total annual expenditure, value of inputs and interest rate. By this, government is encouraged to provide credits to operators at low interest rates so as to give a quantum leap to the crawling productivity level previously experienced by these operators. This can be done through the Central Bank of Nigeria instructing commercial banks to keep a certain percentage of their total reserve for small-scale agricultural purposes. Operators can also form viable cooperative societies to provide mutual assistance to her members so as to assess bank loans with minimal restrictions in terms of collateral, purchasing inputs in bulk to enjoy scale economies.

Table 1: Socio-Economic Characteristics of Respondents

Age	Frequency	Percentage (%)
20-29	15	17
30-39	35	39
40-49	20	22
50-59	12	13
60-69	8	9
Total	**90**	**100**
Gender		
Male	52	58
Female	38	42
Total	**90**	**100**
Marital Status		
Married	55	61
Single	25	28
Widowed/divorced	10	11
Total	**90**	**100**
Level of Education		
No formal education	9	10
Primary education	13	15
Secondary education	39	43
Tertiary education	29	32
Total	**90**	**100**
Household Size		
1-3	6	6
4-6	63	70
7-9	16	18
10-12	5	6
Total	**90**	**100**
Source of Capital		
Personal savings	51	57
Cooperatives	28	31
Bank loans	3	3
Friends/Relatives	8	9
Total	**90**	**100**
Farming Experience (Years)		
1-3	43	48
4-6	36	40
7-9	2	2
10-12	9	10
Total	**90**	**100**
Cooperative Membership		
Member	33	37
Non-member	57	63
Total	**90**	**100**

Source: Field Survey, 2014.

Table 2: Percentage Distribution showing the Fund Security Status of the Piggery Operators

Fund Range (₦)	Frequency	Percentage	Fund Security Status
1,000-200,000	8	9	Insecure
201,000-400,000	9	10	Insecure
401,000-600,000	11	12	Insecure
601,000-800,000	14	16	Insecure
801,000-1,000,000	38	43	Secure
Total	**90**	**100**	

Source: Field Survey Data, 2014.

Table 3: Tobit Regression Model Result for the Determinants of Fund Security of Piggery Operators

Variable	Coefficients	Standard Error	t-ratios
X_1 (Age)	-.211**	.181	-2.683
X_2 (Years of Education)	.223**	.082	2.908
X_3 (Years of Experience)	.324*	.055	1.904
X_4 (Household Size)	.432***	.105	-4.156
X_5 (Stock Size)	.221***	.075	4.020
X_6 (Total Annual Expenditure, ₦)	.543***	.145	-3.333
X_7 (Value of Inputs, ₦)	-.534**	.158	2.468
X_8 (Interest rate, %)	.423***	.110	-15.038

Source: Field Survey Data, 2014.
χ^2 = 61.09 (P<0.01); Log likelihood = -51.90 (P<0.01)
R^2 = 0.60
*****P<0.01, ****P<0.05, ***P<0.10, ns = not significant.

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ECONOMICS OF GARRI PROCESSING IN IVO LOCAL GOVERNMENT AREA OF EBONYI STATE, NIGERIA

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ABSTRACT
Economic of garri processing in Ivo Local Government Area of Ebonyi was studied using 100 garri processors selected using multi-stage random sampling technique. Structured questionnaire were used to collect data bothering on the objectives of the study. The results showed that garri processing is profitable in the study area with average profit value of ₦23,914. Furthermore, among the constraints to garri processing were inadequate raw materials, high labour cost and poor access to credit. Policies that will enhance processors' access to credits and raw materials should be formulated.
Keywords: Economics, Garri and Processing

INTRODUCTION
Cassava is a major root crop grown for food, cash and raw materials for agro allied firms in form of starch, alcohol and among others. It is the second most important staple crop after maize in terms of calories consumed (Nweke, 2004). Nigeria is the highest producer of cassava in the world with annual production of 38.179 million metric tons (IITA, 2005; Onwumere, 2010). Post-harvest deterioration is a major problem with the crop and tackling this problem will open the crop potentials in fighting poverty. FAO (2004) reported that amongst the ways to overcome the aforesaid problem is through processing. Processing has the capability of reducing the bulkiness of the crop, reduction in transportation costs, extends shelf life as well as adding value to the products (Anyaegbulam, 2010). In Nigeria among the major staples, cassava can be processed into, garri is the most popular and indispensable staple food (Mensa, 2002). The reasons include it is ready to eat, storable and easily processed to conform to the organoleptic preference of the consumers (FAO, 2004). Statistics on garri consumption according to Anyaegbulam (2010) reported that approximately 28.41 million people and 31% of Nigerian community consume garri once, twice and thrice daily respectively. Cassava is processed into garri at village levels by variety of small scale methods using graters, millers and pressers. Nevertheless, these processors are beset with problems bothering on climatic factors, inadequate raw materials, high cost of labour, firewood problems, especially during rainy season, high energy costs. Others are poor access to credit, high cost of machine spare parts and competition among processors (Ezedinma and Otti, 2001; FAO, 2004). The study tends to examine the profitability of the enterprise and the constraints confronting garri processors.

MATERIALS AND METHODS
The study was conducted in Ivo Local Government Area of Ebonyi State. It is located between Latitude 6´17 and 5º27´E of Equator and Longitude 12´34 and 7´42N of Greenwich Meridian. A total of 100 garri processors were randomly selected from 13 communities in Ivo Local Government Area for detailed study. Structured questionnaire was used to collect baseline information in processors' socioeconomic characteristics and inputs and outputs of cassava tuber processing into garri. Percentage response was used to address the processors' socioeconomic characteristics and the constraints to garri processing. Budgeting technique was used to address the profitability of garri processing.

$$\pi = TR - TC$$

Where π = profit; TR = total reverence; TC = Total Cost

RESULTS AND DISCUSSION
Table I revealed that most (70%) of the processors were woman and fell below 40 years of age. Most of the respondents (80%) were married with 60% being full time processors. Most (70%) of the respondents used hired labour and used cassava roots from their farms (70%). Table 2 shows estimated costs and return in garri processing. The results revealed that 250kg of garri was obtained from 1000kg of cassava roots. The total variable costs incurred was ₦32,560 and gross margin of ₦29,940 was realized. The total fixed cost incurred was ₦6, 000 with net profit of ₦23,914 realized. The benefit cost ratio of 1:1:6 was realized, implying that in every 1.00 spent, ₦1.6 is realized. Table 3 revealed constraints facing garri processors in the study area include shortage of raw material (80%). This problem is more particular during dry season when the soil is hard, that harvesting becomes

difficult. The other problems were high labourer cost (70%), high energy cost (60%) and lack of access to credit (50%).

CONCLUSION

Garri processing is profitable in the study area. The constraints to the processors were high cost and scarcity of raw material, high labour cost and poor access to credit. The study recommended that processors should form cooperative groups to pull their resources together to overcome financial problem. Policies that will enhance availability of labour of affordable price should be encouraged.

Table 1: Distribution of Respondents According to their Socioeconomic Characteristics

Variable	Frequency	Percentage (%)
Gender		
Male	20	20
Female	80	80
Age	30	30
18-28	40	40
29-39	15	15
40-50	10	10
51-60	5	5
61 & above		
Marital Status		
Single	15	15
Married	80	80
Widow	5	5
Labour Use		
Hired	70	70
Family	30	30
Own farm	70	70
Outside	30	30

Source: Field Survey, 2015

Table 2: Profitability of Garri Production

Items	Output	Unit	Quantity	Unit Price(₦)	Value	%
Revenue		Kg	250	250	63,500	
Variable Costs						
Cassava roots	1000	Kg		10	10,000	25.9
Peeling/ Washing		Manday	8	600	4,800	12.5
Grating/ dewatering					3,000	7.8
Pulverizing/ sifting		Manday	1	500	500	1.3
Toasting		Manday	4	800	3,200	8.3
Sieving and Packaging		Manday	2	500	1,000	2.5
Firewood/fuel					2,600	6.4
De watering/ packing bags					400	1.04
Water					500	1.3
Transportation					1,200	3.11
Opportunity of capital (20%)					5,420	
Total variable cost					32,560	
Total fixed cost					6,000	
Gross margin					29,940	
Total cost					38,560	
Profit (π)					23,914	
Benefit cost ratio						1.6

Source: Field Survey, 2015

Table 3: Distribution of Respondents according to Constraints to Garri Production

Variable	Frequency	Percentage (%)
Shortage of raw material	80	80
High energy cost	60	60
High labour cost	70	70
Poor access to credit	50	50
Theft	34	34
Lack of patronage	24	34

***Multiple responses**
Source: Field Survey, 2015

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DETERMINANTS OF FACTORS THAT INFLUENCE THE AMOUNT OF CREDIT RECEIVED BY CASSAVA-BASED CROP FARMERS UNDER THE NATIONAL SPECIAL PROGRAM FOR FOOD SECURITY (NSPFS) IN ABIA STATE, NIGERIA

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ABSTRACT
The objective of this study was to determine the factors that influence the amount of credit received by Cassava-Based Crop Farmers under the National Special Program for Food Security (NSPFS) in Abia State, Nigeria. Data analysis involved the use of descriptive statistics such as means, percentages and ordinary least squares regression technique. The results show that there were more female beneficiaries than male beneficiaries on the credit scheme. Age, farm size and value of assets owned were positive and significant determinants of the amount of credit received by the farmers at 1% educational status positively and significantly influenced the amount of credit the farmers received at 5% while sex negatively but significantly influenced the amount of credit the farmers received at 1%. Small (inadequate) size of credit was disbursed to the farmers. Farmers should be provided with adequate credit in order to assist them to achieve their potential for increasing output and consequently income on a sustainable basis.
Key Words: Determinants, Influence, Credit, Cassava-Based, Farmers

INTRODUCTION:

The inadequate use of improved inputs consequent upon the low resource endowment of the peasant farmers has made Nigerian Agriculture to remain at the rudimentary and traditional level. Onyebinama *(2004)*, observed that despite the huge investment in science and technology, agricultural production in Nigeria has remained at a subsistence level. A fundamental requirement for correcting this problem is the injection of investible funds into peasant Agriculture.

The recognition of credit as a powerful instrument for the reduction of low income in the developing countries has led to a multitude of programs on agricultural credit, cooperative and integrated rural development (Onyenucheya & Ukoha, *2007)*, Credit for the smallholder, especially in agriculture is assuming increasing importance in many parts of the world as a deliberate response to the needs of numerous entrepreneurs (farmers) with limited capital base (IFAD, 2001). In Nigeria, the transformation of smallholder agriculture from subsistence orientation to market orientation is emphasized by government *(*oboh & bush waha*, 2009)* and this requires the availability of adequate capital. Traditionally, capital for investment in agriculture comes from two sources, namely; personal savings of the farmer and farm credit *(*Oboh & kushwaha, *2009).* However, because of low yield and price uncertainty associated with farming in developing economies, farmers are often entangled in the viscous cycle of low output, low income, low savings and low investment, which again result in low output – a concept often referred to as the vicious cycle of poverty *(*Nwagbo *et al, 1989).* Therefore, credit either from the formal or informal sources remains the major means of improving farm capital investment.

Specifically, the study examined the Determinants of Factors that Influence Amount of Credit Received by Cassava-Based Farmers under the National Special Program for Food Security in Abia State, Nigeria.

METHODOLOGY:

This study was carried out in Abia State, Nigeria. The State is located within the forest belt of Nigeria and lies between latitudes $04^{o}45^{1}$ and $06^{o}17^{1}$ North and longitudes $07^{o}00^{1}$ and $08^{o}00^{1}$ East *(Abia ADP, 2005)*. It has a land mass of 5,833.77km^2 *(ASPC. 2005)*. There are two seasons, the rainy season (April-October) and the dry season (mid-October-March). The temperature ranges between 20^{o}c and 36^{o}c (Abia ADP, 2005). The population of Abia is 2,833,999 (NPC, 2006).

Three communities were purposively selected for the study-Ihim in Ikwuano LGA representing Umuahia zone; Umuobasiukwu in Bende LGA representing Ohafia zone and Obi-ozaa in Ukwa West LGA representing Aba zone. There is an NSPFS project in each of these communities. A random sample of 25 loan beneficiaries from each pilot community was taken. This gave a sample size of 75 respondents. Data were collected using a well structured questionnaire and oral interview of the farmers. Data analysis involved the use of descriptive statistics and z-test to examine the socio-economic characteristics of the program beneficiaries. Ordinary least squares regression technique was used to identify the factors that determine the amount of credit received by the farmers. The model was specified implicitly as follows:

$Y_1 = f(x_1, x_2, x_3, x_4, x_5) + e$

Where y = amount of credit received (₦), x_1= age of respondents (years), x_2 = educational status of respondents (years), x_3 = sex of respondents (male=I, female=O), x_4 = farm size (hectare), x_5= value of assets owned (₦), e = error term

RESULTS AND DISCUSSION:

Table 1 above shows the socio-economic characteristics of the loan beneficiaries. The table reveals that majority (71%) of the beneficiaries were between 40-59 years old with the mean age as 53 years. Onyebinama and Onyejelem (2010) reported mean ages of 50 years and 55 years for farming households in Kwara State, Nigeria and for cassava farmers in the rural areas of Abia State, Nigeria respectively. Also, majority (51%) of the beneficiaries were females showing that more women benefited from the credit scheme than men. Empowering women will likely enable them to embark on income generating activities. Increased income generation by the women will enhance their capacity to assist in providing food for the household, thus ensuring stability at home *(*Mafimisebi, *2008).*

Above 96% of the farmers have at least 0.1ha of land showing that majority of the beneficiaries are small holder farmers. Credit provision will probably enhance the acquisition of more farmland holding per farmer which in turn is expected to lead to increased output and income *(*Nwosu *et al, 2010).*The proportion of the farmers that are literate is about 85%. Literacy of the farmers is likely to influence the amount of credit they receive by enhancing their ability to access information which puts them in a better position to cope with the intricacies of new factor and product markets that the adoption of new technologies and credit introduces them to *(*Onyebinama & Onyejelem, *2010).*

Most (about 93%) of the beneficiaries received loans below N100,000.00 (One Hundred Thousand Naira). This is a common phenomenon in Nigeria that farmers demand for credit is far higher than the supply for credit due to several criteria used to screen successful applicants. Shortage of funds tends to give rise to credit rationing among successful loan applicants *(*Oboh & Kush Waha, *2009).*

Determinants of farmers that influence amount of credit received by program beneficiaries: The lead equation is exponential. The regression results show that age, educational status, farm size and value of assets owned were significant and positively related to amount of credit received. While sex of beneficiaries was significant but negatively related to amount of credit received.

Previous experience of the farmers in farm business activities over the years, as their age increases, enables them to set realistic cost and time targets and utilize credit efficiently *(*Onyebinama, *2004).* As a result, credit allocation to the farm business will increase with the age of the farmer *(*Oboh & Ekpebu, *2011).* The better educated the farmers were, the more favorably disposed they would be to receiving larger amount of credit from formal financial institutions, though the loan sizes may be administratively determined. Education will enable farmers to allocate and utilize credit optimally and identify production risks easily *(*Ebukiba, *2010).*

The result shows that as farm size increases, amount of credit received increases, therefore, farmers with larger farm sizes had increased amount of credit received than farmers with small farm sizes other things remaining constant *(*Okoh & Kushwaha, *2009).* The value of assets owned by the farmers indicates that the larger the value of the assets they owned, the more the amount of credit they received. The reason for this may be a significant number of the farmers had assets of significant value relative to the amount of credit they received. This is consistent with the findings of Mohammed and Temu *(2010),* who reported that the less poor farm households were better advantaged at increasing the amount of formal credit they received than the poor and more poor farm households.

Female beneficiaries had lower amount of credit received than their male counterparts. This is consistent with a priori expectation. The reason may be that female farmers are not considered to be major decision makers and title holders to farmland over and above the male farmers in Africa *(Oboh & KushWaha, 2009),* therefore the female beneficiaries received a total amount of credit that is altogether less than the total amount of credit disbursed to the male beneficiaries although the female beneficiaries were more in number. The null hypothesis that states that, 'farm size, educational status, value of assets owned and sex do not significantly influence the amount of credit received by program beneficiaries is rejected.

CONCLUSION

The result of this study indicates that age, educational status, farm size and value of the assets owned by the farmers increased the amount of credit they received. Male beneficiaries received a total amount of credit that was altogether more than their female counterparts.

Table 1: Socio-Economic Characteristics Of Beneficiaries

VARIABLES	FREQUENCY	PERCENTAGE	CREDIT	MEAN	FREQ.	PERCENTAGE
Age Years						
20-39	5	6.67				
40-59	53	70.67		**53**		
60-79	17	22.67				
Sex						
Male	37	49.33				
Female	38	50.67				
Farm Size(Ha)						
0.1-2.0	63	84.00				
2.1-4.0	4	5.33				
4.1-6.0	4	5.33				
6.1-8.0	1	1.33				
8.1-10.0	1	1.33				
>10.0	2	2.67				
Overall Mean	***1.86***					
Education (Yrs)						
No. formal education	11	14.67				
Primary:						
Incomplete	15	20.00				
Complete	20	26.67				
Secondary:						
Incomplete	1	1.33				
Complete	25	33.33				
Tertiary:						
Complete	3	4.00				
Credit Applied for (₦)'000			**Credit Received (₦)**			
0-49	12	16.00	0-49		66	88.00
50-99	19	25.33	50-99		4	5.33
100-149	17	22.67	100-149		3	4.00
150-199	10	13.33	150-199		1	1.33
>200	17	22.67	>200		1	1.33
Total	**75**	**100.00**			75	99.99
Mean	***₦192,534***		***₦29,218.5***			

Source: Field Survey Data, 2010

Table 2: Determinants of Amount of Credit Received by Program Beneficiaries

		Model		
Variables	**Double-Log**	**Semi-Log**	**Exponential+**	**Linear**
Constant	6.723	386509.852	5.946	1904.083
	(2.032)**	(2.153)**	(8.934)**	(1.090)
Age	0.278	-194687.824	.060	187.465
	(-.252)	(-3.264)***	(3.142)***	(.310)
Educational	-.394	1143.723	022	5869.50
Status	(-1.703)*	(.305)	(2.018)**	(1.712)*
Sex	-190	9671.660	-.204	5699.305
	(-2.220)**	(2.078)**	(-1.913)	(-1.697)*
Farm Size	.656	35917.470	.210	12882.757
	(4.647)***	(4.687)***	(3.162)***	(6.126)***
Value of Assets	.334	32551.628	5.602E-6	6486.324
	(1.694)*	(3.045)***	(3.331)***	(1.723)*
R^2	74.80	74.3	7s3.4	75.0
$\bar{R}^2$	74.10	71.1	72.6	74.4
F-ratio	49.82***	23.19***	66.96***	57.49****

*** ** *= *significant at 1% and 10% respectively.*
+ = *lead equation. Figures in parenthesis are t-ratios.*

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ECONOMIC DIVERSIFICATION IN NIGERIA: GINGER PROCESSING AND MARKETING IMPERATIVES

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ABSTRACT
This paper focused on the imperatives of processing and marketing of ginger to meet the global quality requirement as a potential economic diversification strategy in Nigeria. It relied on information from secondary sources such as food and agriculture organization, commodity trade statistics and field experiences of the authors. The study showed that Nigeria has comparative advantage in ginger quality and production. If these attributes are exploited, Nigeria is capable of leading the world ginger market and provides a platform for wooing the private investors into ginger processing and marketing. It was however observed that the processing methods of Nigerian ginger is still to a large extent, haphazard and not yet standardized, leading to low pricing in the international market. Economic diversification measures, targeting ginger as a major export crop should consider a number of imperatives for a successful policy shift in this direction. Such imperatives include the urgent need for mechanizing the entire manual system of processing ginger in Nigeria, Integrating ginger processing operations through inter-firm agreements, Getting the farmer to recognize the need to maintain higher standards of hygiene during production and processing through seminars, workshops and method demonstrations, encouragement of the private sector involvement, substantial improvements in product quality, market development and access to market information among others.
Keywords: Processing, Marketing, Ginger, Imperatives

INTRODUCTION

Economic diversification is a process of broadening the range of economic activities both in the production and distribution of goods and services (Anyaehie and Areji 2015). It does not necessarily entail increase in output but it enhances stabilization of economies by diversifying their economic base. To diversify the economy demands active participation in wide range of sectors, and firmly integrated into different regions, are better able to generate robust growth and great potential to increase Nigeria's resilience and contribute to achieving and sustaining long economic growth and development in the country. The discovery of crude oil has contributed and assisted Nigeria's economic prosperity and growth. Nevertheless, the current dwindling in oil price since June 2014, after five years of oil windfall, has immensely affected the economy of major oil exporters like Nigeria.

In this present predicament of Nigeria, diversification presents the most competitive and strategic option for the country in light of her developmental challenges and given her background. Diversification has a lot of benefits for Nigeria to maximally utilize her abundant resource – base to rebuild the economy and enjoy the benefits of all the linkages, synergy, economies of scale, grow national technology and foreign investment profile, build human capital, exploit new opportunities, lessen averagely operational costs, increase national competitiveness and grow the standard of living and confidence of the citizens for national renaissance (Seberu *et al* 2015). Diversification according to Ayeni, (1987) and Iniodu, (1995) implies "movement into new fields and stimulation and expansion of existing traditional products." Diversification does not discourage specialization, but requires that resources be channeled into the best alternative uses.

Before the discovery of oil in 1956 in Nigeria, Nigeria was famous in her agrarian economy through which cash crops like palm produce, cocoa, rubber, timber, ground nuts, were exported, thus making Nigeria a major exporter in that respect (Uzonwanne 2015). The high economic gains of the oil industry made the nation to abandon agriculture and depend solely on oil industry. The situation has led to non development of the agricultural sector of the economy. Thus, over the years, agriculture has suffered from years of mismanagement, inconsistent and poorly conceived government policies, neglect and the lack of basic infrastructure. This has exposed the nation to economic instability occasioned by the vagaries of international oil markets, gross unemployment and poverty in the face of plenty.

Nigeria, having experienced disappointment from the oil sector, is attempting to bring back agriculture. This was expressed by the introduction of the value chain approach to agricultural development. Onwualu (2012) maintains that the value chain approach to agriculture has the potentials to open up the economy and generate various activities, which are capable of creating jobs and enhancing industrialization and thus makes the non-oil sub-sector to hold the aces for future Nigeria's sustainable economic growth.

Ginger is a tropical herb extensively grown for its pungently aromatic underground stem or rhizome which is an important export crop valued for its powder, oil and oleoresin (NEPC 1999). It has been used as spices in most countries of the world. Ginger is an important cash crop in Nigeria, which is one of the major world producers and exporters of the crop (Ojiako *et al* 2007). Nigeria currently has the world's largest area under ginger cultivation and is one of the largest producers and exporters of the crop; especially the split-dried form. Large scale production of ginger started in 1927 (Arene *et al* 1986) in Southern Kaduna. Between 1927 and 1982, the production for export fluctuated and ultimately declined due to poor prices in the export markets and because of the economic boom of mineral oil during the 1970's. This situation, led to the neglect of crops that have great potentials to attract foreign currency to Nigeria. One of such neglected crops is ginger. The effect of this is that the area under ginger cultivation declined between 1999 and 2003, after which it recorded a steady increase, though marginally. However the production of ginger has been on the increase except in 1999 when there was a drop from 1998 figures. Available records shows that Nigeria is a very active participant in the world ginger trade. Now that the leadership in Nigeria appears keen to take agriculture seriously, a critical look at ginger could proffer solution to the country's economic woes. Considering the strength of having one of the best quality ginger in the world, their exist ample opportunity to increase production and improve processing methods as a veritable strategy for economic recovery.

Ginger processing and marketing imperatives

The ginger rhizome processing is defined as series of activities that take place from harvesting period (sorting and washing of the rhizomes) to the stage of bringing the rhizomes into various shapes and sizes that will add value to it and aid in shortening the period of drying time. It also entails splitting, peeling, slicing, blacking, rough scraping and grinding, drying for quality product, preservation (Fresh green ginger leaves), extraction of oleoresin and oil products from dried product, stability, packaging for exports and end users (Nwokadi and Ewuziem 2016). Regrettably, despite the popularity of ginger, coupled with its daily usage all over the world; its industrial processing techniques are still under developed, particularly in Nigeria and some major producing countries. Nigerian ginger attracts low prices in the international market. This was attributed to the its quality as reported by Yiljep *et al* (2005) that the processing of Nigerian ginger was not standardized with the result that microbiological, organoleptic and chemical properties of the product often fall short of importers' specifications. This was supported by Okwuowulu (2005) who reiterated that Nigerian ginger was valued as mere raw material for distillation and extraction, hence attracts drastically low price.

Ebewelle and Jimoh (1981) traced the low quality of Nigerian ginger at that time to the traditional drying methods used by farmers to dry ginger, which according to them are varied, haphazard and risky, resulting to mould growth, loss of some volatile oil by evaporation and destruction of some heat sensitive pungent properties. Unfortunately, this situation still prevails today in Nigeria after over one decade of identifying this challenge.

Efforts to mechanize ginger processing started in 1992 when Federal government of Nigeria through the sponsorship of priority Research Project (PRP) that provided funds to National Root Crops Research Institute (NRCRI) Umudike to solve the problem of designing a prototype processing machine for ginger rhizomes. The machine was sent to ginger farmers in Northern Zaria of Kaduna state for field trials and evaluation. The trials were encouraging and more of the type machines were fabricated and sent to Port Harcourt, Owerri, Okigwe and other areas for the same purpose. This machine was reported to have problems in its efficiency of splitting. A new version of this machine has been developed by NRCRI Umudike. It has been tested on farm and sent to kwoi in Kaduna state, Nwaoriebi in Imo state.

Nigeria is among the top ten ginger exporting countries in the world. The aggregate export of the Nigerian increased sharply, rising by more than 50%, by the early 1970s, but also declined rapidly by more than that proportion, with no export at all in 1978, 1980 and in 1981. This rapid decline is believed to be connected with poor producer prices, poor market organization and lack of coordination and regulation of trade practices and quality control standards. However, the world Ginger market grew at a speed of 10% annually from 2008-2012 in terms of quantity (UN COMTRADE 2015: www.gointernational.org.np). The price of Ginger also grew at 12% per annum during that period. At that time, the unit price for Nigeria ginger was $2,463 per ton when the world average was $727 per ton. In the trade Indicator of ITC 2013, Nigeria has been listed on 6th position for ginger export. It is on record that the world is paying prime price for Germany's ($3758), UK's ($3450) and Nigerian Ginger ($2468). Despite the relative advantages of Nigeria in ginger market, the country exported ginger worth only $2.83 Million in 2012 as against $48.42 Million in 2010 and $40.03 Million in 2011.

Processing and marketing Imperatives for economic diversification

The new federal Agricultural Promotion Policy (APP) specified that government will prioritize for export markets the production of such crops as ginger and work with a network of investors, farmers, processors and other stakeholders to deepen the supporting infrastructure to ensure that quality standards are defined and maintained across the value chain. That will involve adding more testing laboratories, improving traceability of crops, disseminating intelligence on export markets and consumer preferences, etc. (FMARD 2016). Whether Nigeria will be able to compete with other countries and remain relevant in the world ginger trade, will therefore depend upon the extent to which we can achieve substantial improvements in processing and marketing techniques. This is clearly seen from the fact that the price of ginger in the world market is closely associated with the origin and quality of ginger. Consequently, policy measures for establishing a viable ginger industry in Nigeria must include processing and marketing issues. Consumer demand for more stringent quality control in the spice industry is ever increasing. Each of the major importing countries has set its own quality standards for dried ginger and its derivatives. These standards are indication of the increasing sophistication of consumers even in the ginger producing countries. In the light of above observations, techniques for processing ginger products should be tailored towards meeting the legislative controls regarding quality standards for different products that favoured markets in destination countries may require.

Integrating ginger processing operations through inter-firm agreement whereby the processor will be in a position to determine the type of ginger varieties planted and the time of planting and harvesting them in return for provision of technical advice, production inputs or credit advance to the producers. This ensures that the right types of varieties for different applications are available in sufficient amount for processing. This is also crucially important to avoid running the processing plants at less than full capacity. Getting the farmer to recognize the need to maintain higher standards of hygiene during production and processing through seminars, workshops and method demonstrations is imperative for improvement of the quality of Nigerian ginger. Also, the development of mechanized processing culture will help. The pressing and urgent need for mechanizing the entire manual system of processing ginger in Nigeria is paramount. Consequently, the direction for the future is to mechanize the processing operations.

Mechanized techniques for processing ginger have been developed at NRCRI, in collaboration with the Product Development Agency (PRODA), Enugu and the National Centre for Agricultural Mechanization (NCAM), Ilorin. The only missing link is the private sector, as a result of negative attitude about investing in agriculture, probably because of the relatively long gestation period of such investments. Government and non-governmental organizations (NGOs) therefore have a crucial role to play in this direction. On its part, government should provide adequate incentives such as tax holidays and other tariff waivers in order to encourage investment in industrial processing. It should also provide affordable credit incentives to farmer cooperatives groups to enable them acquire available processing machines.

Prior to Nigeria's independence, the responsibility for the marketing of export crops, including ginger, was invested on the Nigerian export marketing board. In 1986, the commodity Boards were abolished for reasons connected mainly with the relatively low producer price paid to producers. Currently, the quality and marketing for ginger is both uncontrolled and unregulated. Present marketing system for the export of ginger is essentially the same as that for the domestic trade in ginger. Rural assemblers, speculative middlemen and commissioned agents buy and assemble ginger from producers in the hinter land and sell the ginger to wholesalers. The wholesalers take up the bulk-breaking function of exporting the ginger to the various overseas markets. This implies that substantial improvements in product quality are imperative in order to enhance the competitiveness of the Nigerian ginger in the world trade.

CONCLUSION

Oil has disappointed Nigeria, despite the huge revenues from the sector. Bulk of the oil revenue was not adequately utilized to develop the agricultural sector which used to be the bedrock of Nigeria's economy before the advent of oil. Now there is a call for the revamping of the agricultural sector as a viable means of economic diversification. One of the crops that Nigeria enjoys comparative advantage in its quality and production is ginger. Nigerian ginger is expected to attract high value in the international market, but its processing quality is an impediment to its demand. To this end therefore, Processing and marketing of ginger should be taken seriously in Nigeria, since the crop is cultivated in large quantities, because of its economic values. Despites it's various uses in the country and elsewhere, the utilization is low due to the fact that processing and packaging practices are not mechanized while the marketing systems are not developed. The crop processing methods entails different unique operations such as splitting, peeling, slicing, grinding and scrapping that require different machine operations separately or combined machine functions that will aids the production industries to complete favorably in terms of quantitative and qualitative product in international market. To realize the policy trust of the new federal agricultural promotion policy requires that the private sector will be attracted to the processing and marketing of ginger by setting processing and marketing standards that will the specifications of importing countries. By so doing, huge amount of foreign exchange will accrue to Nigeria and this will go a long way towards achieving the much desired economic recovery in Nigeria.

Table 1: Properties of ginger by major source of supply

Attribute	Jamaican ginger	Indian ginger	Nigerian ginger
Size	6.25-8.75 cm long	Irregular	Irregular
Shape	Irregular, branched and palmate	Irregular	Irregular
Colour	Very light buff	Pale brown	Dark or grey-brown
Appearance	Clean, hard and somewhat fibrous, and free from cork	Fibrous, with cork not entirely removed	Wrinkled
Aroma	Agreeable, aromatic, and somewhat pungent odour	Pronounced lemon-like aroma	Coarse aroma and flavor
Taste	Aromatic, pungent, biting taste	Similar in taste to Jamaican ginger	Very pungent taste
Volatile oil content (%)	1-1.3	1.9-2.2	2-2.5
Non-volatile ether extract (%)	Ca. 4.4	Ca. 4.3	Ca. 6.5-7.0

Source: Ebewele and Jimoh (1988).

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GINGER BUSINESS OPPORTUNITIES AVAILABLE TO INVESTORS IN NIGERIA

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ABSTRACT
This is a positional paper that reviewed the business opportunities available for investors in various aspects of ginger production in Nigeria. The paper gave the botany, cultivation and distribution of ginger in Nigeria. It later X-rayed the business opportunities available in ginger production such as seed ginger production and ware ginger production. The reviewed agreed that unavailability of high quality seed is a major constraint to large scale ginger production. Also the business opportunities in ginger storage were reviewed. It was the popular opinion that buying fresh ginger rhizomes at the glut period and selling them during scarcity will be a profitable agribusiness. Ginger splitting although is said to experiences high level of drudgery but if exploited, it can offer a trade boom. Process of ginger into powder, oil and juice is proposed as an opportunity to industrialists while array of business opportunities are available in ginger marketing and export.
Key Words: Ginger, Business, Opportunities, Marketing

INTRODUCTION
Ginger (*Zingiberofficinale*) is an important spice both locally and globally. Its main active ingredients oleoresin and ginger oil are used for a wide range of culinary, confectionary, and pharmaceutical purposes (Sidi-Aliyu, 2006; Whitney, 2012; Amadi et al, 2013). It is traded globally in various forms such as fresh, preserved, dried, and powdered ginger. Ginger also enters the global market as processed products like ginger oil, ginger oleoresin, ginger candy, ginger soft drinks, ginger shreds, ginger prickles, ginger chutney etc (FAO, 2002). Nigeria has nearly a century experience in ginger production and has established herself as an important producer, consumer and exporter of ginger. Ginger is now the main cash crop supporting the livelihood and improving the economic level of many ginger growers in the main producing areas.
Two commercial varieties are commonly cultivated in Nigeria. The yellow ginger variety (UG 1) locally called "TafinGiwa" with a bold yellow rhizome flesh is stout with short internodes. The black ginger variety (UG 2) locally called "YatsunBiri" with a dull-grey colour rhizome. The yellow variety is more popular than the black variety apparently due to its high yielding capacity and pungency (Kure, 2007, Nmadu and Markus, 2011, Amadi et al., 2012). Trends in harvested land area, yield and total production from 2003 to 2013 is presented in table 1.
Nigerian ginger are amongst the cheapest in the world market due to its poor post-harvest handling processing which results in low quality (Ekundayo*et. al*., 1988; Okwuowulu, 2005). Consequently, the need to improve the quality of Nigeria ginger has been stresses (Okafor and Okafor, 2007). Despite this setback, the innate hotness and aroma of Nigerian ginger is appreciated worldwide ensuring that it commands a high demand both locally and internationally to support viable investment in various sectors of its value chain. Ewuziem et al., (2015) reports that the world is paying prime price for Nigerian ($2,463) ginger and that it contributed a total of $115.564m on the basis of value to the world ginger value of $2401.756m representing a share of 4.81%between 2008-2012. Cumulatively, a total of 51,483 tons of ginger was contributed by Nigeria to the world ginger market which is 1.35% of the world total (3,800,098 tons) during the same period. This paper relied on secondary data to highlights opportunities in ginger value chain in Nigeria that can support viable investments as we seek to diversify our economy to non-oil sources

Business opportunities in ginger value chain

Seed ginger production
High quality seed is a major constraint to large scale ware ginger production (Islam et al., 2012) Ewuziem et al, 2012, reported that high cost of planting material exerted serious pressure on total variable cost of ginger production and recommended a seed ginger multiplication programme as a panacea. At present farmers depend on self-saved seeds or those they get from other farmers. Investment in seed ginger production is therefore a viable venture because of expected patronage from ware ginger producers. In addition, technical backups for such enterprise can be obtained from National Root Crops Research Institute (NRCRI) Umudike which has the national mandate for ginger.

Ware ginger production
Ware ginger production has reported to be profitableboth in Nigeria and many other countries (Islam et al, 2012, Ewiziem et al, 2012, Nmadu and Marcus,2011). Many farmers and their households depend on it especially in major ginger producing areas of Southern Kaduna. An investment of ₦1 in ginger production has been reported to guarantee a return of ₦2.94 (Ewuziem et al, 2012) in the southern guinea savanna of Nigeria based on the yield of 16.5tons per hectare and the following assumptions: labour cost ₦400; mulch is harvested within the farm area hence labour cost of cutting the mulch is used as a proxy for the cost of mulch; and land used is not leased and

therefore did not attract any charges for rent. These assumptions are not sacrosanct and seem highly unlikely in the prevailing circumstances in Nigeria at least for large scale production. Nmadu and Marcus, 2011 showed by the data presented in table 2 that in Southern Kaduna area (The major Ginger growing area in Nigeria), ginger production is profitable agribusiness.

Ginger Storage

Buying fresh ginger rhizomes at the glut period (ie at peak harvest time) when the prices are low and selling them during scarcity when prices are high can be a profitable agribusiness. This of course depends on whether price deferential between the glut and lean times compensates for cost of storage and postharvest losses during storage.

Ginger splitting

A significant proportion of Nigerian ginger is marketed in the split dried form. Splitting of ginger involves a lot of drudgery hence the use of machines to split ginger helps to eliminate this drudgery and save time which can be applied to other useful endeavours. Just like in Cassava where grating has been turned into a viable business and people take their roots to graters for grating, ginger splitting can be developed as an enterprise that will be patronized by farmers, end-users and other stakeholders in ginger. Ginger splitting machines are available on demand from the Engineering Unit of NRCRI Umudike. The Institute also provides repair services for her machines.

Ginger Powder

Ginger powder is one of the popular forms in which ginger is stored and utilized.Split dried rhizomes are ground and sieved to produce the flour or powder. Ginger powder packaged in various forms is available in many markets and shops all over Nigeria. Ginger powder production is a profitable agribusiness enterprise that can accommodate more investors.

Ginger oil

The varieties produced in Nigeria UGI and UGII are high in monoterpene and oil, giving a more pungent aroma and pungency therefore making them ideal for the production of oils and oleoresins (KADP, 2000; Chukwu & Emehute, 2003). Ginger oil has a lot of industrial uses. There are two companies producing oleoresin at present in Nigeria. There is a lot of space for more investors. However investors should note international standards for ginger oil presented in tables 3 & 4 and ensure their products meets these specifications to ensure international acceptance. The Food Chemical Codex standards for ginger oil are the following:

Ginger Juice

The ginger juice, as a convenience food ingredient, may find its widespread use in the industry. The catering industry is itself made up of a variety of outlets such as hotels, restaurants, canteens, hospitals, nursing homes, school meals and prisons. Higher incomes and more active life styles in recent years have resulted in consumers seeking high quality, convenient food items in the markets. The ginger juice, for its anticipated widespread use, may help fill the needs of consumers for a convenient food ingredient. Ahammed et al., (2014) found ginger juice to be stable up to 6 months after evaluation with acceptable sensory and organoleptic properties. This should allow enough time for the marketing of the product.

Ginger Marketing

Ginger is consumed and marketed all over the country. However major ginger markets are located in the major producing areas of Kachia, Kardako and Kwoi. These primary markets feed other secondary and tertiary markets all the country. Marketing ginger both at farmgate, wholesale and retail levels is a thriving business that has sustained many households. In the market, ginger is available in various forms; fresh ginger rhizome, powder ginger and dry ginger rhizome. Out of this, 10% is locally consumed as fresh ginger while 90% is dried primarily for the export markets.

Ginger Export

Ginger as a produce is in very high demand internationally hence ginger export business in Nigeria can accommodate new investors. Nigerian ginger is reputed worldwide for its intrinsic quality. Thus Nigerian ginger is in high demand globally. Though prices are highly variable, local price of ginger is about $2400 per ton while international price is $4000 per ton. However exporters of ginger must note that certain standards are required of ginger meant for export. This minimum international (Asta, 1999) standard is presented in table 5.

CONCLUSION

The hotness and aroma of Nigerian ginger is appreciated worldwide. There is therefore a high demand for quality ginger both locally and internationally to support new investments in most sectors of ginger value chain. This is more so in a depressed economy like we have in Nigeria now that is in dire need of diversification from oil to non-oil sources. Investing in ginger therefore provides an alternative roadmap to our economic emancipation

Table 1: Trends in land area, yield and production of ginger in Nigeria (2003-2013)

Year	Area	Production	Yield (t/ha)
2003	167000	110000	0.66
2004	170000	117000	0.69
2005	181000	125000	0.69
2006	191000	134000	0.70
2007	48660	162390	3.34
2008	55690	175070	3.14
2009	52330	168800	3.23
2010	52330	162223	3.10
2011	48910	460170	9.41
2012	48000	3800	0.40
2013		160000	3.20

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Table 2.The Average Costs and Returns per hectare of ginger produced in the study area.

Costs and returns	Costs(NGN1/ha)	% of total cost
(A) Variable costs		
Herbicide	6723.82	2.35
Fertilizer	49691.36	17.34
Manure	6449.57	2.25
Improved Seeds	75449.21	26.33
Hired Labour	115805.60	40.41
Tractor Hiring	179.54	0.06
Transportation	21261.75	7.42
Sub-total	275,560.81	
Output	4105.38	
AVC/ha = Sub-TVC/output	67.13	
(B) Fixed costs		
Hoes	1812.47	0.63
Axes	453.94	0.16
Matched	896.76	0.31
Basket	92.56	0.03
Knapsack Sprayer	4392.69	1.53
Basins	1458.46	0.51
Digger	1338.63	0.47
Knife	591.27	0.21
Sub-total	11036.78	100.0
Output	4105.38	
AFC/ha = Sub-TFC/output	2.69	
(C) Total Cost		
Variable cost + fixed cost	286597.59	
ATC/ha = TC/Output	69.82	
(D) Gross Income (GI)		
Gross Margin (GM)= GI-TVC	362820.32	
Net Farm Income(NFI)		
Gross Margin-Total Fixed Cost	351783.54	
Average rate of returns on Gross margin	0.97	

Source: Computed from survey data, 2011 (Nmadu and Markus, 2011)

Table 3: Food Chemical Codex Standards for Ginger Oil

Standard	Value	ISO method
Relative density at 20 ºC	0.870-0.882	ISO 279-1981
Refractive index	1.488-1.494	ISO 280-1976
Optical rotation	-47º to -28º	ISO 592-1981
Saponification number	Not more than 20	

Oleoresins standards as defined by the U.S. Essential Oil Association are as follows:

Table 4: Oleoresins standards as defined by the U.S. Essential Oil Association

Volatile oil content	18-35 ml per 100 g
Refractive index	1.488 – 1.498
Optical rotation	-30º to -60º

Table 5: ASTA Cleanliness Specifications for Ginger

Whole insects, dead	Excreta, Mammalian	Excreta, Other	Mold	Insect Defiled/Infested	Extraneous Foreign Matter*1*
by count	by mg/kg	by mg/kg	No more than 3% moldy pieces and/or insect infested pieces by weight		% by weight
4	6.6	6.6			1.00

1 extraneous matter includes but is not restricted to: stones, dirt, wire, string, stems, sticks, non toxic foreign seeds, excreta, manure, and animal contamination.

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FACTORS AFFECTING FOOD SECURITY AMONG COCOA FARMING HOUSEHOLDS IN NIGERIA

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ABSTRACT
There is little or no information on the factors affecting food security among cocoa farming households in Nigeria. Therefore, this study investigated the factors affecting food security among cocoa farming households in Nigeria. Multistage sampling technique was used to select 200 cocoa farming households in the study area and structured questionnaire was used to collect information from the respondents. The data obtained from the information were analysed using descriptive statistics as well as logit model. Findings show that the mean age of the respondents was 52 years while about 58% of the respondents had their age above the mean age. The mean household size in the study area was about five. Result of the logit analysis shows that enhanced farming experience of household heads, increased output of roots and tubers, increased output of cereals and increased output of cocoa drive food security positively among respondents while increase in household size and increase in age of household head retard food security status of respondents in the study area. Arising from the foregoing, this study recommends birth control campaign as well as production of food and cocoa crops in right mix to enhance food security status of respondents.
Keywords: **food, cocoa, farmers, factors, logit model**

INTRODUCTION
Food security exists when all people at all times have access to safe nutritious food to maintain a healthy and active life (FAO, 1996). The main goal of food security is for individuals to be able to obtain adequate food needed at all times, and to be able to utilize the food to meet the body needs. According to (World Bank, 2001), food security is of three folds, these are food availability, food accessibility and food utilization. Food availability for farming households means ensuring sufficient food is available to the households through production. However, it should be noted that simply making food available is not enough; one must also be able to purchase it, especially the low income households (Sen, 1981). Hence, food security connotes physical and economic access to adequate food for all household members, without undue risk of losing the access.

However, while food security for individuals is often the main focus of attention, there are also household, national and international dimensions of food security (Olayemi, 1998). For individual food security, household food security is a necessity. Also important at the individual food security level are non-food factors such as health conditions, social and cultural practices which can affect individual nutrition. At the household level, food security implies adequate access to food at all time. There is adequate access when there is adequate food available to the household and, at the same time, the household has adequate capacity for effective demand for available food. At the national level, food security connotes adequate availability of food from all sources to meet the per capita food requirement of the population over time

In Nigeria, the production of food has not increased at the rate that can meet up with the food demand of the increasing population (Ojo, 2003). While food production increases annually at the rate of 2.5 percent, food demand increases annually at a rate of more than 3.5 percent due to high rate of annual population growth of 2.83 percent (NBS, 1996). The apparent disparity between the rate of food production and demand for food in Nigeria has led to a food demand-supply gap, leading to a widening gap between the food available and the total food requirement and hence posing a threat to national food security. In order to combat the food problems, the federal government of Nigeria over the last 10 years (1998-2007) embarked on different policies and strategies deemed appropriate to solve the problems. Some of these are geared towards empowering the people (through job creation, provision of credit facilities, promoting peace and security) and boosting production by promoting private enterprise. Nonetheless, providing food at affordable prices still remains a mirage.

Arising from the foregoing discussions on food security and production in the cocoa growing area, this study strives to provide answers to the following questions: what is the food consumption pattern of cocoa farming households and what are the factors affecting the farming households' food security status in the study area?

METHODOLOGY
The study was carried out in Ondo state of Nigeria. The state has eighteen Local Government Areas (LGAs) out of which fifteen of them produce cocoa. The study employed multistage random sampling technique for the selection of its respondents. The first stage involved a purposive selection of four notable cocoa producing LGAs. The selected LGAs included two high cocoa producing LGAs (Idanre and Ondo East) and two low cocoa producing LGAs (Akoko South East and Akoko North West). The second stage involves the random selection of

two communities from each of the selected LGAs while the third stage involves the random selection of respondent households from the selected communities. However, from the eight communities, a total of two hundred respondent households were randomly selected. The number of samples taken from each community depends on the entire population of the farming households in the communities. Hence, the sampling was carried out proportionate to size. Descriptive statistics as well as logit model was employed as analytical tool in this paper. Logit model was used to analyse the determinants of food security status in the study area. Logit model is usually applicable where the dependent variable is dichotomous and not continuous. Logit model is a probability function and can be represented by taking Y (dependent variable) as a probability. The logistic (logit) probability function is represented as

$P_i = 1/1+e^{-zi} = f(Z_i)$……………………………………………………...(i)

$\log (P/1\text{-}P) = f(Z_i)$…………………………………………………………..(ii)

But $Z_i = \beta X_i$ ……………………………………………………………..(iii)

Therefore, $\log (P/1\text{-}P) = f(\beta X_i, u)$…………………………………...……...…..(iv)

$\log (P/1\text{-}P) = 1$ if $C_i \geq Z_i$, while $\log (P/1\text{-}P) = 0$, if $C_i < Z_i$. (Hence, any household whose C_i is equal to or greater than Z_i is said to be food secure while any household whose C_i is less than Z_i is said to food insecure).

Where:

Z_i = Recommended daily per capita requirements (2450Kcal.); C_i = Per capita calorie consumption of household$_i$; log(P/1-P) = Food security status of households (1, for food secure households; 0, for food insecure households); X_i = Vector of explanatory variables; β = Estimate of the explanatory variables; u = Independent distributed error term.

The explanatory variables included in the model are:

X_1 = Household size (number); X_2 = Age of household head (years); X_3 = Farming experience (years). X_4 = Output of roots and tubers (Kg); X_5 = Output of cereals (Kg); X_6 = Output of cocoa (Kg); X_7 = Off farm income (₦); X_8 = Level of education (formal education = 1; otherwise = 0); X_9 = Association membership (1, if belongs to an association, 0, if otherwise).

RESULTS AND DISCUSSION

The mean age for cocoa farming households' head is 52.2 years (Table 1). About 42% of the total respondent households' head had their age below the mean age, while about 58% of the respondents had their age above the mean age of 52.2 years. Hence, there were more older households' head than their younger counterparts in the study area. This may have negative impact on the farm size since young people are stronger and are expected to cultivate larger-size farm than older respondents (Oni *et al*, 1999). Also, Table 1 shows that 83.5% of the respondent households were headed by males showing that majority of the households in the study area were headed by males. As regards to the educational status of the respondent household heads, 65.5% of the respondent household heads had formal education. Hence, most of the household heads in the study area had formal education. Education is a form of human capital; hence it could impact positively on household ability to take good and well informed production and nutritional decisions. It could also be observed in Table 1 that 93.5% of the respondents were married. This shows that majority of the household heads in the study area are married implying that there is likelihood that there could be more family labour, available to farming households. The mean household size in the study area is about five members per household (Table 1). The household size could have great implications for labour supply for farm work and also food security. A large household is expected to provide more labour for the cultivation of large farm size.

Table 2 shows the result of the logit model. The value of Chi-square shows that the overall model is significant at 1% level. This indicates that the model has a good fit to the data. Out of the nine independent variables used in the model, six variables were found to be significant in determining the food security status of the farming households. The variables are household size ($p<0.01$), age of household head ($p<0.1$), farming experience of household head ($p<0.05$), output of roots and tubers ($p<0.01$), output of cereals ($p<0.1$) and output of cocoa ($p<0.01$).

Household size was a significant factor in determining household food security status in the study area. A unit increase in household size will reduce the probability of household to be food secure by 0.23. Hence, increase in household size would lead to decrease in the food security status of the household. This result is expected because increase in the member of household means more people are eating from the same resources, hence, the household members may not be able to have access to enough food when compared to a situation with smaller household size. The result is in line with the findings of (Agbola, 2004). Findings also showed that age is a significant determinant of the probability of a household to be food secure or food insecure. A unit increase in the age of household head will reduce the probability of household to be food secure by 0.000074. This could be attributed to the fact that the productivity of old household head will decline as they get old thereby impacting on their food security status. This result is in consonance with (Agbola, 2004) who claimed that increase in age decreases food security. As for farming experience of household head, a unit increase in farming experience of household head increases the probability of household to be food secure by 0.0090. This result is expected because a more experienced farmer is likely to have higher level of productivity and hence be able to provide more food for his household members. With respect to the output of roots and tubers, a unit increase in output of roots and tubers increases the probability of household to be food secure by 0.00022. This finding is in line with (Olayemi, 1998). The finding could be attributed to the fact that increases in output for roots and tubers is likely to be synonymous to the availability of more food. Findings further revealed that output of cereals was a significant determinant of the probability of a household to be food secure or food insecure. A unit increase in output for cereals increases the probability of household to be food secure by 0.000094. Increase in output for cereals would make more food (cereals) available to the household and hence would make the household to be more food secure. In terms of the impact that output of cocoa had on food security status of households, findings showed that a unit increase in output of cocoa increases the probability of household to be food secure by 0.00051. Cocoa being a cash crop will enable household to generate more income. This will make money more available for use for households to buy food anytime they wish and hence would make the households more food secure.

CONCLUSION AND RECOMMENDATIONS

Based on the empirical evidence emanating from this paper, it concludes that household size, age of household head, farming experience of household head, output of roots and tubers, output of cereals and output of cocoa significantly impact on the food security status of respondents in the study area. The findings also made this study conclude that experience and age of farming household heads as well as right mix in production of food items as well as cocoa will improve the food security status of respondents in the study area.

The study therefore recommends that there should be an enlightenment programme in the study area on the need for birth control since the study reveals that food security decreases with increasing household size.

Table 1: Demographic and socio-economic characteristics of the respondents

Variables	Frequency	Percentage
Age (in years)		
≤ 20	2.00	1.00
21—30	25.00	12.00
31—40	23.00	11.50
41—50	37.00	18.50
51—60	52.00	26.00
61—70	39.00	19.50
Above 70	22.00	11.00
Mean	52.2o	
Standard Deviation	15.55	
Gender		
Male	167.00	83.50
Female	33.00	16.50
Educational status		
No formal education	77.00	38.50
Primary education	68.00	34.00
Secondary education	50.00	25.00
Tertiary education	5.00	2.500
Marital status		
Single	5.00	2.50
Married	187.00	93.50
Widow/widower	6.00	3.00
Divorced	2.00	1.00
Total	**200**	**100**
Household size		
1—2	7.00	3.50
3—4	66.00	33.00
5—6	67.00	33.50
7—8	48.00	24.00
9—10	12.00	6.00
Mean	5.37	
Standard Deviation	1.91	

Source: Field survey, 2007

Table 2: Logit Model Result

Variables	Coefficient	P-values	Marginal effect
Household size	-.9799958	0.000***	-0.2348728
Age of household head	-.0003091	0.096*	-0.0000741
Farming experience	.0375907	0.034**	0.0090092
Output of roots and tubers	.0009004	0.007***	0.002158
Output of cereals	.0003908	0.082*	0.0000937
Output of cocoa	.0021256	0.000***	0.0005094
Off farm income	-.0000424	0.195	-0.0000102
Level of education	-.1914788	0.416	-0.0458912
Association membership	.499997	0.411	0.1198328
Constant	2.311033	0.036	
Chi-square	103.22		
Log likelihood	-85.573628		
P-value	0.0000		

Source: Field Survey, 2007
*** significant at 1%, ** significant at 5%, *significant at 10%.

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EMPIRICAL ANALYSIS OF COSTS AND RETURNS TO GOAT FARMING IN BASSA LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA

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ABSTRACT
This study was carried out to evaluate the profitability of goat farming and identify the constraints associated with the enterprise in Bassa local government area of Plateau state. Multistage sampling procedure was employed in selecting the respondents in the study area. Well-structured questionnaires were used for primary data collection.. The data collected were analyzed using budgetary techniques (profitability analysis) and descriptive statistics. Budgetary analysis revealed that the gross margin (GM) and net farm income (NFI) were ₦171,200/small-holder goat farm and ₦139,700/small-holder goat farm respectively. Also the results of the efficiency ratios estimated includes; returns per naira invested (0.81), operating expense ratio (0.45), and benefit cost ratio (1.81); indicating that goat farming was a profitable enterprise. The major problems identified were financial constraints (94%), poor foundation stock (75%), and poor remunerative income/poor pricing (69%). Based on the findings from the study there is need to improve small scale goat farmer's access to agricultural credit through microfinance institutions and commercial banks sources. Also, livestock research institutes should be encouraged to produce more superior quality breeding stocks. More agricultural service centers should also be established. These constraints, if addressed, would improve productivity and profitability of goat production in Bassa Local Government Area (LGA).
Keywords: Goat farming, profitability analysis, constraints

INTRODUCTION
Goats were among the first farm animals to be domesticated. Goats disseminated all over the world because of their great adaptability to varying environmental conditions and the different nutritional regimes under which they were evolved and subsequently maintained (Peacock, 2005). They proved useful to man throughout the ages due to their productivity, small size, and non- competiveness with him for food. In Nigeria, goats make a very valuable contribution, especially to the poor in the rural areas (Aliyu, 1999). Goat undeniably plays a vital role in the rural economy of many developing countries in Africa. Goats are very important in the protein diets of the people, as well as a good, stable source of livelihood especially for the poor in the rural areas. Goat production is mostly carried out by smallholder farming households where the animals are kept in small flocks at an average of 5-10 head/family. It requires low initial capital and guarantees a high return on investment in as fast as two years; hence, it is an attractive undertaking among rural households. Goats are hardy and well-adapted to harsh climates. Due to their grazing habits and physiological characteristics, they are able to browse on plants that would normally not be eaten by other livestock species (Ojoye, 2006). Goats provide their owners with a broad range of products and socio-economic services; hence they can be used as gifts, in traditional and religious rituals and rites (Ojoye, 2006). Goats can play a vital role in ensuring the food security of a household, often being the only asset possessed by most rural farming households (Peacock, 2005; Birthal *et al.*, 2005). Goats play an important socio-economic role in rural areas. They are prolific and require low inputs for a moderate level of production, reach maturity early and are profitable to keep (Dolberg. 2001). Farmers and pastoralists are increasingly relying on goats as means of survival and a way of boosting their income (Peacock, 2005). Goats can withstand heat stress and can endure prolonged periods of water deprivation. They have additionally great adaptability to adverse climatic and geophysical conditions, where cattle and sheep cannot survive. They can efficiently utilize poor quality forage. Goat meat is widely consumed in the developing countries. According to FAOSTAT, (2008), total meat inventory is about 280 million MT. Goat meat represents only 2% of this total. The total amount of goat meat produced in 2008 was 4.9 million MT. The developing countries produced approximately 97% of this amount, reflecting the great importance of goat meat to feed millions of people in these countries. Although there are now considerable amount of published research on small ruminants in tropical areas of Africa, there is limited information available on small-holder goat production in Nigeria (FAOSTAT, 2008). The contributions of goats to the people and economies of Nigeria is well underestimated, basically because their production is considered as small in scale, and goat products seldom enter a formal marketing system. For these reasons, goats are accorded a low status and given a low priority in national development in most African countries. Much of the work published has the disadvantage of having been carried out under controlled conditions at research stations and the results may not reflect the actual situation of small scale production systems prevailing in rural areas (FAOSTAT, 2008). Thus it is necessary to study the performance and limitations of goat farming in order to recommend strategies for their improvement. Therefore, the general objective of the study is to estimate the profitability and constraints associated with goat farming in the study area, while the specific objectives are to; (i) determine the profitability

of goat farming (ii) identify the constraints associated with goat farming in the study area. Knowledge of this is necessary to assist the current or prospective goat farmers and agricultural policy makers in taking decisions and making recommendations that will improve production and profitability of goat enterprise.

MATERIALS AND METHODS

The study was conducted in Bassa Local Government area of Plateau State, Nigeria. Multi stage sampling procedure was employed in selecting the respondents for the study. The first stage, involved the purposive selection of Bassa Local Government Area (LGAs) which is noted for rearing of goats out of the 17 other LGAs in Plateau state. Second stage involved the purposive selection of three (3) districts out of nine in Bassa LGA at constant proportion of 0.334. The districts include Jere, miango, and mista ali. The final stage involved random selection of the respondents from a list of four hundred (400) goat farmers in the selected districts, compiled by the local extension agent at a constant proportion of 0.20. A total of eighty (80) respondents were interviewed. Primary data was collected using questionnaires. Data generated was analyzed using profitability analysis and descriptive statistics. To further substantiate the profitability of this enterprise, efficiency ratios such as: percentage profit margin, return per Naira invested, operating expense ratio (expressed as a percentage) and benefit cost ratio were analyzed.

RESULTS AND DISCUSSION

The estimated gross margin and net farm income were ₦171,200/small-holder goat farm and ₦139,700/small-holder goat farm, respectively (Table 1). Cost of foundation stock accounted for half (50.8%) of the total cost while revenue from weaned kids had the highest share (61.4%) of total revenue. The total revenue on the average was ₦312,000. The profit margin percentage was 45% while return per Naira invested was 0.81, implying that every ₦1 expended returned ₦0.81 to the enterprise and the operating expense ratio of 0.45 indicates that 45% of gross revenue was used to cover operating expenses, which accounted for about 81.7% of the total costs. The benefit cost ratio was 1.81These ratios are indicative of the profitability of goat enterprise in the study area.

Constraints associated with goat farming

The major constraints associated with goat farming in the study area are financial constraints (94%); accessibility of institutional credit for goat farming projects was relatively cumbersome, poor foundation stock (75%). Difficulty in getting good quality breeding stock (buck) was also a major constraint. The absence of organized efforts for breed improvement of goats has further compounded this problem. Another major (69%) constraint was poor remunerative income and low pricing of the surplus live goats. The trade of live goats is unorganized and their pricing in most cases does not favour the goat farmers. The live goats were sold not on the basis of their body weight in the livestock markets; this resulted in under-estimation of the value of live animals, hence low profit (Kumar, 2007).

CONCLUSION AND RECOMMENDATIONS

Based on the major findings from the study provisions should be made by private, public and other stakeholders in the agricultural sector to improve the livestock marketing structure as well as provide small scale goat farmers access to institutional credit through microfinance institutions and commercial banks sources. This could enable farmers to embark on large scale goat farming projects, obtain good quality breeding stock to increase production and profitability. Also, livestock research institutes should be encouraged to become the centers of production of superior quality breeding stocks. These will reduce the problem of poor foundation stock. In addition, more agricultural service centers, e.g., ADPs, etc., should be established to provide technical knowledge, recommended inputs and market information this will help to improve the quality of output, thereby solving the problem of poor remunerative income/poor pricing.

Table 1: Profitability analysis of a small- holder goat farm (20 does and 1 buck) with two (2) production cycles per annum

S/N Item	Mean amount (₦)	Percentage of revenue/cost (%)
A. Revenue		
i. *30 weaned kids @ ₦5000/kid	150,000	48.1%
ii. 18 culled doe @ ₦9000/doe	162,000	51.9%
a. Total Revenue (TR)	312,000	
B. Variable costs		
i. cost of foundation stock		
21 weaned kids @ ₦4000/kid	84,000	48.7%
Labour cost	18,500	10.7%
Medication/veterinary services	6000	3.4%
Maintenance cost of housing units	7,500	4.4%
Cost of feed	24,800	14.5%
b. Total variable cost (TVC)	140,800	81.7%
c. Gross margin (GM) (TR-TVC)	171,200	
C. Fixed costs		
i. Cost of house units	31,500	
d. Total fixed cost (TFC)	31,500	18.3%
e. Total cost (TC) = TFC +TVC	172,300	
f. Net farm income (NFI) = TR-TC	139,700	
g. Profit margin (%) =f/a *100		44.77%
h. Returns per naira outlay (₦) = f/e	0.81	
i. Operating expense ratio (%) = b/a	0.45	
j. Benefit cost ratio (BCR) = a/e	1.81	

* Foundation stock: 20 does, 1 buck; at 10% mortality rate 18 does will attain maturity: 18 does kidding twice a year (36 kids on the average): at 15% mortality rate 30 does will survive to weaning age

Table 2: Production constraint of goat farmers*

Constraints	Frequency	Percentage (%)
Financial constraints	75	93.75
Poor foundation stock	60	75
Poor remuneration/Low profit	55	68.75
High mortality/poor growth rate	35	43.75
Feed availability	20	25

*Multiple responses

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ECONOMICS OF BITTER YAM (*Dioscorea dumetorum*) TO RURAL HOUSEHOLDS IN EMUOHA LOCAL GOVERNMENT AREA OF RIVERS STATE

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ABSTRACT
*The study examined the socio-economics of three leafed yam (Dioscorea dumetotum) to rural households in Emuoha Local Government Area of Rivers State. Structured interview schedule was the instrument used to get information from 100 bitter yam farmers from ten communities using the simple random sampling technique. Data collected were analysed using the descriptive statistics and cost benefit ratio. The result reveals that majority of the respondents are females (52%), married (60%), between the ages of 41-50 years (42%), had First School Leaving Certificate (FSLC) and have been farming bitter yam for over 12 years (42%). The cost benefit ratio is 1.79, indicating a profit of ₦0.79 for every ₦100 invested in bitter yam production. The constraints to bitter yam production include lack of capital (x = 3.15), infection of bitter yam by beetle (x= 3.00), spoilage/rottenness of bitter yam (X=2.73) and flooding of farms (x=2.63). The study therefore, recommended that technologies on how to prevent beetle from attacking bitter yam and how to prevent spoilage of bitter yam should be disseminated to farmers and rural households should be encourage to go into bitter yam farming as a source of livel*ihood since it is a profitable venture.

Keywords: Bitter yam, Economics, Household, Food

INTRODUCTION
Bitter yam (*Dioscorea dumetorun*) is among the yam family that belongs to the genus *Dioscorea* and family *Diocoreacae* (Bai and Ekanaayake, 1998). There are other names for bitter yam which include trifoliate (three leafed) yam and cluster yam. Bitter yam is called 'ji una or ji ona by Ojoto and some Igbo speaking communities or areas or towns in the south-eastern staes in Nigeria while in Emohua Local Government Area of Rivers State, it is called ele-he-lu (White bitter yam), nkpu-ta-nkpu (Pupple bitter colour) and ngwa Benin (Yellow bitter yam). They are generally called ele-he-elu in Ikwerre speaking language. It is usually eaten as as a food mainly for adult. In the study area, bitter yam also serves as food for the diabetic patients and as herb for the treatment of various ailments such as elipsy. In the south-western Nigeria, bitter yam is used in the treatment of malaria (Dike *et al*, 2012) which indicates that bitter yam has ethno-medicinal benefits to the rural people. Bitter yam is rich in phyto-nutrients, including proteins (Medoua *et al*, 2005, Alozie *et al* 2009), yet it is among one of the most uncultivated tropical tuber (Enujiugha and Ayodele-oni, 2003). In spite of the numerous potentials found in using bitter yam in bakery, homes and pharmaceutical industries (Musieba *et al*, 2013). The state and nation are faced with the problem of inadequate food supply because of government over reliance on oil, land degradation as a result of oil activities and the attendant malnutrition problem in the rural areas necessitated the study with the aim of finding how food supply could increased and be available for people to utilize them.
The white colour does not stay long after harvesting but the rest can stay longer. The most preferred one is the white coloured bitter yam. However it could not be kept overnight. It has to be harvested and eaten under 24 hours. But the yellow and purple specie bitter yam could stay as long as the farmer wants. It can be harvested and kept in the house for one to two weeks. However, they are not preferred by rural households. Another limitation of the use of bitter yam is the unpalatable bitter taste and high post-harvest hardening nature of the tubers (Medoua *et al*, 2005). High post-harvest hardening of tubers could be prevented by drying and milling bitter yam into flour. In this regard, it is necessary to survey bitter yam production among rural farmers in Rivers State and investigate simply methods of how to improve on the traditional method of drying and milling.

METHODOLOGY
The major occupation of the people of Emohua is farming such as yam, cassava, three leaf yam, vegetable, pepper, okro, and cocoyam. Emohua is made up of 21 communities. Ten communities were purposively selected from the LGA. This was based on the highest number of farmers who produce bitter yam. The selected communities were: Egbeda, Omudioga, Ubinin, Ibaa, Rumuji, Ndele, Ovogo, Npremini, Ogbakiri and Itue. From each of the selected communities, a proportionate number of 10 bitter yam farmers were randomly selected, giving a total number of 100 bitter yam farmers. A well-constructed structured interview schedule was used for relevant data collection. Data collected were analyzed through the use of mean statistics, percentages and cost benefit ratio.

RESULTS AND DISCUSSION

Table 1 reveals that a higher percentage (42.0%) of the respondents was in the age bracket of 41-50 years, was females (52%) and married (60%). The mean year of 42.2 years indicates that the respondents were still young and active and in their productive stage, females are more in bitter yam production and they are responsible men and women. Also, majority (57%) of the respondents had First School Leaving Certificate (FSLC) and have been farming bitter yam for over 12 years (42%) indicating low literacy level in the study area however, they have enough experience in bitter yam farming. The mean year of farming is 12 years.

The above result shows that a total cost of ₦19500 was required to produce 10 kilogrammes to 50 kilogrammes of bitter yam. This gave ₦35000 when a heap of 50kg is sold for ₦3500. The total revenue is ₦35000. This gave a profit of ₦16000 indicating that bitter yam production is a profitable venture. Also, the net return for bitter yam production is ₦35000 in Emohua LGA of Rivers State. Furthermore, the cost benefit ratio shows that for every ₦100 invested in bitter yam production, a profit of ₦0.79 is returned. This shows that the business is profitable.

Perceived socio benefits of Bitter Yam production

Table 2 shows that a little above half (51%) of the respondents perceived that the socio benefits of bitter yam production to the rural dwellers is that it is very cheap to buy followed by 40% of the respondents who say it is a source of livelihood and 12% said it is very good for diabetic patients.

Constraints to Bitter Yam Production

The constraint to bitter yam production is shown in Table 3. From Table 3, using a mean score of 2.50 as the decision rule, out of the seven variables given for respondent to react, only four of the variables were accepted as constraints to three leaf yam or bitter yam production. They lack of capital (x = 3.15), infection of bitter yam by beetle (x= 3.00), spoilage/rottenness of the yam (X=2.73) and flooding of farms (x=2.63). This implies that lack of capital; insect's infection and flooding were the major constraints to bitter yam. This agrees with Albert and Ekine (2012) who observed that lack of funds was a major constraint to the development of rural business in the state.

CONCLUSION

Bitter yam is popularly grown as a food crop in Nigeria. Although there are some cultural bias against it but it is grown by farmers of different social class. This often is attributed to its cost which is very minimal compared to other varieties of yam. Since insufficient fund is the main constraint to the production of bitter yam, it is recommended that the farmers should be formed into cooperative groups for easy access to farm credits.

Table 1: Socio-Economic Characteristics of Respondents

Variables	Frequency	Percentage	Mean
Age (Years)			
20 - 30	10	10.0	
30 – 40	35	35.0	
40 – 50	42	42.0	
50 – 60	6	6.0	44years
60-70	5	5.0	
Above 70	2	2.0	
Sex			
Male	52	52.0	
Female	48	48.0	
Marital status			
Single	60	60.0	
Married	30	30.0	
Divorce /Separated	7	7.0	
Widow/Widower	3	3.0	
Educational level			
No Formal Education	18	18.0	
FSLC	57	57.0	
SSCE/WAEC	25	25.0	
OND/NCE	-	-	
HND/B.Sc /B.Ed	-	-	
Years of Farming			
0 – 2	-	-	
2 – 5	16	16.0	
6 – 8	12	12.0	12years
8- 12	30	30.0	
Above 12	42	42.0	

Source: Field Data, 2015

Cost Benefir Ratio for Bitter Yam Production
Cost of Production
Fixed cost
Land Inherited/leased for one
Variable Cost
Cost of labour ---------------------------Family Labour
Cost for clearing land ---------------------- ₦4500
Cost of bitter yam seedlings -------- ₦1500 for 10 tonnes x 8 plots of land(1 hactare) = ₦12000
Total Cost of Production -------------------- ₦16500
Revenue
One heap(10tonnes) of 50 sold for -------------------- ₦3500 x 10 = ₦35000
Gross Margin Profit = Total Revenue – Total Cost
= ₦35000 - ₦9500 = ₦16000

$$\text{Cost Benefit Ratio} = \frac{\text{Total Revenue (TR) TR} = ₦35000}{\text{Total Cost (TC)} \quad \text{TC} = ₦19500} = \frac{₦35000}{₦19500} = 1.79$$

Table 2: Percentage Distribution of Types of bitter yam cultivated

Benefits	Frequency	Percentage
Good for diabetes (medicinal)	12	12.0
Very cheap to buy	51	51.0
Very easy to plant and harvest	4	4.0
Is a source of business	40	40.0

Source: Field Data, 2015

Table 3: Mean Distribution of constraints to bitter yam production

Constraints	Strongly Agreed (4)	Agreed (3)	Disagreed (2)	Very Strongly Disagreed (1)	Total Score	Mean X	Remarks Reject
Low patronage	20	25	20	6	186	1.86	Reject
People are not aware of bitter yam	25	22	10	9	195	1.95	Reject
Low educational level of farmers	2	3	31	30	109	1.09	Reject
Flooding of farms	30	35	15	8	263	2.63	Accept
Spoilage/rottenness of the yam	32	36	15	7	273	2.73	Accept
Lack of capital	35	40	20	15	315	3.15	Accept
Infection by yam beetle	35	38	17	12	300	3.00	Accept

Source: Field data, 2015

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ANALYSIS OF TECHNICAL EFFICIENCY OF TRIFOLIATE YAM (*Dioscorea Dumentorum*) PRODUCTION IN EBONYI STATE, NIGERIA

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ABSTRACT
The study was carried out in Ebonyi State, Nigeria, to determine the socio-economic characteristics of the farmers; the technical efficiency of the farmers; and the constraints to production of trifoliate yam by smallholder farmers. The study involved a multistage sampling technique and a random sample of 60 smallholder farmers. Random field data for the study were collected from the respondents using well structured questionnaire and oral interview. Data collected from the study were analyzed using simple descriptive statistics and Cobb-Douglas stochastic frontier production model. The results of the study showed that among the trifoliate yam farmers in the study area, the mean farm size is 0.19ha, and the mean farm output is 2117.17kgha^{-1} annually. Farm size and fertilizer input are significantly positively related to trifoliate yam production, while the use of stakes is significantly negatively related to trifoliate yam production. Sex and farming experience are significantly positively related to the technical efficiency of the farmers. The technical efficiency of the farmers ranges from 44.0 to 90.0 percent, with a mean of 57.0 percent. The mean technical efficiency of 57.0 percent implies that the output of trifoliate yam farmers in the study area can be increased by about 43.0 percent with the existing level of resources. This can be achieved by adequate access to credit for production through farmers' cooperative societies and micro-finance institutions among others.
Keywords: Technical efficiency, production, trifoliate, yam

INTRODUCTION
Trifoliate yam (*Dioscorea dumentorum*) is an important food security crop among smallholder farmers in Nigeria. It readily intercrops with maize, vegetables, okra and cowpeas, and occupies a prominent position in the diet and farming systems of southeastern agricultural ecological zone of Nigeria (Onyekwere *et al.*, 2010). Nutritionally, it is superior to commonly consumed yams, having higher protein and mineral content (Baquar and Oke, 1976). It contains dry matter (28.62%), crude protein (11.07%), ash (2.20%), fibre (2.06%), fat (1.73%), total carotenoid (217.73 µg/100g) and carbohydrate (69.71%). The high fibre content makes it an important diet for people with high cholesterol level in the blood. Trifoliate yam is not a good source of carbohydrate as other yam varieties, hence it can be recommended for the diabetics (Ezeocha *et al.*, 2009). In spite of the economic values of trifoliate yam in Nigeria, there is a dearth of information on the technical efficiency of trifoliate yam smallholder farmers, and this study attempts to provide the information. Technical efficiency refers to the ability to produce the highest level of output with a given bundle of resources (Onyenweaku and Nwaru, 2005). Farrel (1957) provided the impetus for developing the literature on empirical estimation of technical, allocative, economic and profit efficiency of the farmer. Efficient use of farm resources is an important part of agricultural sustainability which enables increase in farm production by improving efficiency within the input of existing resource base and technology (Ajibefun, 2004). Among the approaches used in measuring efficiency, stochastic frontier approach has been used extensively in measuring the level of efficiency and inefficiency. Aigner *et al.*, (1977) and Meeusen and Broeck (1977) independently proposed the stochastic frontier model. The stochastic frontier approach is preferred for accessing efficiency in agriculture because of the inherent stochastic involved (Kirkley *et al.*, 1995; Coelli *et al.*, 1998). In the light of the foregoing, the specific objectives were to determine the technical efficiency of the farmers and the constraints to production of trifoliate yam by smallholder farmers in the study area.

MATERIALS AND METHOD
Multistage sampling technique was used for the study. Two (2) Agricultural Zones were randomly chosen from the three (3) agricultural zones in the study area. Four (4) Local Government Areas (LGAs) were purposively selected for the study. These comprised 2 LGAs known for trifoliate yam production from each of the 2 agricultural zones selected for the study. Twelve (12) randomly selected communities comprising 3 communities from each of the 4 purposively selected LGAs were used for the study. A random sample of 60 smallholder farmers comprising 15 respondents from each purposively selected LGA were used for the study. Random field data for the study were collected from the respondents using well structured questionnaire and oral interview. Data were collected on the socio-economic characteristics of the farmers including their age, sex, educational level, farm size, household size, farming experience, farm output and farm income. Also data were collected on the farmers'

farm specific factors including rent on land, planting material, staking material, fertilizer, labour and depreciation of farm assets, and farmers' production constraints.

Data Analysis

Data collected from the study were analyzed using descriptive statistics and econometric model. The socio-economic characteristics of the farmers were described using simple means and percentage values. The technical efficiency of the farmers in the use of farm specific factors in production was determined using the explicit functional form of the Cobb-Douglas stochastic frontier production model which is specified as:

$InY_i = \beta_0 + \beta_1 I_n X_1 + \beta_2 I_n X_2 + \ldots + \beta_7 I_n X_7 + V_i U_i \ldots (1)$

where:

In = natural logarithm; Y_i = trifoliate yam output (kgha^{-1}) of the *i-th* farmer; X_1 = rent on land (₦ ha^{-1}); X_2 = planting material (kgha^{-1}); X_3 = staking material (₦ ha^{-1}); X_4 = fertilizer (kgha^{-1}); X_5 = labour (MDha^{-1}); X_6 = depreciation of farm assets (₦ ha^{-1}); β_0= constant intercept; $\beta_1 - \beta_5$ = estimated coefficients; V_i = random error term; U_i = technical efficiency which has half-normal distribution and is independent of V_i

The socio-economic factors that influence the technical efficiency of the farmers in the study area were estimated as:

$TE_I = b_0 + b_1Z_1 + b_2Z_2 + \ldots + b_7Z_7 + e$ ………… (2)

where: TE = technical efficiency of the *i-th* farmer; Z_1 =age of farmer (years); Z_2 = sex of farmer (Dummy variable: 1=male; 0 = female); Z_3 = household size; Z_4 = Educational level; Z_5 = Farming experience; Z_6 =Extension contact; b_0= Constant intercept; b_1 - b_1= Coefficient to be estimated

Equations 1 and 2 were jointly estimated using the Cobb Douglas stochastic frontier production model in a single stage maximum likelihood estimation procedure using computer software frontier version 4.1. Constraints to production of trifoliate yam in the study area were identified during the study, and these formed the basis to improve the productivity of the farmers based on recommendation from the findings of the study.

RESULTS AND DISCUSSION

Table 1 shows the maximum likelihood estimates of the Cobb Douglas stochastic frontier production function for trifoliate yam farmers in Ebonyi State, Nigeria. Table 1 indicates that the total variance (sigma square) (0.0263) is statistically significant at 10 percent probability level, and this implies the goodness of fit and the correctness of the specified assumptions of the error terms distribution.

The estimated production factors (Table 1) used by the farmers indicate that the coefficients of farm size (0.0186) and fertilizer input (0.0030) are significantly positively related to trifoliate yam production according to *a priori* expectations, implying that the more the farm size and the quantity of fertilizer used by the farmers, the more the output of trifoliate yam produced in the study area. The coefficient of stakes (-0.3109) is significantly negatively related to trifoliate yam production, implying that as the farm size increases the farmers resort to staking methods that lead to reduction in their cost of production.

The estimated efficiency (socio-economic) factors (Table 1) influencing the technical efficiency of trifoliate yam production indicate that the sex and farming experience are significantly positively related to the technical efficiency of the farmers at 10.0 percent probability level. While more female farmers (Table 1) participate in the production of trifoliate yam in the study area, farmers with more years of farming experience are more likely to be technically efficient in the production of trifoliate yam, in agreement with Onyenweaku and Nwaru (2005).

Table 2 shows the frequency distribution of technical efficiency of trifoliate yam farmers in the study area. The technical efficiency of the farmers ranges from 44.0 to 90.0 percent, with a mean of 57.0 percent. This implies that the most technically efficient farmer will require 10.0 percent cost saving to become the best practice or frontier farmer, while the least technically efficient farmer will require 56.0 percent cost saving to become the best practice or frontier farmer. These figures compare favourably with the technical efficiency of between 31 and 95 percent observed by Onyenweaku and Nwaru (2005) in a study of food production in Imo State, Nigeria, and the technical efficiency of between 21 and 88 percent observed by Dung *et al*. (2010) in a study of Hausa potato production in Kaduna State, Nigeria. The mean technical efficiency of 57.0 percent implies that the output of trifoliate yam in the study area can be increased by about 43.0 percent with the existing level of resources.

Table 3 shows the production constraints of trifoliate yam farmers in Ebonyi State, Nigeria, which include inadequate capital (75%), high cost of seed yam (66.67%), low yield (35%) and poor storage facilities (58.33%).

CONCLUSION

The results of the study show that among the trifoliate yam farmers in the study area, the mean farm size is 0.19ha, and the mean farm output is 2117.17kgha^{-1} annually. Farm size and fertilizer input are significantly positively related to trifoliate yam production, while the use of stakes is significantly negatively related to trifoliate yam production. Sex and farming experience are significantly positively related to the technical efficiency of the farmers. The technical efficiency of the farmers ranges from 44.0 to 90.0 percent, with a mean of 57.0 percent. The mean technical efficiency of 57.0 percent implies that the output of trifoliate yam farmers in the study area can be increased by about 43.0 percent with the existing level of resources. This can be achieved by adequate access to credit for production through farmers' cooperative societies and micro-finance institutions, while information on solutions to low yield and poor storage facilities can be obtained through increased farmers' contact with the extension service.

Table 1: Maximum Likelihood Estimates of the Cobb Douglas Stochastic Frontier Production Function for Trifoliate Yam (Dioscorea dumetorum) Farmers in Ebonyi State, Nigeria

Production Factors	Parameter	Coefficient	Standard Error	t-ratio
Constant intercept	β_0	6.5489	2.3633	2.7711***
Farm size (ha^{-1})	β_1	0.0186	0.0070	2.6599***
Planting material (kg^{-1})	β_2	0.0688	0.0515	1.3343
Fertilizer (kg^{-1})	β_3	0.0030	0.0012	2.4681**
Stakes (ha^{-1})	β_4	-0.3109	0.1823	-1.7058*
Labour (MD ha^{-1})	β_5	0.1626	0.1794	0.9062
Depreciation of farm assets (Nha^{-1})	β_6	0.2897	0.2241	1.2929
Efficiency Factors				
Constant intercept	b_0	0.4657	0.4466	1.0427
Age (years)	b_1	0.0018	0.0033	0.5558
Sex	b_2	0.1749	0.0895	1.9545*
Household size (no.)	b_3	-0.0074	0.0099	-0.7505
Educational level (years)	b_4	-0.0056	0.0072	-0.7816
Farming experience (years)	b_5	0.0112	0.0063	1.7838*
Extension contact (no.)	b_6	0.0606	0.0256	0.2361
Diagnostic Statistics				
Total variance (Sigma square)	σ^2	0.0263	0.0064	4.0997*
Variance ratio (Gamma)	γ	0.9999	6.6182	0.1511
Likelihood ratio test		12.9205		
Log likelihood function		24.0736		

Source: Field Survey Data, 2015
Note: *, **, and *** = Significant at 10%, 5% and 1% respectively.

Table 2: Frequency Distribution of Technical Efficiency Indices

Technical efficiency range	Frequency	Percentage
0.00 – 0.20	0	0.00
0.21 – 0.40	0	0.00
0.41 – 0.60	44	73.33
0.61 – 0.80	13	21.67
0.81 – 1.00	3	5.00
Total	100	100.00
Maximum technical efficiency	0.8971	
Minimum technical efficiency	0.4445	
Mean technical efficiency	0.5722	

Source: Field survey data, 2015

Table 3: Production Constraints of Trifoliate Yam (Dioscorea dumetorum) Farmers in Ebonyi State, Nigeria

Variable	Frequency	Percentage
Inadequate capital	45	75
High cost of seed yam	40	66.67
Low yield	21	35
Poor storage facilities	32	53.33

Multiple responses from farmers
Source: Field Survey Data, 2015

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A REVIEW OF MARKETING STRATEGY CONCEPTS, CLASSIFICATION AND APPLICATION: IMPLICATION FOR AGRICULTURAL TRANSFORMATION

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ABSTRACT
The paper attempted to re-examine marketing strategies and their implication for agricultural transformation. It employed descriptive approach in the methodological analysis of the concepts and derived useful implication of the marketing strategies for the agricultural sector. On the basis of the marketing strategies analyzed, the paper recommended concerted focus on the downstream subsector of Nigerian agriculture with the application of the marketing strategies to ensure that what was produced gets to the final consumer. This recommendation is coming on the heels of our current economic state where the country is experiencing recession and in dire need of economic diversification.
Keywords: marketing strategies, agriculture, transformation

INTRODUCTION
Strategy is the first level of planning for an organization, making the big decisions that shape the lower-level detail. It takes account of resources available and makes broad decisions about how these are to be allocated. Medium-term strategy takes account of the longer-term strategic intent of the firm, including its vision, mission and values. Strategic planning is the process of identifying and formalizing strategy, including writing the strategic plan. Strategic planning usually looks at least a year ahead and possibly up to ten years or more. How far you can practically plan for depends on the rate and depth of change. An organization's strategy that combines all of its marketing goals into one comprehensive plan. A good marketing strategy should be drawn from market research and focus on the right product mix in order to achieve the maximum profit potential and sustain the business. The marketing strategy is the foundation of a marketing plan. Marketing strategy both influences and is influenced by overall organizational strategies. It has a primary customer focus in selecting who should be customers and then guiding what and how to sell to them. The marketing strategic plan is best written in parallel with the business strategic plan so each influences the other. Sometimes the reality is that the marketing plan follows the business plan (though this can cause many problems). There are no shortcuts to achieving the ultimate goals of your business through a proper marketing strategy. You should be ready to invest a lot of time, effort, patience, and finances in this goal. When you pay attention to the key elements of a good marketing strategy, it will be easier for you to develop a logical, effective plan that will lead your business to success.

Components of Marketing Strategy
There is hardly a small business owner who is not obsessed with this term: marketing strategy. That's the main aspect that makes the difference between successful entrepreneurs and those that fail. It's strange how everyone cares about discovering the perfect marketing techniques for their business, but we don't bother realizing what *marketing strategy* really means. Let's start from the fundamentals. Marketing strategy is a collection of techniques that enable a particular organization to direct its resources towards the best opportunities in terms of increasing sales and achieving sustainable advantage over the competition. A company's marketing strategy consists of long-term activities that contribute towards developing strong brand awareness. Now that we have a clear definition of the term, it's time to get into the details: when can you be sure that you have a good marketing strategy? Pay attention to the following components, and you'll get there:

Target Audience
Who are you trying to reach through your marketing efforts? Who falls into the category defined as *the perfect customer*? This is the first step in every marketing strategy: identify your target audience. This doesn't mean you'll ignore potential buyers who don't fit into the criteria you set at this stage. Everyone interested in your products and services will still be able to get them, but you should definitely narrow your marketing efforts to the category of people you are most likely to attract. When you identify the interests of your target customer, you'll adjust the overall style of your marketing strategy in a way that suits this category of users. You'll create the perfect TV ads, you'll write blog posts in a language they understand, and you'll easily connect with them via social media.

Awareness
The ultimate goal of any business is to gain more trust with current clients and achieve better brand awareness among the target audience. Some of the classic ways to boost the awareness for your brand include advertising

(TV, newspapers, magazines, and online) and word of mouth. These tactics are not outdated as many contemporary marketers think. You should still consider them as part of your content marketing strategy.
In the current market conditions, the concept of building brand awareness is mostly determined through online marketing techniques. This means that your business needs a website, as well as a blog where you will post high-quality articles related to your niches. Videos, podcasts, info graphics, images, and presentations are also important. Visual and audio content creates lasting impressions.

Unique Advantages

Your brand has to offer a unique advantage if you want your target audience to choose it over competitors' offers. What are the main things that distinguish your product/service from the similar offer on the market? If you cannot identify such advantages, you better think of them as soon as possible. Then, you'll focus your marketing strategy on promoting them.
If for example, you are promoting new photo editing software, you'll face huge competition and you'll have to attract the audience with unique features. The customer wants effectiveness, speed, great choice of filters and editing options, and unique flare that will make the photos different from the mainstream trends. If the description of your offer gets the attention of your target audience, you'll be one step closer to achieving the goals of your marketing campaign.

Communication with Your Clients

It's important to know when and how to communicate with your audience. You cannot simply create social media profiles and use them whenever you have time for them. The connection you develop with your customers is a key aspect for the success of your marketing strategy. Social media is certainly important, but you have to use it strategically. Consider paid advertising on Face book, Twitter, and other platforms. These ads will be featured in front of a huge audience, so you'll easily attract a base of followers with this method.
When you obtain a decent number of followers, you'll need to maintain successful communication with them. Don't make it all about your business. You'll certainly promote your products and services as the best choice on the market, but you should focus your attention on the needs and wants of your followers. Identify the problems they have and show how your business is a proper solution. Monitor the activity of your audience and make sure to publish updates during traffic peak times!

Elements of Marketing Strategy

There are many elements of marketing and, if a marketing-led view of the firm is taken, they touch all aspects of the company. Although these elements are discussed separately below, they are all interlinked and can have bi-directional influence on one another.

Segments

The first big decision is who should be our customers and who should not. In other words, what customer segments will be addressed? This is based first on the overall strategic intent of the firm, for example to be a high-end exclusive and low-volume provider, or to compete in mass markets where price is critical .The decision is also based on research that indicates the profitability of different customers groups and how well the company is able to compete in each segment.

Brand

The brand is the overall intended message of the company, its products and services. It describes what customers and others should think and feel whenever they encounter the company or its products and services. Brand is influenced by and influences the strategic intent of the firm and helps focus all other communications, products and interactions. Brand is fragile in that it is what customers think and feel rather than what the company communicates. This makes shaping decisions about brand critical.

Competition

An important marketing decision is the nature of competition, for example whether to compete on quality, price, service, etc. Decisions here will be affected by brand and will shape further activity such as the approach towards promotion, the use of advertising, the response to competitive action, and so on.

Products

Having understood and selected customers, marketing strategy should have a significant influence on the products created. This not only includes the overall functionality but also the focus on quality, features, price points and so on, in order to produce products that align with the brand and complete effectively in the marketplace.

Price

While the exact price may not decided in strategic planning, the price ranges should be understood particularly in terms of what the target customers are willing and able to pay, and also what price breaks are important to be able to compete in the markets being addressed.

Promotion

Promotional strategy includes decisions about what approaches to promotion will be used, for example TV advertising, direct marketing and so on. Promotion can be extremely expensive, so a key part of the strategic decision here is in the amount of budget that is being allocated.

Communication
Related to brand and promotion, the way that communications with customers and other stakeholders (such as the media) need to be decided should be considered. This includes broadcast information about products, one-to-one and things in between. It also includes how service conversations will be conducted, for example using web interfaces or directs phone conversation.

Outsourcing
A big decision that can be applied within any of the above is the 'make or buy' choice of whether to do things in-house, bring in external experts or pass on the work to third party suppliers. Two key factors in the outsourcing decisions are first the ability of the company to do the work in comparison with suppliers, and secondly the costs of doing this. The impact on brand should be a key consideration also. Many companies who outsource such as service calls have suffered huge brand damage from suppliers who do not deliver brand values.

Types of Marketing Strategies
Marketing is a strategy used by companies to communicate with the consumer and make him knowledgeable about the various features of their products and services. It is an essential part of attracting the target buyers to a particular product, and companies use various innovative or tried-and-tested techniques to stay ahead of their competitors and make their place in the market. Some of the strategies include affinity marketing, alliance marketing, ambush marketing, call to action marketing, close range marketing, cloud marketing, community marketing, content marketing, cross – media marketing, database marketing, digital marketing, guerilla marketing, evangelism marketing, freebie marketing etc.

CONCLUSION
The multiplicity of marketing strategies examined by the study indicates that agricultural transformation in Nigeria can enjoy a boost if the marketers of agricultural produce are acquainted with them. The problem of agriculture in the country has gone beyond production; much focus is now on the downstream subsector which encompasses processing, value addition etc. These developmental efforts are not likely to make serious economic sense if these products do not get to the final consumer. It is therefore important that stakeholders in the agricultural sector should begin to integrate marketing of agricultural produce and byproducts into the development plan of the sector as a means of ensuring that the capacity of the sector to contribute to economy is enhanced. This is an important issue to be considered especially now diversification of the economy is imperative and the need is imminent.

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ESTIMATING THE TREND OF CORRUPTION IN NIGERIA: IMPLICATION FOR THE AGRIBUSINESS SECTOR

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ABSTRACT
There has been much emphasis on the fight against corruption by different administrations in Nigeria. Simultaneously, Transparency International (TI) has continued to rank nations on its corruption index over these years. Between 1996 and 2015, Nigeria's position on this scale has been fluctuating, bringing with it varying implications for the agribusiness sector. Against this backdrop, it has become necessary to empirically ascertain the nation's overall performance in her fight against corruption. Data obtained from Transparency International over the period covering 1996 to 2015, were subjected to descriptive and inferential analysis using trend function. The results showed that Nigeria's corruption index for the period was 19.725(1.34) on a scale of 0-100. At the beginning of the period (1996), Nigeria was ranked the most corrupt country in the world with an index of 6.90. The pre-democracy period (1996-1998) recorded mean index of 14.50(6.62). The three different civilian dispensations of 1999-2007, 2008-2010, and 2011-2015 recorded indices of 16.33(4.12), 25.33(1.53), and 25.60(0.89), indicating improvements in reducing corruption. The trend analysis returned a time coefficient of 0.857 which was significant at 1% alpha level, and an r^2 value of 0.714; these are indications that improvements in corruption reduction in Nigeria were as a result of interplay between varied factors over time. It is recommended that government institutions be strengthened to intensify their efforts at reducing corruption in the nation's public life.
Keywords: Corruption, corruption index, transparency, trend analysis

INTRODUCTION

Nigeria has over time been cruelly identified with the unfortunate characteristic of one of the most corrupt countries in the world. Corruption is a complex social, political and economic phenomenon that is prevalent in all countries in varying degrees. There is no international consensus on the meaning of corruption. In the literature, corruption is commonly defined as the misuse of public power for private benefit (Lambsdorff, 2007). Although this definition has been widely adopted, several critics have observed that such a definition is culturally biased and excessively narrow (UNDP 2008).

The trend of corruption observed over time indicates that Nigeria's fortunes may be dwindling. The international community has finally appreciated and come to terms with the reality of the "cancer of corruption" and its ubiquitous nature; hence, corruption being a persistent feature of human existence worldwide, its solution lies in the collective action of key global institutions with organized international joint efforts against corruption. These efforts have produced a lot of anti-corruption measures including bi-lateral and multilateral agreements, enactment of national anti-corruption laws such as the Nigeria's Economic and Financial Crimes Commission Act, 2004, the designing of international framework and strategies for the prevention of corruption and the making of an all-important United Nations Convention Against Corruption which has now become the reference point for anti-corruption fight all over the world.

The need to study corruption and anti-corruption has continued to generate passionate commentaries and academic interests. While it is obvious that this interest has made the subject matter better understood to an extent, the hundreds of information being incorporated into its study, research data and the diversity of some of the findings have sometimes established some levels of complications too. Apart from the fact that some have attempted to mischaracterize corruption as a tool for development under such labels as "grease the wheels" arguments or the "efficiency grease", the question still persists, for instance, on how corruption should be situated, whether within the context of the "moralists", "developmentalists" or "functionalists" definitions. More directly, should the definition be public-office centered, market-centered or public-interest centered? Whatever opinion that finally prevails, the fact that the country has been submerged in a deep ocean of corruption over time is undisputed. This situation spells doom for the agribusiness sector, which is built on legal frameworks, corporate identities and business drives. To sustain the tempo in resuscitating the agribusiness sector, with the view to create more jobs, and diversify Nigeria's economy away from oil, it has become necessary to empirically ascertain the nation's experience in corruption over certain time periods. Thus, the focus of this is to estimate the trend of corruption in Nigeria, using data obtained from Transparency International between 1996 and 2015.

The definition of corruption becomes more complicated when viewed in terms of such classification as supportive corruption, transactional corruption, extortive corruption, defensive corruption, investive corruption, personal and institutional corruption, traditional and modern corruption, local, national or international corruption, or representational corruption, grand and petty corruption. Or simply put, should corruption be viewed as corruption and nothing more? Many questions continue to arise in our experience and engagement of corruption and corrupt practices.

Corruption has been defined as the dishonest or fraudulent conduct by those in power, typically involving bribery. It is the illegitimate use of power to benefit a private interest (Morris 1991). Corruption is the giving of a bribe to an official so that the truth will not be told. It involves the embezzlement of public fund for personal use and any act which is considered to be criminal act according to the law of a particular society. Andvig *et al.* (2000) identified four main forms of corruption namely bribery, embezzlement, fraud and extortion. While bribery is understood as the payment (in money or kind) that is given or taken in a corrupt relationship. Equivalent terms to bribery include, for example, kickbacks, commercial arrangements or pay-offs. These are all notions of corruption in terms of the money or favours paid to employees in private enterprises, public officials and politicians. They are payments or returns needed or demanded to make things pass more swiftly, smoothly or more favourably through state or government bureaucracies. They identified embezzlement as theft of resources by people who are responsible for administering them, e.g., when disloyal employees steal from their employers. It is not considered corruption from a strictly legal point of view, but is included in a broader definition.

METHODOLOGY

This study focused on the Nigerian experience of corruption over different government administrations in the country. It adopted time series approach using data obtained from the database of Transparency International. Specific data used was the corruption index (CI) computed for most countries of the world. The data covered a period of 20 years, from 1996 to 2015 (Table 1). Data were subjected to trend analysis through OLS procedure. The data were segmented according to different political dispensations in the country, and examined; while a regression model was fitted to examine the trend of corruption in Nigeria for the period under investigation. The model was explicitly specified as follows:

$$CI = a + bt$$

Where,

CI = Corruption index of Nigeria (Proxy for incidence of corruption)

t = Time (in years)

a = Intercept of the function

b = Slope coefficient estimated.

RESULTS AND DISCUSSION

Nigeria's Corruption Profile between 1996 and 2015

The trend analysis conducted indicated that despite all the policies of the different administrations examined in the preceding sections, Nigeria's lot among nations with respect to maintaining a clean image was on the decline, as suggested by the results presented in the preceding sections according to different administrations, spanning the period under study. A general observation of the summary statistics of Nigeria's corruption indices as presented in Table 2 shows rather an unpleasant situation for the country.

As shown in Table 2, Nigeria's corruption profile for the period under investigation was not bright. The corruption index which is measured on a scale of hundred, adjudges the country with the highest score (100) as clean, while the country with the least score (0) is regarded as most corrupt. Nigeria's mean score for the twenty years under review was 19.73; with 6.90 recorded in 1996 as the least, and 27.00 recorded in a number of later years as the highest.

Incidences of Corruption in Nigeria under Different Administrations

Pre-Democracy Nigeria (only for 1996-1998)

Nigeria's military governance experience spanned for 38 years of the nation's sovereignty. Within this period, abundant cases of corruption were experienced and reported by different people in the country. However, data for quantitatively measuring these cases were absent, until 1996 when Transparency International (TI) began computing the now widely-accepted corruption index for countries. Thus, the pre-democracy era which this study captures was only a three-year period of between 1996 and 1999. The pre-democracy era was the darkest of all in Nigeria's corruption history. Mean corruption index in this period was 14.50%, and Nigeria was ranked the second most corrupt country in the world within this period of Gen Sani Abacha's dictatorship. Also, during this period (1996), Nigeria recorded her worst corruption profile with an index of meager 6.9%. Of course, little was done to curb corruption by the government of the day, except to gag perceived and real political and social activists.

Democracy Dispensations

Administration of Olusegun Obasanjo

On assumption of office in 1999, the president made verbal commitment to sanitizing the Nigerian public life. The extent to which he was able to realize this can be measured by the corruption indices recorded for the country under his watch. This regime brought Nigeria up from her previous profile by a 1.83 points on the scale to mean index of 16.33 between 1999 when it came to power to 2007 when it exited. Strong fluctuations can be observed in the data before 2005 when a steady improvement was recorded. However, given the perceived intensity of the fight against corruption within this period, one can safely opine that the achievement was minimal. It can be recalled that it was within this period that the ICPC and EFCC, two institutional bodies that were constitutionally empowered to fight corruption, were created. As such, it would have been expected that greater results be obtained.

Umaru Yar'Adua's Administration

Although short-lived, indices indicate that his administration's fight against corruption probably using the EFCC and ICPC and humane and gentle approach yielded greater results. After one year in office, Yar'Adua lifted Nigeria's index by 5 points on the scale to 27% in 2008 (the highest the country has ever attained till date), and ranked the country 141 in the world, after the 2007, 148 ranking. By 2010 when he died, Yar'Adua had brought Nigeria's ranking to 134. The change in Nigeria's corruption index between the two administrations (Obasanjo and Yar'Adua) was a leap of 9 points of the index (25.33 – 16.33), and a climb of 14 (from 148 in 2007 to 134 in 2010) points in position. This was the best single jump the country ever got.

Goodluck Jonathan's Administration

After taking over power as required, he (Jonathan) continued in the fight against corruption still using ICPC and EFCC. Although he continued the fight he met, Jonathan failed to improve upon the achievements of his predecessor. Although there was only a 1% increase in 2011 from the index of 2010, Jonathan sadly plummeted Nigeria to a position of 143 in 2011, a complete reversal of the 2010 ranking left by Yar'Adua. However, by the end of his administration, the country had moved up to the 136th position with an index of 26%. It can be seen from the data that this administration only maintained the results it inherited on the average, remaining at a mean index of 25.60% (previous administration's index was 25.33%). The standard deviation of 0.89 shows that the indices obtained for the different years under the regime varied little, giving the impression that the fight against corruption within this period lost the tempo it met on ground from its predecessor.

Trend of Corruption in Nigeria

The results of the trend analysis in Table 3 shows a negative intercept of the function to the value of -1698.82, which is an indication that Nigeria's fortune in this regards is still below the acceptable benchmark. The negative intercept is an indication that the country needs a lot of improvement to shift from the region of more corrupt countries to cleaner lots. An r^2 value of 0.714 indicates that over time, Nigeria's corruption index varied by about 71%. The implication is that the variations observed in the corruption indices recorded for the country was greatly influenced by time differences.

The coefficient of time which is 0.857 that is significant at 1% alpha level is an indication that the corruption index was positively influenced by time; increasing by the value of the coefficient on yearly basis. This scenario reflects poor improvement, since between 1996 and 2015 the country could only add 20.10 points (the range) on her index, despite the highly publicized fight against corruption especially by civilian administrations in the country. This is equivalent to 1% increase per year. The time coefficient of 0.857 which was significant at 1% alpha level, and an r^2 value of 0.714; these are indications that improvements in corruption reduction in Nigeria were as a result of interplay between varied factors over time.

CONCLUSION

This study has used available data on countries' corruption profile compiled by an independent body to assess Nigeria's fortunes on international standards over a period of twenty years. The analysis which was streamlined along government dispensations within the period under study, has shown that the country's corruption profile improved over time, with very visible fluctuations within and between different administrations. The result equally suggests that there is a lot of room for improvement on the corruption index. It is glaring that if this trend is not nipped in the bud, the difficulty of Nigerians in feeding themselves will deepen. In fact, the entire agribusiness industry which is primary in the development of the country will worsen. It is the opinion of this study that the institutions vested with powers to curb the rate of corruption in the nation wake up to their constitutional duties, and ensure that when this present administration expires, Nigeria would have jumped astronomically to higher ranks and scores when measured against any anti-corruption scales used by anyone.

Table 1: Nigeria's corruption index from 1996 to 2015

Year	Corruption Index (%)
1996	06.90
1997	17.60
1998	19.00
1999	16.00
2000	12.00
2001	10.00
2002	16.00
2003	14.00
2004	16.00
2005	19.00
2006	22.00
2007	22.00
2008	27.00
2009	25.00
2010	24.00
2011	25.00
2012	27.00
2013	25.00
2014	25.00
2015	26.00

Source: Transparency International.

Table 2: Summary statistics of Nigeria's corruption index (N=20)

Range	Min	Max	Mean	Std. Error	Std. dev	Variance
20.10	6.90	27.00	19.7250	1.34150	5.99937	35.993

Source: Computed from Transparency International data

Table 3: Trend statistics of Nigeria's corruption index

Variables	Coefficients	Std. Error	T-value
Constant	-1698.82	256.33	-6.627***
T	0.857	0.128	6.704***
r^2	0.714		
r^{-2}	0.698		
F-ratio	44.950***		
Durbin-Watson	1.169		

Source: Computed from Transparency International data. ***indicates significance at 1% alpha level.

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COMPARATIVE ANALYSIS OF ECONOMIC AND TECHNICAL EFFICIENCY IN CRAYFISH PRODUCTION IN OIL AND NON-OIL PRODUCING COMMUNITIES OF AKWA IBOM STATE, NIGERIA

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ABSTRACT
The paper examined the comparative economic and technical efficiency of resource utilization in cray fish production in oil and non-oil producing communities of Akwa Ibom, Nigeria, using a production function approach. Data for the study were obtained from a cross section of 40 respondents each from both oil and non-oil producing areas using a multi-stage sampling procedure. Regression results indicated that capital, fixed costs and fuel were not significant (P < 0.05) determinants of output in oil producing communities. The index of resource-use efficiency revealed that respondents from oil producing communities were not only inefficient in the allocation of productive resources, but grossly over-utilized, capital, fuel, labour and fixed costs with an allocative efficiency index of 0.0761, 0.00043, 0.00770, and 0.005324, respectively. However, respondents from non-oil producing communities were inefficient in the allocative of productive resources, and also under-utilized fixed costs, fuel and labour with and allocative efficiency index of 2.3010, 4.562, and 3.315, respectively. Given the over-utilization of fixed costs, labour, and fuel strategies and policies aimed at controlling and monitoring the activities oil companies oil exploration and exploitation in oil producing communities will thus significantly improve efficiency of utilization of resources; but, given the under-utilization of resources in non-oil producing areas, strategies aimed at sensitization of crayfish farmers on efficient utilization of resources become imperative.Generally, access to insurance scheme, effective extension service delivery programme, access to loan at one digit rate will raise output and net returns in crayfish production.

Keywords: Economic and Technical efficiency, crayfish, oil and non – oil.

INTRODUCTION
Fisheries occupy a unique position in the agricultural sector of the Nigerian economy. In terms of Gross Domestic Product (GDP), the fishery sub-sector has recorded the fastest growth rate in agriculture to the GDP. The contribution of the fishery sub-sector to GDP at 2001current factor cost rose from ₦ 76.76 billion to ₦ 162.61 billion in 2005 (CBN Report, 2005). Fish is an important source of protein to large teaming population of Nigeria. Fish provides 40% of the dietary intake of animal protein of the average Nigerian (FDF, 1997).
Crayfish as a common source of animal protein have been very expensive and out of reach of the common man. This is as a result of low production by excessive dredging, oil spills and toxic waste disposal into rivers. However, the use of crayfish is wide and extensive, including ecological sustainability, economic and socio-cultural uses, biotechnological and recreational values. World Bank (1995) observed that Nigeria is confronted with numerous environmental problems estimated to cost $3 billion annually if unchecked. Other problems are desertification and loss of bio-diversity.
The efficiency or inefficiency of utilization of available resources for crayfish farming has remained an unanswered question in the quest for increased crayfish production in Akwa Ibom State in particular, and Nigeria in general. An efficient method of production is that which utilises the least quantity of resources in order to produce a given quantity of output. A production process that uses more physical resources than an alternative method in producing a unit of output is thus said to be technically inefficient. However, since economic efficiency embodies both technical and allocative efficiencies, once the issues of technical inefficiency have been removed the question of choosing between the set of technically efficient alternative methods of production, allocative efficiency, comes to fore .According to Oh and Kim (1980), allocative efficiency is the ratio between total costs of producing a unit of output using actual factor proportions in a technically efficient manner, and total costs of producing a unit of output using optimal factor proportions in a technically efficient manner. However, a farmer using a technically efficient input combination may not be producing optimally depending on the prevailing factor prices .Thus, the allocatively efficient level of production is where the farmer operates at the least-cost combination of inputs. According to Yotopoulos and Lau (1973), a firm is allocatively efficient if it was able to equate the value of marginal product (MVP) of each resource employed to the unit cost of that resource; in other words, if it maximises profit. Therefore allocative efficiency measure, quantifies how near an enterprise is to using the optimal combination of production inputs when the goal is maximum profit (Richetti and Reis, 2003).Although a number of studies have been carried out

on efficiency in livestock and crops production in Nigeria ,most of such studies dwelled on technical efficiency with only a few dealing with the critical issue of allocative efficiency (Okoruwa *et al*., 2001; Agbamu and Fabusoro, 2001; Ajibefun *et al*., 2002; Ojo, 2003;Ogunyinka and Ajibefun, 2004).

METHODOLOGY

Study Area: The study was conducted in the oil block zones and non-oil block zones of some Local Government Areas in Akwa Ibom State. Akwa Ibom State is the nation's third largest petroleum producer (NNPC, 2007). The state has a population of 3.9 million people, as of 2006 with a density of 35 persons per square meter, (NPC, 2006). Akwa Ibom State is situated between latitudes $4^0 32^1$ N and $5^0 3^1$N and longitude $7^0 25^1$ E and $8^0 25^1$ E and situated between Cross River, Rivers and Abia State on the South Eastern Nigeria sandy deltaic coastal plain. It has a total area of 8412km^2, a shoreline of 129km long and encompasses the Qua Iboe River Basin, the eastern part of the lower Cross River Basin and the eastern half of the Imo River estuary (NES, 2000). The Qua Iboe River, Cross River, Imo River and their tributaries control the drainage, and deposition of sands and clays. Qua Iboe River is the major hydrographic feature, which drains a greater part of the state and enters the sea at Ibeno, which is the major operational base of Mobil Producing Unlimited in Akwa Ibom State. Multi – stage sampling technique was used in the selection of 77 respondents drawn from different locations in the study area while structured questionnaire sets were employed in generating information and data from them.

Model Specification and Estimation

The production response function model was implicit according to Oladumi (1998) and Mbanasor and Obioha (2003).

$Y = F (b_{1,} b_2, b_3, b_4, b_5,)$---1

WhereY = value of output in naira; $b_{1,}$ = fixed cost invested (₦); b_2, = value of variable cost (₦); b_3, = labour (man days); b_4, = Fuel (₦); b_5 = fire wood (₦); b_6 = value others outputs; e = error term

Elasticity of Production

The elasticity of production shows the change in output relative to a unit change in input (Mbanasor and Obioha, 2003). The marginal value product (MPP) was used to determine the productivity of the marginal factors cost (MFC), which was used to determine efficiency use. MFC was either the purchased unit price of the input or the opportunity cost. Six percent interest rate was used to obtain the opportunity cost of fixed assets and other production inputs Ie for every one naria spent in fish production (fish hunting) was therefore ₦1.06. Labour and fishing materials were valued at their current market price. However, MPP is taken as the MVP since

$\text{Log } Y = \log b_0 + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_2 + b_3 \log x_3 + b_4 \log_4 + b_5 \log x_5 + b_6 \log x_6 + ei$----------------2

The objective was realized by calculating and comparing the allocative efficiencies of fish production in oil and non-oil producing communities. However, a rigorous comparison of allocative efficiency of any two groups of farms requires that they are characterized by constant nature of scale and the same configuration of input and output prices (Onyenwaka, 1994). Examining the allocation efficiencies of the two groups of farmers, the following implicit production function was estimated for each group: Four functional forms of the equation, namely, linear, exponential, double-log and semi-log were tried for each data set and the best fit was taken for the lead equation. Allocative efficiency was determined by equality of the Marginal Value Product (MVP) of the ith input to its price or Marginal Factor Cost (MFC); that is,

$MVP_{Xi} = P_{Xi}$ or Py fi = PXi---3

Where: MVPXi = 1, 2, 3…………..e the Marginal Value Product of the ith input, and

fi = dy/dxi = Marginal Physical Product (MPP) of the ith input, and

py = Unit Output Price

For all the resources measured in physical units, the allocative efficiency index, wij, for each farmer type was given as:

$$\frac{MVPXi}{PXi} = \frac{pyfi}{Pxi} = Wij \text{ ------------------------------------ } 4$$

Where i is a particular resources, j is the farmer type and all other variables are as defined.

The equation above is translated to: MVPXi = pyfi = wij for resources measured in monetary terms.

The maximum or absolute allocative efficiency for a particular group of farmers is confirmed with respect to a given resource if Wij = 1. The resources is over-utilized if Wij <1 and under-utilized if Wij >1. The groups of farmers would have equal allocative efficiency if Wij = Wi_2. This explained hypothesis (iii). Furthermore, to ascertain the level of which a particular resource should be increased or decreased from the current level of use in order to achieve maximum allocative efficiency, the following formula was used:

Kij = (1 - Wij)

Where Kij is the percentage by which the level of use of a particular resource should be increased or decreased to achieve the objective of maximum allocative efficiency.

Allocative efficiency estimates

The results of the estimates of allocative efficiency in crayfish production in oil and non-oil producing communities are shown in Table 2 and 3. However, the estimation of resource-use efficiency required the determination of parameters such as marginal physical product (MPP), marginal factor cost (MFC), and marginal value product (MVP). The marginal factor cost of each input was determined as the average farm cost of an input per unit output, according to Chukwuji et al. (2006). Estimates of allocative efficiency of production resources employed crayfish production were 0.00761, 0.0043, 0.00771, – 0.005392, and 0.0003510 respectively for labour, fuel resource, boat, fixed costs and oil. The indices indicate that apart from fire boat that was under-utilized, all other resources were over-utilized implying sub-optimal resource allocation in crayfish production in oil producing communities, while in non-oil producing communities estimation of allocative efficiency were 2.3010, 4.562, 3.315, and 1302 for labour, fuel, fixed costs, and boat, respectively. Problems of oil spillage and gas flaring associated with activities oil exploration exploitation may be responsible for the over-utilization of fixed costs, labour, and fuel in oil producing areas in the production process. The gross inefficiency and over-utilization of labour found in both areas of the study may be attributed to free education, massive migration of people from fishing ports to urban, lack of social amenities. Comparable results of the over-utilisation of labour in small-scale agricultural production and processing in Nigeria, have been reported by Olarinde and Kuponiyi (2004), Akanni and Adeokun (2004), Nyong and Nweze (2012).

CONCLUSION AND COMMENDATIONS

The findings reveal t hat oil exploitation has some negative impact on the socioeconomic status of crayfish farmers' productivity, crayfish farmers' income, resource utilization and allocation. The study shows that continuous pollution of oil communities and impact of better job opportunities have resulted in over-utilization of resources of fish production in oil producing communities. The result of the crayfish farmers in both areas implies that they could increase their productivity by effectively and efficiently utilizing allocative resources. Based on the findings, adequate compensation both in cash in kind should be given to crayfish farmers affected by oil pollution while the government through its agency such as Niger Delta Development Commission (NDDC) should be directed to fund agricultural programmes by giving special grant to crayfish farmers affected by oil spillage.

Table 1.0: Estimated production functions for Respondents in oil and non-oil producing areas

Variables	oil producing areas	Non-producing area
Intercept	8.43	21.46***
	(-2.10)	(4.01)
Labour	653.40	1.573**
	(0.18)	(5.21)
Canoe	75345	-1.452
	(1.321)	(1.537)
Outboard	6789.000**	9.5432
engine	(1.024)	(1.543)
Nets/fishing	54.28**	621.2800**
materials	(1.3492)	(1.654)
Capital	56321	53.789
	(1.765)	(0.234)
R^{-2}	0.450	2.312
R^2	0.8800	0.5930
t-ratio	23.01	41.62

t-statistic computed; *** statistically significant at 1%; statistically significant at 5%

Source: Field Survey Data,

Table 2.0: Indices of allocative efficiency of resource utilized in crayfish production in oil producing areas

Variable	Marginal physical product (MPP)	Marginal factors cost (MFC) ₦	Marginal factor cost (MFC) ₦	Allocative efficiency	Remarks
Labour	0.0471	3.05.43	98.24	-0.007610	Overutilization
Boat	0.02336	0.006432	8.4	0.000430	Over utilization
Fuel	-0.0004	0.00631	25100	0.000771	Over utilization
Capital	2.611	4.3214	3215.01	0.0053920	Over utilization
Fishing nets	0.0674	0.2134	8432.01	0.00003510	Over utilization

Computed from survey data

Table 3:0 Indices of allocative efficiency of resource utilized in crayfish production in non-oil producing areas

Variable	Marginal physical product (MPP)	Marginal factors cost (MFC) ₦	Marginal factor cost (MFC) ₦	Allocative efficiency	Remarks
Labour	1.342	54.0123	3245	2.3010	Over utilization
Boat	0.00571	2.00034	34256	4.562	Underutilization
Fuel	1.4321	0.04321	26300	3.315	Underutilization
Capital	5.2310	7120.34	10234	1.302	Underutilization
Fishing nets	0.000643	1.0632	6540	0.005210	Over utilization

Computed from survey data,

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DETERMINANTS OF FINANCING OF AGRICULTURAL COOPERATIVES IN ABIA STATE, NIGERIA

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ABSTRACT
Access to adequate capital for their operations has been identified as one of the factors limiting agricultural cooperatives in achieving their production potentials, as well as developing market opportunities to sustain production. Identifying the factors which played significant roles in capital accumulation by cooperatives posed research challenges. This study which was carried out in Abia State Nigeria, described some of the characteristics of the cooperatives, identified their sources and types of capital, and volume of capital, and determined the factors that influenced this volume of capital. Thirty (30) agricultural cooperatives were randomly selected from three LGAs from the three (3) agricultural zones of the state which were Aba, Umuahia and Ohafia zones. Data were collected with structured questionnaire which was administered to the representatives of the selected cooperatives; and analysed with descriptive and inferential statistics. Four independent variables were fitted to a multiple regression model to determine the effect of these factors on the volume of capital used by the cooperatives. The results showed that membership size, retained income, and access to credit were found to have significant effects on the volume of capital available to the cooperatives, with coefficients of 5077.66($\alpha_{.=0.05}$), 0.288($\alpha_{.=0.1}$), and 54706.23($\alpha_{.=0.01}$), respectively. It was recommended among others, that farmers should be encouraged to form cooperative societies; while the government is enjoined to free up the bottlenecks that hinder credit administration in the country to enable farmers tap into the immense benefits intended to accrue from access to agricultural credit.
Keywords: Cooperatives, capital accumulation, credit access, Nigeria.

INTRODUCTION

The general roles of finance apply to all types of businesses. Like any other, agricultural cooperatives must maintain sufficient level of capital to ensure financial stability for their operations. Once a cooperative is up and running, it is expected that it will be able to accumulate sufficient capital through successive successful business operations to cover continued functioning costs, finance growth, and build up the net-worth of the cooperative (Rathbone, 1995; Von. Pischke, 1995; Harris, 1998; Von. Pischke *et al*, 2004).

Cooperatives offer their members distinct advantages in addressing a variety of production, product marketing and distribution situations and issues. Producers, through cooperative actions have the opportunity to own and control businesses related to their production operations, and are thus allowed to address common problems or develop market opportunities which they could not otherwise achieve alone (Rathbone and Davidson, 1995; Harris, 1998). In Nigeria, the role of cooperative societies in enhancing the living standards of the rural farmers (and the entire populace) cannot be over-emphasized. Farmers form cooperative societies with the cardinal aim of improving their productivity through collective supply of materials and inputs, consolidating product prices through harmonized bargaining opportunities and consistent stabilized marketing outlets. Furthermore, members of cooperative have the highly important advantage of owning and controlling their business through democratic processes and procedures. All these benefits raised above notwithstanding, the impacts of cooperatives in the country are not perceived, as it ought to be due to many problems which face them.

With the above benefits of cooperatives in mind, the Department of Cooperatives of the Abia State Ministry of Agriculture and Rural Development has continued to register, under relevant acts, hundreds of cooperative societies whose businesses are diversified, with the aim of boosting development especially in the rural sector, by empowering rural farmers for improved productivity (MARD, 2004). In most rural areas, cooperatives only enjoy nominal existence, or often lack the democratic identity where they are even minimally functional. In the list of issues that bedevil the optimal performance of cooperatives boldly stands out the stringency of capital, which has left very few options but to trail below the threshold of adequate productivity and self-reliance.

It is therefore the objectives of this study to establish the characteristics of cooperatives in the study area; determine their sources of capital; determine the amount of capital available per production cycle; and determine the factors that affect their capitalization level.

Theoretical Framework

Literature has established that co-operatives rely heavily on their members for accumulation of capital. This reliance implies that membership characteristics such as size, the individual decisions of the memberships and aggressiveness towards realizing members objectives or desire, will greatly affect their capital base. Notwithstanding other determining factors (which also affect capitalization of any other form of business), cooperation group solidarity feature will influence decision to be made by the cooperatives. This position is informed by the cooperative principals of democratic governance and equal complete participation of all members. These principals dispose the cooperative to diverse opinions coming from the members whose rights it is to air their opinions.

The coalition theoretical structure (Staatz, 1983) was developed to examine the hypothesis that the capital base of cooperatives is profoundly influenced by its structural characteristics, cooperative governance (Williamson, 1996), and other external factors such as government policies. The theory of the cooperative firm suggests the presence of transaction costs within the traditional structure (Vitaliano, 1983; Staatz, 1987). These transaction costs are generated by a set of vaguely defined property rights constraints originating from the structure of traditional cooperatives and leading to conflicts over residual claim and decision control. These property rights constraints include free-rider, horizons portfolio, control and influence costs problems; all of which do not provide members within the traditional cooperative structure with the incentives to make optimal investment decisions (Cook, 1995; Cook and Iliopoulos, 2001).

According to the coalition theory, the cooperative consists of many groups with different objectives. Each attempts to maximize their own individual utility, often at the expense of other groups. This situation is particularly relevant to agricultural cooperatives, as in Nigeria as elsewhere in the world, because costs and benefits can be allocated among groups according to a variety of rules (Zusman, 1982). The coalition decides which group will benefit and which will bear the cost of operations by setting prices for member products, offering specific services, and choosing capitalization strategies. In this context, sufficiently high transaction costs within the groups may promote *pareto* inefficient strategies. If transaction costs are higher than the increase in value resulting from the inefficient strategy, groups have no incentive to negotiate an efficient solution based on the compensation principle. Consequently, cooperative strategies will not be determined solely by the efficiency principle, but also by the initial distribution of resource and power among members (the coalition groups).

Directly linked to this is the ability to repay loans. Onyenaucheya and Ukoha (2007) found that farmers' ability to repay loans is determined by a number of factors which include the amount of loan borrowed, income, and distance between home and loan source of a farmer borrower.

METHODOLOGY

This study was carried out in Abia State Nigeria. The term Abia is coined from the four geopolitical compartments namely Aba, Bende, Isukwuato and Afikpo that make up the state at its creation in 1991. It covers a land area of 5,834 square kilometres; and lies between latitudes 07^0 00' and $08^0$10' East of the Greenwich Meridian and Longitudes 04^0 45' and 06^0 17' North of the Equator. The state is located within the tropical rain forest with luxuriant vegetation and temperature ranges of 20^0C to 36^0C which supports agricultural production. Abia State shares common boundaries with Imo State on the East, Enugu on the North, and Rivers State on the South. The State experiences two major seasons in the year: The dry season which lasts between October and March, and rainy season which stretches from April to early October. According to the 2006 population census estimates (NPC, 2007), the State has a population of 1,913, 917 decomposed into 48.78 percent males and 51.25 percent females spread into 17 local government areas. Abia State is delineated into three agricultural zones namely: Aba, Ohafia and Umuahia. Agriculture is the major occupation of the people which employs about 70 percent of the population, especially in the rural areas.

A multistage sampling technique was adopted in the selection of sample for this study. The first stage involved a random selection are agriculture from the three agricultural zones in Abia State. Three Local Government areas were randomly selected from the agricultural zone. Ten agricultural producing cooperatives were selected from each Local Government Area to give a total of 30 cooperatives.

Data were collected on the variables specified in the model through the use of structured questionnaire administered to the representatives of the cooperatives. Especially with respect to operational facilities and examination of business records shall be a source of information for the study. Data were analyzed with descriptive statistics and multiple regression analysis. A model constituting six variables was specified. The implicit form of the model is as follows:

$$CAP = f(Z_1, Z_2, Z_3, Z_4)$$

Explicitly,

$$CAP = b_0 + b_1Z_1 + b_2Z_2 + b_3Z_3 + b_4Z_4 + \varepsilon$$

where,

CAP = The amount of capital employed in production in the previous production year (Naira).

b_0 = The intercept of the function

$b_1,\ldots,b_5$ = Regression coefficients
Z_1 = Membership size (number of persons in each cooperative society)
Z_2 = Retained income (Naira) (Lagged 1 year)
Z_3 = Business expansion (years of operation of the cooperative society)
Z_4 = Access to credit (Access to credit = 1, non-access = 0)
ε = Error variable.

Four functional forms of the model were evaluated from which the lead equation was chosen on the basics of conventional principles such as explanatory power of the model (i.e. r^2 value) and the behavioural consistency of the variables with *a priori* expectations. The functional forms include linear, exponential, semi log and double log.

RESULTS

Determinants of Cooperative Financing

(a) Membership size (Z_1)

The number of cooperators a cooperative has had a regression coefficient of 5077.66 which is significant at 1% level. This implies that as the membership strength of a cooperative society increases, its capital base increases by ₦5077.66. It was shown that a greater proportion of cooperative capital was generated through membership contributions. Thus, it is also expected that a positive trend would exist between the amount contributed and the number of contributing units. In Abia State, as in other parts of Sub-Saharan Africa, income level is very low in the rural areas. Cooperative societies are groups of mainly peasant farmers whose production potentials and investment propensity are below even threshold. Thus, if the cooperatives capital base is to be strengthened, two factors emanating from the influence of this variable should be considered. The number of the contributing units, i.e. the cooperators, has to be increased. The effect will be that, through joint efforts, which the coalition theory propounds, gross benefits and risks will be shared. Under the assumption that the effects of risks are reduced when shared among a large number of people, the resulting benefit, which in this case is strong production capital, will smoothen off on the long run. Another point, which may be of very positive imperative for accumulation of large capital, is improving the income level of the cooperators. This way, the per unit contribution will be high, thus leading to increased capital.

(b) Retained income (Z_2)

The income realized by the cooperatives in the previous production year had a positive significant coefficient of 0.258. The implication is that unit increase in retained income resulted in an increase of 25.8% in production capital. This result is consistent with *a priori* expectations, since a proportion of income is ploughed back into production in the preceding year. One of the cardinal objectives of the cooperative initiative is the mutual welfare of its members. Collective profits are shared in accordance with the principles of cooperation. A proportion of such annual profits is set aside for continuity following proportions that are previously agreed upon by the members. As the proportion of retained profits increases, probably as a result of increased income from previous production or by outright agreement by the members to increase it, the capital that will be available for the next production equally increases. Thus, the emphasis here should be on whether there is an arbitrary agreement to raise the proportion of income to be ploughed back. But if this is done, dividends which the cooperators would receive would be reduced. It then follows that the members would be sacrificing present profits for future capital needs.

These issues would demand the need for external credits. In order to break the cycle of low income, poor retained profits, poor investment potentials and low capital volume, there is the need to attract external intervention in the form of credits. It was established in the earlier sections of this report that members contributed production inputs such as cassava stem, seeds, fertilizer and labour. Improved varieties of such inputs can be sourced from research institutes if the means is available, and the result would be enhanced output and higher income.

(c) Access to Credit (Z_4)

The amount of credit that the cooperatives had access to had a positive coefficient of 54706.23 that is significant at 1% level, indicating that access to credit by the cooperatives would increase their capital by per member by ₦54,706.23.

CONCLUSION

The results obtained in this study have shown that cooperatives in Abia State have similar socioeconomic characteristics. The results also showed that a greater proportion of capital is generated through membership contributions, retained income and credit. Furthermore, mean capital employed in a production cycle is very low for most of the societies. However, it was revealed that size of membership, income from the previous year, as well as access to credit were factors that determined the amount of capital cooperative could accumulate.

Since retained income was a significant determinant of capital volume, efforts at increasing income of cooperatives would be a probable option. This increase in income, accruing from sales of products, and provision of services, can only be achieved if the production of the products, which the cooperatives have comparative advantage in, is optimized. The emphasis should re-direct towards production efficiency in order to maximize use of resources. Thus, in the midst of inadequate production resources, and poor technology, cooperatives can increase their output and manage more effectively their resources by focusing their production thrust on the products that yield them greater output.

Government on their own part can enhance credit administration to agricultural cooperatives. The data generated in the study revealed that credit is the most contributing variable to the capital volume of the cooperatives; and indication that if credit is adequately available to the cooperatives, their production would be enhanced. To improve access to credit, existing credit guarantee schemes can be made more functional. Such schemes can be made farmer-friendly such that they will have minimum pre-requisites. As a group which unit components are under the pressure of low incomes and poor investment potentials, cooperatives are not able to meet with the heavy collateral requirements required to compete with the conventional credit arrangements provided by the financial and other lending institutions.

Table 1: Regression statistics of determinants of cooperative capital level

Variables	Linear+	Exponential	Semi Log	Double Log
Constant	-84146.50	-2173247	10.581	8.248
	(-0.943)	(-4.721)***	(20.23)***	(4.647)***
Z_1 (MEMSIZ)	5077.66	311982.9	$2.66\text{x}10^{-2}$	1.075
	(2.450)**	(4.201)***	(2.91)**	(4.954)***
Z_2 (RETINC)	0.288	-21246.30	$1.714\ \text{x}10^{-6}$	$8.03\ \text{x}10^{-2}$
	(1.812)*	(-0.373)	(2.055)*	(0.483)
Z_3 (COPAGE)	-2301.65	-100746	$-154\ \text{x}10^{-2}$	-0.197
	(-0.554)	(-1.873)*	(-0.633)	(-1.252)
Z_4 (CREDACC)	54706.23	32594.36	0.33	0.398
	(4.751)***	(0.169)	(0.774)	(0.705)
F	**58.743*****	**15.64*****	**8.562*****	**12.34*****
R^2	**92.70**	**77.30**	**65.10**	**72.80**

+ Indicates lead equation. ***p<0.01, **p<0.05, *p<0.1.

Source*:* Survey data, 2012.

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ECONOMICS OF YAM MARKETING IN AKAEZE IN IVO L G A OF EBONYI STATE, NIGERIA

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ABSTRACT
This study presents the Economics Of Yam Marketing In Akaeze In Ivo L G A Of Ebonyi State. The objectives of the study are to determine the socio-economic characteristics of yam marketers in the study area, to determine the marketing channels of yam marketing in the study area. Primary data were used in the survey. The primary data were collected from a random sample of 80 yam marketers in Ebonyi State. The respondents were drawn from rural and urban markets in the agricultural zones of the state. The data analyzed using descriptive statistics such as frequency, percentage and Chart .The result shows that more males (58.75%) participated in yam marketing than females (41.25%) in the study area. Also, the result shows that majority of yam marketers are matured individuals (56.25%) who are in their youthful age (41-60 years). Yam marketing in the study area goes through a network of intermediaries before it reaches the final consumers. Those intermediaries are the producer, wholesalers and the retailers. The marketing of yam in the study area could be improved by reliable information on the area and provision of basic infrastructures as this will facilitate faster delivery of yam and ensure marketing efficiency in the study area.
Keywords: Economics, yam marketing, Nigeria

INTRODUCTION
Yam *(Dioscorea* spp.) is an annual tuber and monocotyledonous crop. The plant Genus comprises of over 600 species with only 10 species producing edible tuber. Six of these edible species are cultivated in Africa and only 3 of them are available in Nigeria. In Nigeria, the primary species cultivated are the white yam *(Dioscorea rotundata*), yellow yam *(Dioscorea cayensis*) and water yam (*Dioscorea alata*), (Amusa, 2000).
Yam is a popular starchy food. Nigeria is the world's largest producer of edible yams, with *Disoceara.* ro*tundata* and *Disoceara. alata* as the two most cultivated yam species in the country, Yam tubers are processed into various food forms which include pounded yam, boiled yam , roasted yam or grilled yam, etc. Yam is an extremely vital crop, not only to the domestic market but also to the export market. Domestically, it is not only a main source of income but it is a stable crop vital to food security. (Bolarinwa and. Oladeji, 2009)
Market exits when ever buyers and sellers can be in touch with one another. In modern times, buyers and seller many not necessarily meet face to face before a market exit, but a trader in one state can negotiate with another trader in another state, either by telephone , about his willingness to buy then market has been established .(okorie C. 2006). Markets are places where people buy and sell commodities (Njoku 2000). The market can be in rural or urban areas. The objectives of the study are to determine the socio-economic characteristics of yam marketers in the study area, to determine the marketing channels and Identify marketing problems of yam marketing in the study area.

METHODOLOGY
The study was carried out in Ebonyi State. The study covered one out of the agricultural zones in Ebonyi state. Multistage random sampling technique was used in selection of agric zone and respondents. One local government area was randomly selected from the three agricultural zones. Two markets were randomly selected from the L G A. The markets chosen were: Nkwogbo in Umuogbo, Orie Akaeze Ukwu. Forty yam marketers were selected randomly from each chosen market. This gave a total number of 80 Yam marketers. The primary data were collected with structured questionnaires. The data collected were analyzed using descriptive statistics such as frequency, percentage and Chart

RESULTS AND DISCUSSION
Table.1 shows that more males (58.75%) participated in yam marketing than females (41.25%) in the study area. Also, the result shows that majority of yam marketers are matured individuals (56.25%) who are in their youthful age (41-60 years). The result shows that trade of yam marketing was dominated by married people (62.5%). This implies that the trade is a source of income to many families from which they meet their basic needs. The result reveals that majority of the respondents (62.05%) had household sizes of 6-10 persons and 74 .00% of the yam marketers had one form of education or another while 26.00% had no formal education. This shows that literacy level was high amongst them and could enhance marketing technology. The level of education was identified to enhance the marketing efficiency and the marketing techniques and this was in line the findings of Obasi, (1991).

The classification of trade in the study area shows (43.75%) of the respondents were wholesalers and (37.05%) were producers while (18 .75%). This implies that the study area is a place traders can get yam in larger quantity

Marketing Channels For Yam Sold In Akaeze In Ivo LGA:

The result of the marketing channels network of the interrelationship that exited in the movement of yam in the study area from the producer to the consumer, Yam marketing in the study area goes through a network of intermediaries before it reaches the final consumers. Those intermediaries are the producer, wholesalers and the retailers. The producers are farmers in the study area who produces yam and sale in large quantities to the wholesalers from other states and wholesalers within the village, producers who sale to retailers in the village and wholesalers who sales to other major dealer from other places and wholesaler to retailer to the final consumers in the study area. A significant proportion of yam sold in the study area study area is from the farmers.

Marketing Channels of yam distributed in Akaeze in Ivo L G A

- Producers→ Wholesalers → Retailers → Consumers
- Producers → Retailers → Consumers
- Producers → Consumers
- Wholesalers → Retailers → Consumers
- Wholesalers → Consumers

Fig 1 shows the marketing channel for in the study area. This channel shows five marketing channels through which yam can be distributed to the study area from the producers to the consumers. The marketing channel involved in yam marketing in the study area shows that yam moves from the producers to the consumers, producers to the Wholesalers and from Wholesalers to the consumers. Furthermore it may likely move from producer to wholesalers who in turn sale to the Retailers, where it finds its way to the Consumers.

CONCLUSION

The study had shown the economics of yam marketing in Akaeze in Ivo L G A of Ebonyi state. The result of the survey of the socio economic characteristic of respondents showed that 58.75% were males and 43.75% were females the trade is gender sensitive and needs serious strength and 56.25% of the respondents were between the age of 41-60 years old, showing that the trade required people that can withstand the physical stress of the trade.
The marketing of yam in the study area could be improved by reliable information on the area and provision of basic infrastructures as this will facilitate faster delivery of yam and ensure marketing efficiency in the study area.

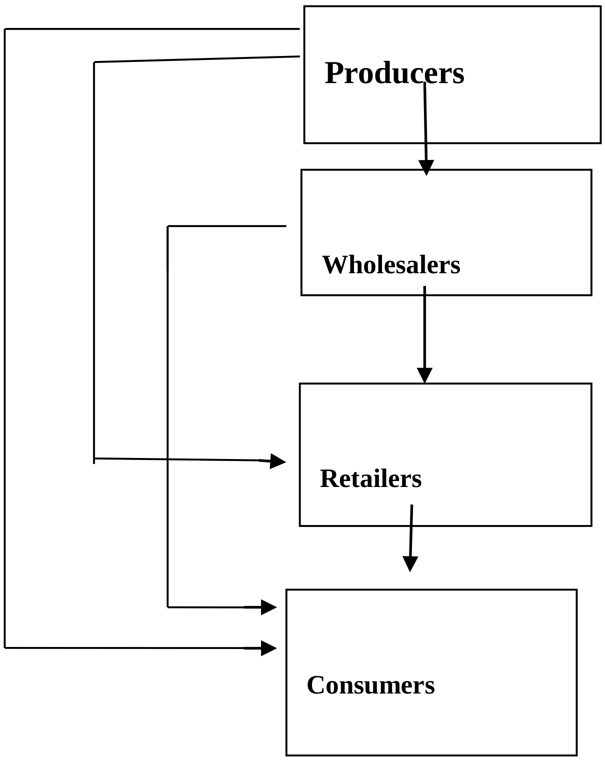

Fig 1: marketing channels of yam marketing in the study area

Table 1: Social Economic Characteristics of the Yam Marketers

Variables	Frequency	Percentage
Male	47	58.75
Female	33	41.25
Household size		
1-5	21	26.25
6-10	50	62.05
Above-10	09	11.25
Tertiary	11	9.16
Age		
21-40	25	31.25
41-60	45	56.25
Above	10	12.05
Education		
No formal Education	21	26.25
Primary	33	41.25
Secondary and Above	26	32.05
Marital Status		
Married	55	68.75
Single	05	06.25
Divorced	15	18.75
Widow	05	06.25
Producers	30	37.05
Wholesalers	35	43.75
Retailers	15	18.75
Marketing Experience		
5-10	44	55.00
11-15	31	38.75
15-Above	05	06.25

. Source: Field Survey, 2010

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AN UPDATE ON PROFITABILITY OF COCOYAM PRODUCTION AT NRCRI UMUDIKE IN 2015 PLANTING SEASON

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ABSTRACT
A gross margin analysis of cocoyam production at National Root Crops Research Institute Umudike was done in 2015 planting season was carried. The experimental study showed that the enterprise is profitable. Labour constituted about 42.90% of total variable cost of production, which is the most important resource in cocoyam enterprise. One hectare cost of cocoyam production was N573,480 while total revenue was N936,400 and gross margin was N362,920. The study showed that the result of profitability analysis of cocoyam production is profitable by returning N1.63 to every N1.00 spent. There is need therefore to encourage farmers to go into rapid production of cocoyam to enhance their revenue, food security and livelihoods.

INTRODUCTION
Cocoyams (Colocasia esculenta and Xanthosoma mafia) are important carbohydrate staple food particularly in the southern and middle belt areas of the Nigeria (Asumugha and Mbanaso, 2002). Cocoyam is a stem tuber that is widely cultivated in the tropical regions of the world and is a well – known food plant which has a long history of cultivation with Nigeria being the largest producer of cocoyam (3.45mt) in the world (9.97mt) and accounting for about 34.57% of the total output (FAOSTAT, 2013). In the last decade, attention has been focused on means of eliminating food insecurity and hunger worldwide. The targets of the first Millennium Development Goal (MDG) between 1990 and 2015 are to halve, the proportion of people who suffer from extreme hunger and people, whose income is less than $1 a day (FAO, 2005).

Expansion in cocoyam production has therefore the potential of bridging the wide demand and supply gap, and enhancing the income (thereby reducing poverty) of the rural farmers, particularly the vulnerable group. Opata and Nwaeze (2009) reported that many rural people, particularly women have gained interest in the production, processing and marketing of cocoyam, essentially because of the rapid increase in its share of the urban market in Nigeria.

Resource allocation to cocoyam is significantly low when compared to crops such as yam and cassava (Okorji and Obiechina,1995; Okoye,2006). Production has not been given priority attention probably because of cocoyam's inability to earn foreign exchange and its unacceptability to the high income groups for both consumption and other purposes (Nweke, 1987; Onyenweaku and Eze,1987). The need for increased food production to meet the demand of ever-increasing population in Africa, where population growth rate is higher than the rate of increase in agriculture production had been long emphasized (World Bank, 1992).

The production is labor intensive with most operations carried out manually at the traditional level (Okoye, 2006). Zuhair and Hunter, (2000) reported that the cultivation of cocoyam is declining. To meet the demand for cocoyam, there is need to increase its production (Eze and Okorji, 2003).The study will therefore serve as a basis for information to the farmers on cocoyam profitability which is expected to drive increased cultivation of the crop.

MATERIALS AND METHODS
Six cocoyam cultivars NCe 001, NCe 002, NCe 003, NCe 004, NCe 011, NCe 012 of the *Colocasia* spp were used for the study which was carried out at NRCRI, Umudike in 2015 planting season. Data, such as resource allocation which includes; labour in mandays, inputs, cost items as well as output (yield) and value of produce were taken. Data was analyzed using the Cost and Returns analysis procedure on per hectare basis.

RESULTS AND DISCUSSION
Table 1 show that output per hectare was 4,682kg. The total value of production was N936, 400 at the cost of N200/kg for cormels and corms respectively. Total variable cost of production was N573,480. Labour constituted about 42.90% of total variable cost of production. This implies that production is labour intensive because most operations were carried out manually. This followed the findings of Okoye, (2006) and Okoye *et al*., (2004). The results show a gross margin of N362,920, indicating that cocoyam is profitable by returning N1.63 for every N1.00 spent. This excludes the fixed costs which most times are minimal and not significant due to depreciation.

Table 1: Gross Margin Analyses for Cocoyam Production at NRCRI Umudike

	Output	Unit Quantity (kg)	Price	Total
A	**Revenue**	4682	200	936,400
B	Variable Cost			
	Cocoyam setts (corns and cornel)	902	200	180,400
	Fertilizer	400	120	48,000
	Bags	20	100	2,000
	Baskets	10	150	1,500
	Total			**231,900**
C	Labour input (mandays)			
	Land preparation (Tractorization)			15,000
	Setts preparation	17	1000	17,000
	Planting	15	1000	15,000
	Weeding	$61^{\times 2}$	1000	122,000
	Fertilizer Application	13	1000	13,000
	Spraying	9	1000	9000
	Roughing	5	1000	5000
	Slashing	18	1000	18,000
	Earthening up	15	1000	15,000
	Harvesting	47	1000	47,000
	Carriage/Expenses			3,000
	Total			**246,,000**
D	Opportunity cost of variable cost at 20%			95,580.00
E	Total variable cost (B+C+D)			573,480.00
	Gross Margin (A-E)			362,920.00
	BCR=A/E			N1.63:1.00

CONCLUSION

The study estimated the gross margin for cocoyam production per ha in NRCRI Umudike. The results of the gross margin analysis showed that cocoyam production is profitable by returning N1.63 to every N1.00 spent. Farmers should be encouraged to go into cocoyam production since it is a highly profitable venture. Given that cocoyam is an important staple food in Nigeria, any attempt to increase its productivity would be a right step towards the resolution of the food crisis especially in Nigeria. Farmers are therefore encouraged to go into rapid production of cocoyam since it is highly profitable. This will enhance their revenue, improve food security and livelihoods among cocoyam farmers.

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ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

SUB-THEME II:

POST HARVEST PROCESSING, PACKAGING, VALUE ADDITIONS, VALUE CHAINS AND EXPORT PROCESSING

INVESTIGATION OF FARMERS INVOLVEMENT IN COCOYAM PRODUCTION AND POST HARVEST PRACTICES IN OHAFIA AGRICULTURAL ZONE OF ABIA STATE, NIGERIA

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ABSTRACT
The study investigated the levels of involvement of cocoyam farmers in various cocoyam production and post harvest practices like processing, storage and marketing among farmers in Ohafia zone of Abia State. The data for the study were collected from 68 cocoyam farmers randomly selected from four communities in Ohafia zone. The data collected were analyzed by means of descriptive statistics such as frequency tables, percentages and mean-scores. The result showed that majority of the farmers were highly involved in most of the cocoyam agronomic and post harvest practices as shown by the mean scores. Land clearing ($\bar{x}$= 3.88) and planting ($\bar{x}$=3.88) had the highest involvement by farmers followed by marketing ($\bar{x}$=3.68), weeding ($\bar{x}$= 3.64), processing and harvesting activities. It was recommended that farmers should be encouraged to participate in pest and disease control activities and other areas where they showed low level of involvement in cocoyam production for increased production of cocoyam in Abia state.
Keywords: cocoyam production, post harvest, Ohafia

INTRODUCTION

Cocoyam is one of the major tuber crops in Nigeria after yam. Two major species of cocoyam cultivated in Nigeria are *Xanthosoma maffafa and Colocasia esculanta. Even though in Ghana and other countries cocoyam represents only xanthosoma maffafa while colocasia is known as taro.* The cultivation of cocoyam in most African countries including Nigeria is essentially in the hands of resource poor farmers with minimum inputs (NRCRI, 2011). The bulk of the production of cocoyam is in the south east Nigeria, as a major food crop in Nigeria especially in female headed households (Enyinnia, 2001; FAO, 2008). In some South east Nigeria, cocoyam cultivation and marketing is still neglected despite the wide adaptability, nutritional value and economic value of the crops . In Aninri Local Government Area of Enugu State where cocoyam is greatly produced in large Quantity, cocoyam is perceived as woman crop. A woman who does not have a cocoyam farm can as well be qualified as a non-farmer. Good agronomic practices should be observed throughout the period of cultivation of cocoyam for an increased crop yield, Such practices are recommended spacing (50 cm – 100 cm), used of improved varieties, weed control, use of fertilizer or organic manure, control of pest and diseases etc (NRCRI, 2008), Harvesting should be done when the crop is fully matured between 7-8 months with the following symptoms of maturity such as the yellowing of the leave, the drying of the leave, the suiting up of the corms on the ground. Delayed harvesting might cause damage of the corms. Nigeria production output of 5,143kg per hectare is low compared with 13,493kg per hectare in Japan and 13,333 kilogram per hectare in China (Ogbonna *and Nweze*, 2012). The annual output of 180 tonnes in Nigeria is as a result of poor practices and poor participation of farmers in cocoyam production practices. Investigating into the various practices and the level of farmers involvement in the activities will aid in the management of labour and other resources in production.

Objectives of the Study

The general objective of this study was to investigate farmers involvement in cocoyam production and postharvest practices in Ohafia agricultural zone of Abia state, Nigeria.
Specific objectives
1 Describe the socio economic characteristics of farmers in the study area.
2. Ascertain farmers involvement in the cocoyam production and postharvest activities
3. Identify the challenges to cocoyam production among respondents.

METHODOLOGY

The study was conducted in Ohafia agricultural zone of Abia state, Nigeria. Out of the three agricultural zones of the state Ohafia was purposively selected because the people cultivate cocoyam. Two extension blocks Umunneochi and Isuikwuato were randomly selected from the zone., followed by random selection of two circles in each of the blocks. In each of these circles, twelve cocoyam farmers were randomly selected from the list of cocoyam farmers in the area, making it a total number of 68 farmers for the study. Data collected were analyzed by means of descriptive statistics such as frequency tables, percentages and mean. A 5 point Likert scale was used to achieve the involvement value and was calculated thus 5+4+ 3 +2+1 = 15/5 = 3.0 . 3.0 means acceptance while <3.0 means rejection

RESULTS AND DISCUSSION

Table 1 shows the socioeconomic characteristics of respondents and the result showed that majority (41.17%) of respondents were between 51-60 years showing that more elders were into cocoyam production. Only 26.46% were youths between 20-40 years. The table also showed that 73.52% of respondents were married majority (81.17%) of respondents had formal education only 8.83% were illiterate, larger proportion (55.88%) were female. Majority (50.0%) of the farmers had 11-20 years experience in cocoyam farming while (32.35%) had above 20 years farming experience. Majority of the cocoyam farmers had large house hold size (61.76%) and farm size (55.88%) of 1-2 hectares per farm family. Most of the cocoyam farmers practiced both subsistence and commercial farming whereas majority (35.29) of the farmers had annual income of less that ₦100.00 per annum while many (26.47%) earned ₦500.000 thousand from farming annually. The result also revealed that 97.05% of the farmers had access to labour, 85.29% had access to land and 92.64% had access to agricultural information Table 2 revealed that majority of cocoyam farmers in Abia State were highly involved in most of the cocoyam production and post harvest activities. Land clearing and planting had the highest level of involvement with the Mean(X) of (3.88 and 3.88) followed by marketing (3.68) weeding (3.64) processing (3.62) and harvesting (3.41) activities. Farmers were also highly involved in tillage (3.32) and storage (3.35) activities. The result also showed low involvement of farmers in earthling up (2.35) erosion control (1.35) pest and disease control (2.41) and fertilizer application (2.79) as shown by the mean scores. The major constraints militating against cocoyam production among farmers were fund, poor yield high incidence of disease, unavailability of disease control chemicals as shown in Table 3

CONCLUSION AND RECOMMENDATION

The study investigated the socio economic characteristics of cocoyam farmers in Ohafia zone of Abia state, level of farmers involvement on cocoyam production/post harvest activities and the constraints to cocoyam production among farmers in the study area. The study revealed that most of the respondents were married elderly and educated farmers with over ten years farming experience. The level of farmers involvement in cocoyam production and post harvest practices was encouraging and it showed that they farmers were really into cocoyam farming. The areas where farmers showed low involvement on cocoyam production were earthening, fertilizer application and disease control. The major constraints to the farmers were fund poor yield and problem of diseases. Farmers should be encouraged to carry out all the recommended practices for increased production of cocoyam and Agricultural research should focus on the development of high yielding and disease resistant cocoyam cultivars for food security.

Table1; Distributions of Respondents According to Socio-economic Characteristics

Variables		Frequency	Percentage
Age:	20-30	2	2.94
	31-40	16	23.53
	41-50	12	17.64
	51-60	28	41.17
	Total	68	100.00
Marital Status	Married	50	73.53
	Single	18	26.47
	Total	68	100.00
Educational Status	Tertiary	18	26.47
	Secondary	22	32.35
	Primary	22	32.35
	No school	06	8.83
	Total	68	100.00
Sex	Male	30	44.12
	Female	38	55.88
	Total	68	100.00
Farming Experience	< 10 years	8	11-76
	11-20	34	50.00
	21-30	22	32.35
	31-40	04	5.89
	Total	68	100.00
Households size	< 3	12	17.65
	2-6	42	61.76
	7-10	14	20.59
	Total	68	100.00
Farm size (ha)	<1 hectare	20	29.41
	1-2	38	55.88
	3-4	10	14.71
	Total	69	100.00
Type of farming	Subsistence	12	17.65
	Commercial	22	32.35
	Both	34	50.0
	Total	68	100.00
Farm income per annum	<100.000	24	35.29
	101.000-300,000	14	20.59
	301,000-500,000	18	26.47
	Above 500,000	12	17.65
	Total	68	100.00
Access to inputs	Labour	66	97.05
	Credit	25	36.76
	Hand	58	85.29
	Information	62	92.64

Source; Field Survey, 2014.

Table2; Distribution of Respondents According to their Involvement in Cocoyam Production and Post harvest Practices.

	Very often	Often	Undecided	Not often	Not involved	Total	MEAN	Decision
Land clearing	20 (100)	36 (44)	2 (6)	4 (8)	6 (6)	264	3.88	A
Tillage operation	14 (70)	28 (112)	2 (6)	14 (28)	10 (10)	226	3.32	A
Planting	22 (110)	34 (136)	0 (0)	6 (12)	6 (6)	264	3.88	A
Weeding	14 (70)	40 (160)	0 (0)	4 (8)	10 (10)	248	3.64	A
Fertilizer application	12 (60)	12 (48)	0 (0)	22 (44)	22 (22)	190	2.79	R
Erosion control	6 (30)	12 (48)	4 (12)	24 (48)	22 (22)	92	1.35	R
Earthing	0 (0)	18 (78)	6 (18)	20 (40)	24 (24)	160	2.35	R
Pest/disease control	2 (60)	14 (56)	10 (30)	26 (52)	16(16)	164	2.41	R
Harvesting	12 (60)	36 (144)	2 (6)	8(16)	10(1)	232	3.41	A
Processing	10(50)	42(168)	2(6)	8(16)	6(6)	246	3.62	A
Storage	10(5)	30(120)	2(6)	12(24)	28(28)	228	3.35	A
Marketing	16(80)	36(144)	2(6)	6(12)	8(8)	250	3.68	A

KEY: Figures in parenthesis = %. * Mean ≥ 3.0 = **Acceptance (A), Rejection(R) <3.0**

Table3; Distribution of Respondents According to Constraints to Cocoyam Production

Constraints	Frequency	Percentages
Inadequate fund	54	79.41
Unavailability of fertilizer	46	67.64
Unavailability of herbicides	30	44.11
Unavailability of disease control chemicals	48	70.58
Inadequate planting materials	29	42.64
Poor access to manure	48	70.58
Poor yield	54	79.41
High cost of labour	42	61.76
Poor storage method	35	51.47
Poor extension contact	46	67.64
Poor post harvest product	30	44.11
Crude implement	46	67.64
Low plant adaptability	42	61.76
Poor marketability	30	44.11
High incidence of disease	48	70.58
High mortality	40	58.82

Source; Field Survey, 2014.

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LIMITATIONS AND PROCESSING TECHNOLOGIES OF SWEETPOTATO PRODUCTION BY FARMERS IN ANAMBRA STATE, NIGERIA

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ABSTRACT
The study examined limitations and processing technologies of sweetpotato production by farmers in Anambra State, Nigeria. Multistage sampling techniques were used for the study. Four local governments out of the 21 local governments in the State were purposely selected due to their popularity in sweetpotato production. Two communities were selected from each local government to give a total of 8 communities that were used for the study .15 sweetpotato farmers were selected from each community using simple random sampling technique and this gave a total sample size of 120 farmers. Data were generated through a structured interview schedule. Out of 120 questionnaires distributed, only 100 were retrieved and used for analysis. Percentage, frequency, mean score and standard deviation were used for data analysis. Results show that 79% of the farmers were female and their mean age was 38yrs. Majority (58%) of the farmers were not aware of the technologies introduced to them while, some farmers were aware of the innovation. None of the farmers adopted the technologies. Too much attention on other crops with a weighted mean score 2.74, high perishability of sweet potato with a weighted mean score 2.63, inadequate finance with a weighted mean score 2.60, pest/disease infestation (2.48), high cost of sweet potato processing equipment (2.48) farmers' low knowledge on sweet potato value Chain (2.45), in adequate extension services with a weighted mean score 2.42 were identified by the farmers as the major constraints to sweet potato production technologies in the study area.
Keywords: limitations, processing and production.

INTRODUCTION
Nigeria is one of the largest producers of sweet potato (ipoema batata) in sub-sabaran African with annual production estimated at 3.46 million tons per year (Omoare, Fakoya, Fapojuwo and Oyediran, 2014). According to Okorie and Onyeneke (2012), sweet potato is an important food security crop and a short-term crop that can be consumed by boiling and mashing or frying. It could be mono-cropped or intercropping or intercropping in complex cropping systems with some staple crops like yam, and maize. A brief analysis of potato production in various countries of Africa reveals that Egypt is Africa's number one potato producer, followed by malawi while Nigeria is known to be the fourth biggest producer of potato in Africa (Ugonna, Jolaoso and Onwualu, 2013). However despite the global attention given to sweet potato with regard to food security Nigeria is still recorded number one of the world's lowest average potato yield/hectare with a value of 3.1. Potato consumption is also very low with a value of 3.2 kg per capita per year. In Nigeria, more than 85% of the potato production is done by farmers who maintain small farms and carry out their operations manually with traditional farm tools such as hoes and cutlass (Okonkwo, Amadi and Nwosu (2009). Despite the important of the sweetpotato in Nigeria as a country the crop has received so much little attention in some States due to a paucity of information on the factors limiting sweet potato production. In the light of the above, this study therefore, designs to investigate the limitations and processing technologies of sweet potato production in Anambra State, Nigeria. Specific objectives of the study were to ascertain the processing techniques being adopted by the farmers in the study area and to identify the challenges to sweet potato production in Anambra State.

MATERIALS AND METHOD
The study area for this research is Anambra State. The State is located in the South east of Nigeria. It is bounded by Delta State to the West, Imo State to the South, Enugu State to the east and Kogi State to the North. It has estimated population of 4,77,828 million people (NPC, 2006) which stretches over about 60kilometers between surrounding community. The target population for this study was all the sweetpotato farmers in the state. Multistage sampling techniques were used for this study. Four local governments out of 21 local governments in Anambra State were selected due to their popularity in sweetpotato production. Ayamelum local government, Anambra East local government, Anambra West Local Government and Awka North local government were selected.

In the second stage, two communities each from a local government were selected. Here Omor and Umumbo in Ayamelum Local Government, Nando and Igbariam in Anambra East,Nzam and Igbede in Anambra West,Achala and Uzum in Awka North local government were selected. This gave total of eight (8) communities. Third stage, 15 farmers were selected from each community using simple random techniques and this gave a total sample size of 120 farmers. Out of 120 questionnaires distributed, only 100 were retrieved and used for analysis.

Measurement of variables

To ascertain the processing techniques being adopted by farmers, six steps adoption model were used. (Madukwe, 1995, and Udemezue, 2014). The farmers were asked to show their adoption stage for the different processing technologies of sweet potato production. Total adoption score for each farmer was calculated by summing the adoption score for the variously technologies.

These were the response categories and corresponding weighted values: Not aware 0; Aware 1; Interest 2; Evaluation 3; Trial 4; Adoption 5

The challenges to sweet potato production in the study area were achieved using three point likert-type scales. The farmers were asked to indicate their levels of the challenges to sweet potato production. Their response categories were very serious =3, serious =2, not serious =1. These values were added to obtain a value of 6 which were later divided by 3 to get a mean score of 2.0. Variables with mean score less than 2 were seen as not serous while variables with mean score equal to or above 2 were seen as very serious challenges to sweet potato production in the state.

RESULTS AND DISCUSSION

Distribution of farmers According to Socioeconomic characteristics

Table1 shows that 79% the farmers were female while 21% of the farmers were male. This implies that women dominated sweet potato production activities in the study area. This result is in line with Olagunju *et al* (2013) who saw women as the dominance of sweet potato production in Ogun State, Nigeria. Majorities (53 %) of respondent were married while 10% of the respondents were single and this could be the reasons women and children were available as family labour. The average mean age was 38yrs. The indication is that the farmers were predominantly in their active age and this could also enhance their potential for investment, acceptance, adoption and application of both exotic and indigenous technologies for increased productivity. The average mean household size of the respondent was 5. The implication of this is that the farmers enjoyed a relatively large family size which is a source of labour in the farm production. About 66% of the respondents were full time farmers that combined sweet potato production with other farming crops. However, majority (49%) of the respondents acquire land by rent while about 68% of the respondent cultivated 0.1-0.499 hectare of land. The average farm size cultivated for sweet potato production was 0.23ha. This shows that sweet potato farmers in the study area were still under small scale farming. This result is in consonance with spore (2013) which observed that sweet potato is grown mainly by women on small plots of land. About 63% of the respondents used family labour while 68% of the respondent sourced agro-input from their fellow farmers.

Distribution of the farmers based on their level of adoption of sweet potatoes processing techniques

Figures in table 2 show the levels of adoption of processing techniques used by the sweet potato farmers in the study area. According to NRCRI, sweet potato could be processed into the followings; Processing of sweet potato into fermented fufu four, Processing of sweet potato into unfermented flour for use in confectioneries, Processing of sweet potato into starch and Processing of toasted sweet potato.

The findings revealed that majority (58%) of the farmers were not aware of processing sweet potato into fufu flour, 14% of the farmers were aware while 19% and 9% of the farmers were in interest and evaluation stage of the adoption process. About 45% of the respondents were not aware of processing sweet potato into flour for confessionary, 14% of the farmers were aware, 10% and 6% of the farmers were into evaluation and trial stage respectively. Similarly majority (55%) of the farmers were not aware of processing sweet potato into starch while 14% of the farmers were aware. 8%, 16% and 7% of the farmers were in interest, evaluation and trial stage of adoption process. About 39% of the farmers were not aware of processing sweet potato into toast, 23% of the farmers were aware while 38% of the farmers were in interest stage. Majority of the farmers who were not aware of the processing sweet potato into various forms revealed that they were not fully informed about the innovation by the extension workers and this characterizes one extension worker to cover a wide range of farmers at a short time. Inadequate extension services among farmers were assumed to be an impediment to adoption of new technologies disseminated to farmers. The implication of the above is that some of the farmers who said that they were aware of the innovation might not have full knowledge of it due to inadequate extension service and this could be the major reason they stopped at the trail stage of adoption process. On the other hand, another set of farmers complained about the high cost of processing equipment and this could as well be the reasons some of them did not reach trail stage. Therefore, for a farmer to adopt an innovation there should be full dissemination of the technologies by the extension workers. This finding is in agreement with Chinaka and Udemezue (2015) who saw inadequate extension services among farmers as an impediment to adoption of new technologies disseminated to farmers.

Constraints to sweet potato production and processing technologies

Figures in table3 indicate the different levels of constraints militating against sweet potato production. The constraints were categorized into very serious (3), serious (2) and not serious (1) and later ranked in descending other of the constraints. Too much attention on other crops with a weighted mean score 2.74 was ranked first, high perishability of the crop with a weighted mean score 2.63 was ranked second, inadequate finance with a weighted mean score 2.60, pest/disease infestation (2.48), high cost of sweet potato processing equipment (2.48) farmers' low knowledge (2.45), inadequate storage facilities (2.44) and inadequate extension service with a weighted mean score 2.42 respectively.

In views of the above constraints, it could be reasonable to infer that high cost of processing material, inadequate finance and inadequate storage facilities could alternatively shift farmers' attention to other crops like cassava, rice, maize among others. Scarcity and high cost of equipment restricts farmers from procuring necessary farm implement in timely manner and adoption of improved varieties may be delayed in due cost. Therefore, inadequate finance, poor storage facility and high cost of processing material greatly limit sweet potato production to a small scale level, thereby impeding the value addition of sweet potato. This result is in line with the findings of Philip, Nkonya, pender and Oni (2009) who saw inadequate finance, high cost of processing material and in adequate storage facilities as an impediment to agricultural productivity in Nigeria. Low knowledge on sweet potato, inadequate extension service and perishable nature of sweet potato were also seen as another constraints working against sweet potato farmers in the study area. Inadequate extension service could make farmers being inaccessible to some innovations because they may see such innovations as an intruder designed to impede their farming system and this could be the reasons some farmers were stagnant and static in adoption process. But with the help of extension service farmers could be persuaded and become more dynamic in decision to adopt an innovation as well as discarding his/her laggard mind in adoption process. This result agrees with Omore et al (2014) who said that inadequate extension service was a constraint to sweet potato production in Ogun State, Nigeria

CONCLUSION AND RECOMMENDATIONS

Sequel to the findings of the study, 79% of the farmers were female and the mean age was 38yr. Majority (58%) of the farmers were not aware of the processing techniques introduced to them while some farmers were aware of the technology. In the same vein, none of the farmers adopted the technologies because they were not fully informed about the technologies by extension workers. However, too much attention on other crops, high perishability of sweet potato, inadequate finance, pest/disease infestation, high cost of processing equipment, farmers' low knowledge on sweet potato value chain, inadequate storage facilities and inadequate extension services were identified as the major constraints to sweet potato production and processing in the study area. This study therefore, recommends that more land should be put into sweet potato cultivation as to increase the efficiency at which farmers operate. There is also the need to launch initiatives and enlighten the various sectors of the economy on the usefulness of sweet potato Industries like flour mills, bakeries, textiles industries among others should be enlighten and encourage exploiting the potentials of sweet potato so that farmers in the local areas would be aware of the composite use of sweet potato varieties. Farmers should be encouraged to form farmers association and cooperative to increase their chance of obtaining loan from financial institutions and benefit from various farm credit schemes. Researchers should be endeavored to develop less cost management processing equipment to farmers as to reduce the perishability of sweet potato.

Table1: Percentage distribution of farmers According to Socioeconomic characteristics

Variable	Frequency	Percentage	Mean
Sex			
Male	21	21	
Female	79	79	
Marital Status			
Single	10	10	
Married	53	53	
Widow	15	15	
Divorce	11	11	
Separated	11	11	
Age			
21-30	26	26	
31-40	32	32	
41-50	24	24	38
51-60	15	15	
61 and above	3	3	
House hold size			
1-5	83	83	
6 above	17	17	5.0
Farm size			
0.1-0.499	69	69	
0.5-0.990	20	200	0.23
1.0 and above	11	11	
Occupation			
Full time farmers	66	66	
Trading	23	23	
Civil servant	11	11	
Source of farm land			
Inherited	13	13	
Purchase	24	24	
Sited	14	14	
Rented	49	49	
Source of labour			
Family	63	63	
Hired	37	37	
Source of agro-inputs			
Input dealers	14	14	
AADP	9	9	
NRCRI	9	9	
Fellow farmers	68	68	

Source: Field survey, 2016

Table 2: Percentage distribution of the farmers based on their level of adoption of sweetpotatoes processing techniques:

	Not aware	Aware(1)	Interest(2)	Evaluation(3)	Trial(4)	Adoption(5) %
Fufu floor	58	14	19	9	-	-
Four	45	14	25	10	6	-
Starch	55	14	8	16	7	-
Toasted	39	23	38	-	-	-

Source: Field Survey, 2016

Table 3: Constraints to sweet potato production and processing technologies

Variables	Mean	SD
Too much attention On other crops	2.74	0.056
High perishability of Sweetpotato	2.63	0.066
Inadequate finance for Sweet potato	2.60	0.075
Pest/disease infestation	2.48	0.067
High cost of sweetpotato Processing equipment	2.48	0.81
Farmers' low knowledge on Sweetpotato value chain	2.45	0.80
Inadequate storage facility	2.44	0.86
Inadequate ext service	2.42	0.87
Climatic limitations	1.89	0.078
High cost of farm labour	1.89	0.079
Land tenure system problem	1.70	0.081
Non availability of planting Materials	1.59	0.671

source: Field survey,2016

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ANALYSIS OF PROCESSING AND VALUE ADDITION TECHNIQUES OF ROOT AND TUBER CROPS IN ABIA STATE, NIGERIA

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ABSTRACT
This study was conducted to enlighten root and tuber crops producing households on various ways of adding value to their produce via processing and packaging in order to: increase the shelf life of their produce; enhance the nutritional content of their produce; prevent spoilage; satisfy their consumersand boost their farm income. To achieve this, the researchers consulted the post harvest technology programme of the National Root Crops Research Institute, Umudike, Abia State, Nigeria in order to gather information on innovative post harvest techniques of root and tuber crops as well as studied published materials on post harvest processing methodsof root and tuber crops with a view to bridging the knowledge gap between research institutes and farmers.
Keywords: cassava, processing, value additions techniques, root and tuber crops

INTRODUCTION
Nigeria is blessed with abundant tropical root and tuber crops. However, the potentials of these root and tuber crops in contributing to economic growth are far from being fully exploited. This is because, though the country produces root and tuber crops in large quantities, ninety-nine percent of what is produced is consumed internally in limited value forms (Eke-Okoro *et al*., 2014) hence, the country continues to import starch, flour, sweeteners and adhesives that can be made from root and tuber crops.The primary objective of the Agricultural Transformation Agenda (2011-2015) with respect to root and tuber crops is mainly to transform bulk of the root and tuber crops into value added products by adopting improved production and processing technologies thereby enhancing food security, income generation and rural economic development (Eke-Okoro *et al*., 2014). However, most post-harvest losses incurred by households involved in the production of root and tuber crops are as a result of insufficient knowledge on how to process these root and tuber crops into various value added products needed for food consumption, animal feed and industrial raw materials. Hence, this study was conducted to enlighten root and tuber producing households on how to engage in meaningful value addition in order to diversify their products and boost farm income.

MATERIALS AND METHODS
The study was conducted at National Root Crops Research Institute, Umudike, Abia State, Nigeria. Data for the study were obtained through oral interview with the section head of post harvest technology programme of the institute, as well as from other published materials on root and tuber crops processing methods.The data collected were documented and presented as flow charts for the production of value added root and tuber products as presented in the results and discussion.

RESULTS AND DISCUSSION
Method of garri preparation: Peel and wash cassava roots; grate the root into mash using cassava grater; the grated cassava mash is fermented and dehydrated by putting it in a sack and placing it on fermentation rack for 1-5 days depending on the preferred garri flavor in a given locality. Fermentation is very important because it gives garri its preferred sour flavor, and detoxifies the cyanide; sieve to remove fiber and poorly grated materials; frying is done to achieve starch gelatinization of the particle and drying; finally, the fried garri is allowed to cool, sieved and packed (Ukpabi, 2008). See fig1

Method of fufu preparation : Peel and wash cassava roots; soak in water to ferment for 2 days; remove from water and grate into mash; put the [illegible] leave for a day; de-water the mash by pressing inside a clean bag; break the pressed mash into granules; spread thinly to dry on a clean surface, preferably on a raised platform; when dry, mill into fine powder; package in an airtight container or food-grade polyethylene bag (Aniedu and Oti, 2008). See fig2

Method of cassava chip and flour preparation: Peel and wash cassava roots; grate the root into a mash; de-water the mash by pressing inside a clean bag; break the pressed mash into granules; spread thinly to dry on a clean surface preferably on a raised platform; when dry, mill into fine powder and sift; package in an airtight container or food grade polyethylene bag (Aniedu and Oti, 2008). **Note:** The whole process from harvesting of cassava to drying of the cassava granules must be completed within 24 hours for the flour to be of high quality (Aniedu and Oti, 2008). See figs 2,3,4&5

Method of starch preparation: Peel and wash cassava roots; grate into a mash; mix with a lot of clean water (about 10 times the volume of cassava mash); sieve using muslin cloth; allow the starch to sediment and decant the water; wash the cassava starch by adding water, stirring and following processes 3 and 5 two or more times; spread out in a tray to sun-dry on a raised platform or oven-dry at 50^{0c}; mill finely and package in an airtight container (Aniedu and Oti, 2008). See fig6

Method of sweet potato production : Peel and wash fresh sweet potato root, grate the root into mash, dewater the mash by pressing inside a clean bag, break the pressed mash (cake) into fine granules, spread thinly on clean trays (or black polyethylene sheet on a raised platform to prevent contamination by dust, stones) and allow to dry. When dry mill, mill finely and sift if necessary. Then package in polyethylene bags or any other air tight container (Amamgbo, 2009). See fig7

Method of yam flour production: Select fresh yam tubers, peel, wash and cut into thin slices. Parboil in water for 5 minutes, sun- dry or oven-dry at 80^{0c}. Then, mill into fine flour, sieve and package in airtight container (Ukeje *et al*., 2014). See fig8

Method of yam chips production : Select fresh yam tubers, peel, wash and chip using knife or chipping machine. Blanch in boiling water for 5 minutes, sun-dry on raised platform or oven dry at 80^{0c}, and package the dry chips for future use in food-grade polythene bag (Aniedu and Oti, 2011). See fig 9

Method cocoyam chips preparation: Select fresh cocoyam corms, wash and precook for some minutes. Peel the precooked cocoyam and slice, alternatively cocoyam corms can be fermented after washing for 24 hours without precooking. Then dry on raised platform and package for future use (Okonkwo *et al.*, 2014). See fig10

Method of cocoyam flour production: Select fresh cocoyam corms, wash with water and precook for some minutes, then peel and slice into pieces. Alternatively, fermentation is applied after washing when if corms are not precooked by soaking the chips in water for 24 hours to remove acridity. Then dry on raised platform to avoid contamination, mill into flour, sieve and store in airtight container (Aniedu and Oti, 2009). See fig11

Method cocoyam flakes production: Select fresh cocoyam corms from harvested ones. Wash the selected corms with clean water in a large bucket or dish. Boil in pressure pot or cooking drum for about 1-3 hours. Peel the boiled corms; this can be done traditionally by the use of hand or knife. Slice the peeled cocoyam with knife and sun-dry on raised platform to prevent contamination (Okonkwo *et al.*, 2014). See fig12

CONCLUSION

This study has shown that root and tuber crops can be processed into variety of value added products to boost farmers income. Hence, farmers are encouraged to utilise the value addition techniques illustrated on the flowcharts to diversify their output in order to enhance their income and living standard.

Flow charts for the production of value added root and tuber products

i) *Garri*

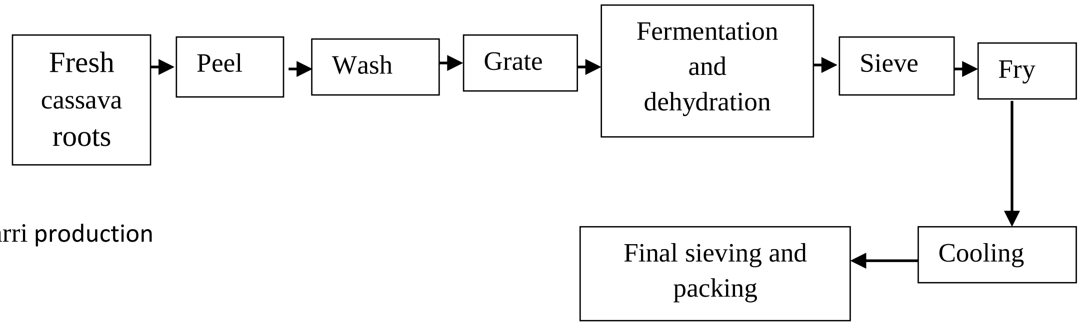

Fig. 1: Garri production

ii) Fufu (Odourless fufu flour)

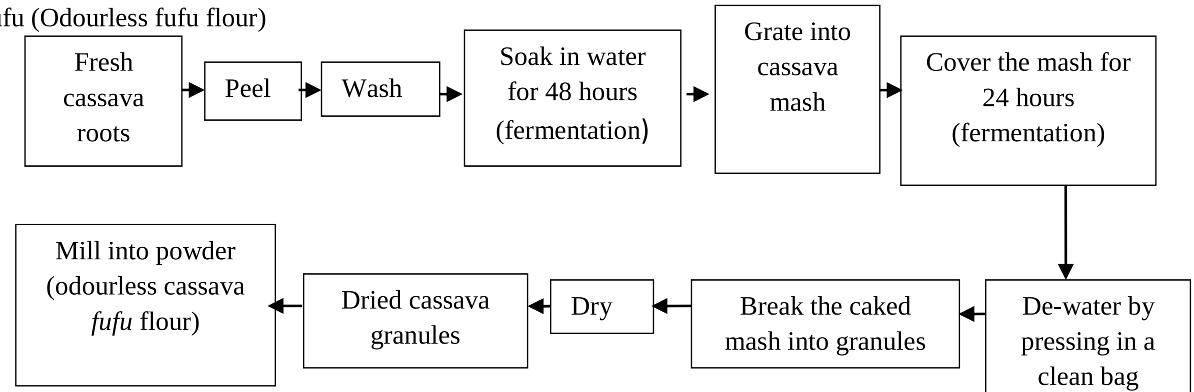

Fig 2: Odourless fufu flour production
Source: Aniedu and Oti 2008.

iii) Cassava chip for industrial purposes

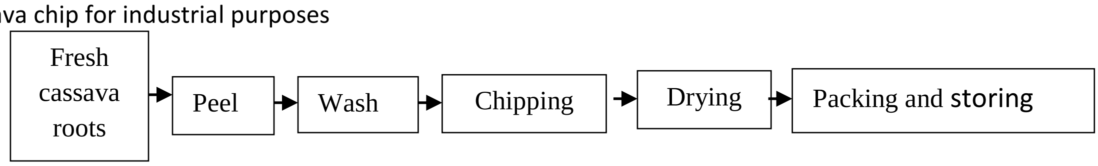

Fig. 3: Cassava chip for industrial purposes
Source: IITA, 2007.

iv) Food chip (*Abacha*)

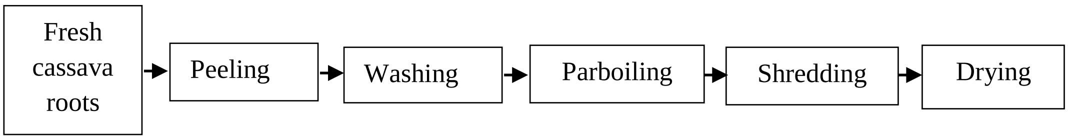

Fig. 4: Food chip (Abacha) production
Source: IITA, 1990.

iv) High quality cassava flour (HQCF)

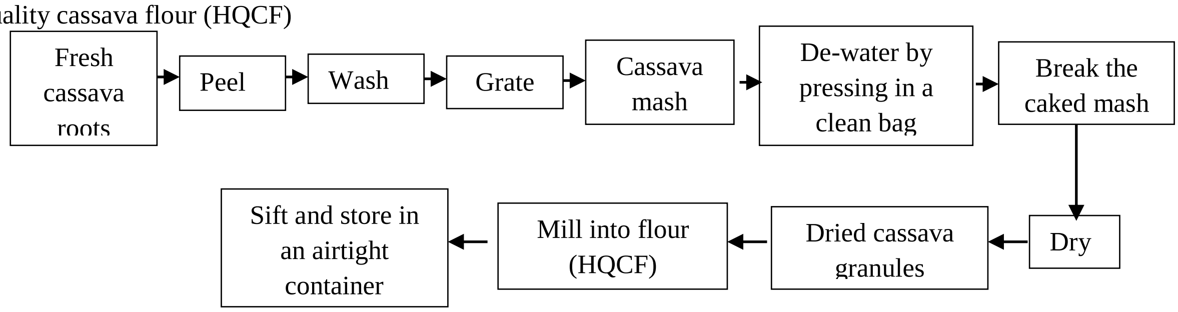

Fig. 5: High quality cassava flour production
Source: Aniedu and Oti, 2008.

vi) Cassava starch

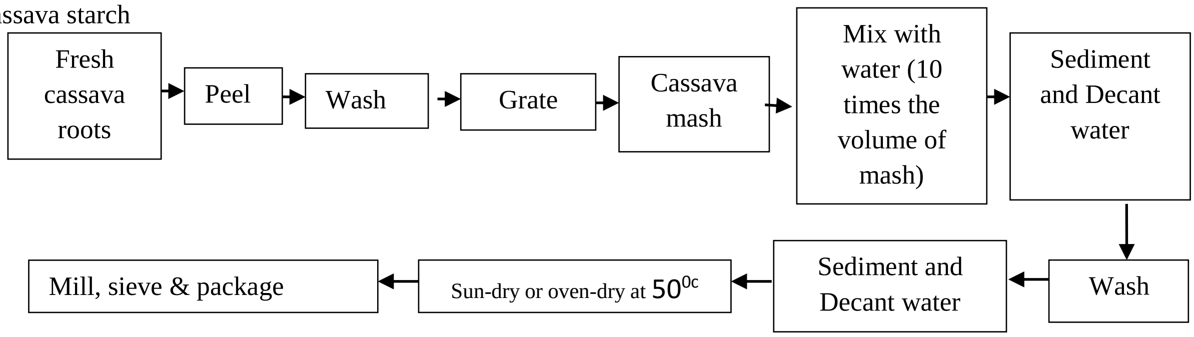

Fig. 6: Cassava starch production
Source: Aniedu and Oti, 2008.

vi) Sweet potato flour

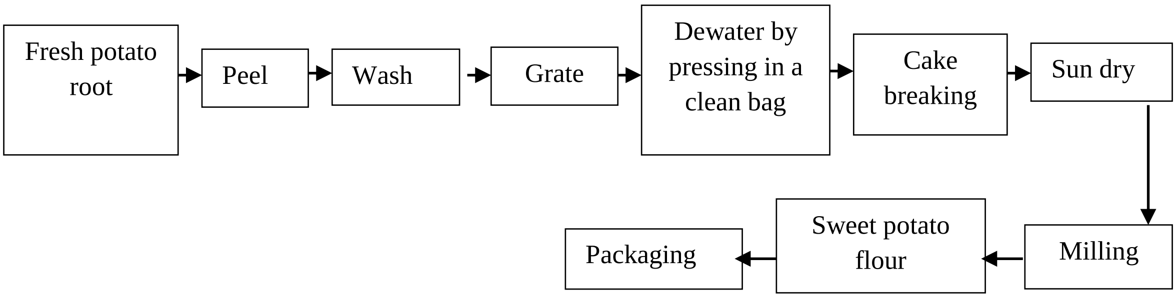

Fig. 7: Sweet potato flour production
Source: Amamgbo, 2009.

vii) Yam flour

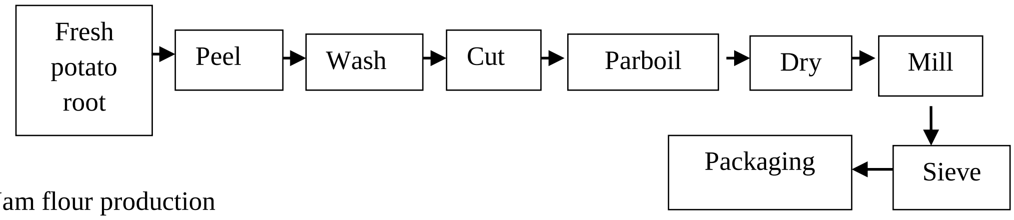

Fig. 8: Yam flour production
Source: Ukeje *et al.* 2014.

viii) Yam chips

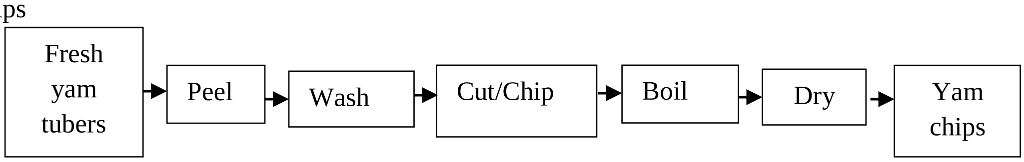

Fig. 9: Yam chips production
Source: Aniedu and Oti, 2011.

ix) Cocoyam chips

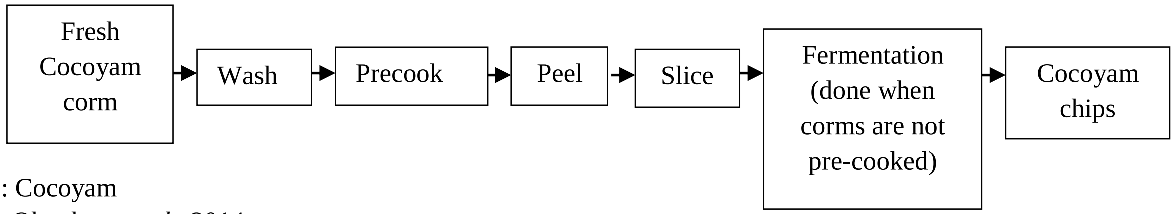

Fig. 10: Cocoyam
Source: Okonkwo *et al.*, 2014

x) Cocoyam flour

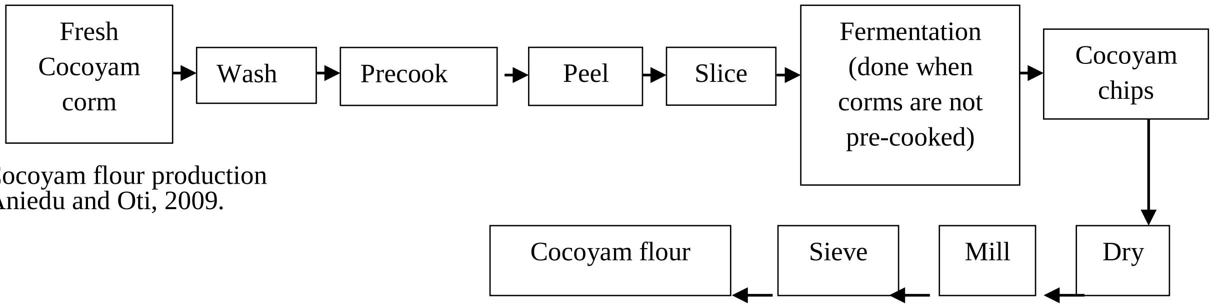

Fig. 11: Cocoyam flour production
Source: Aniedu and Oti, 2009.

xi) Cocoyam flakes

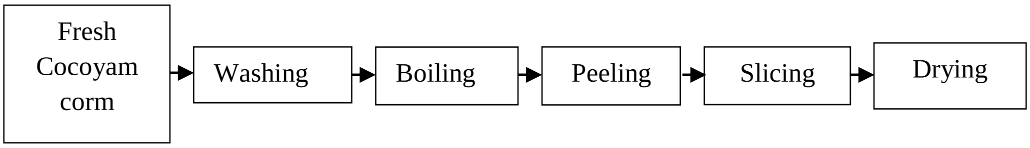

Fig. 12: Cocoyam flakes production
Source: Okonkwo *et al.*, 2014

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SOME ISSUES OF PACKAGING AND LABELING OF AGROCHEMICALS IN JOS, PLATEAU STATE, NIGERIA

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ABSTRACT
Application of agrochemicals on the Jos Plateau has become very necessary due to diminishing availability of labour and the desire of farmers to synchronize farm operations for maximum production. This study was carried out to investigate the problems that led to some mishaps in the application of the agrochemicals. The findings revealed that 26% of the agrochemical products sold to farmers are inadequately packaged and that about 29% the labels on these packages were not very legible. The result also indicated that 22% of the information read from the labels was not helpful in equipping the farmers for adequate agrochemical application.
Keynotes: packaging, labeling, agrochemicals, Jos

INTRODUCTION
Crop production in Nigeria, like many other tropical regions of the world is very heavily labour dependent in order to carry out field/cultural activities most especially when the need to time these farm cultural operations fairly precisely remains an absolute necessity for ensuring meaningful output (crop yields).
The use of agrochemicals for crop production and for agriculture generally has become very necessary not only to circumvent high cost of and scarcity of available farm labour but to synchronize field operations in order to ensure maximum productivity. These and other reasons may be responsible for the ever increasing demand for and usage of agro-chemicals in Nigeria. The apparent rise in the level of agrochemical usage has invariably increased with some negative environmental impacts (Jeong and Foster,2003;Griffins and Malburg, 2012), serious health problems (Atreya,2008; Bhandari, 2014) and great dependence on imported chemicals with attendant far reaching economic implications. It is generally believed that the recent shift in agricultural production most especially crop production to accommodate extensive usage of agrochemicals will pose these serious challenges and others that may not have been assessed adequately.
The study area [9^0, 33^I N -9,^{0}88^I N; 8^0,61 ^{I}-9^0.18^I E] located on the Jos- Plateau, is a tropical mid-altitude location, about 1500M above Sea Level and covering about 700 KM^2. The area has the potential for the production of both tropical and some temperate crops because of its heavy rainfall and moderate temperature, favorable for the cultivation of potato (*Solanum tuberosum*), wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*), as well as a wide range of temperate vegetables and fruits such as celery, radish, strawberries, cauliflowers as well as apples and grapes. The moderate climatic condition has attracted a lot of animal nomads from all over West Africa, a major factor that led to the establishment of the National Institute For Veterinary Research(NVRI) located in K-Vom (09^0 , 44^I N and 08;45^I E).
In response to recent shift in agricultural policy which seems to encourage more active private sector participation, there was a noticeable increase in the introduction of some of these temperate crop varieties, which may be termed indiscriminate because it was carried out without adequate quarantine, appropriate seed certification procedure and adhering to necessary bio-safety measures. This may possibly account for some of the upsurge in some crop pests and diseases as exemplified by the recent upsurge in potato blight epidemics recorded on the Jos Plateau (Chuwang, 2014). In order to control these pests, diseases and weeds, the farmers have resorted to increased usage of all sorts of agro-chemicals with varying degrees of success and most importantly, unquantifiable levels of environmental impact. It has also been documented that synthetic chemicals used for agriculture have deleterious impacts on ground and surface water, composition of atmospheric gases, soil properties, responses of organisms to stimuli etc (Bhanbari,2014; Gregg, 2015)
Recently, there was an increase in the reported cases/incidences of food poisoning from consuming unwholesome farm produce such as cowpea and grains as well as fruits and vegetables. This unwholesomeness of the farm produce was blamed mainly on improper preservation with chemical substances. Just recently, the EU (European Union) placed a ban on the importation of agricultural food produce from Nigeria (Anon, 2013, Anon, 2015). The continuous consumption of these and other farm produce are most likely to pose danger to consumers if the issue of inappropriate agrochemical usage is not addressed.
The object of this paper is to provide some sort of information on the packaging, labelling and viability and safety of agrochemicals used for agricultural production in the Jos area. It is also hoped that this information will provide a basis for making sound decisions on the problem at hand.

METHODOLOGY

The field assessment of the farming system(s) of the study area was carried out through oral/written interviews where questionnaires were administered to 10 respondents in 10 selected locations namely *Barkin-ladi*, *Bokkos, Heipang, K-Vom, Vwang, Gassa, Mangu, Kerang, Ampang-West* and *Gindiri.* Most of these areas are located on the higher plains of the Jos Plateau, North Central Nigeria.

Information was collected included the packaging, labeling and the reliability of all the package and the composition of the active ingredients of the chemicals. Other aspects of the farming system of the area, and personal aspects of the farmer's life provided information that were also analyzed but not presented in this paper.

The data collected was analyzed statically using the simple percentage technique with the aid of MS-Excel, 2010 version. All deductions and or conclusions arrived at in this study were based on the outcome of this analysis.

RESULT AND DISCUSSION

Packaging of the agrochemicals

The packaging of the agrochemicals is as presented in Fig 1. The result shows that about 61% of the respondents affirmed that the products were very adequately packaged and about 5% reported that the agrochemicals were not properly packaged. It will be safe to assert that about 74% of the farmers felt the packaging was adequate and very adequate but the remaining 26% were of the opinion that the packaging needed to be improved upon.

The implication of this result is that the products will be prone to all sorts of abuse and deterioration due to open contact with moisture and other environmental elements. Poor packagings are indicative of possible adulteration or other forms of post-production alterations and mis-management in transit which may lead to some of the problems mentioned earlier. Farmers have reported that fertilizer used on the farm contained mainly clay or kaolin or sand this can invariably lead to crop loss or other failures in the farming system.

Labeling on Agrochemical containers

The legibility and visibility of the instructions on the agrochemical container's labels was assessed by this study and the result is presented in Fig 2. About 71% of the farmers agreed that the instructions on the agrochemical container labels were visible and legible but about 29% felt the labels were either not visible or fairly or barely visible. If the instructions cannot be fully read due to poor visibility it means that the products may not be utilized properly because most farmers rely on the instructions they can glean from the labels on the product containers. In Fig 3 we shows the level of help that the farmers obtained from these labels towards understanding the way to handle the agrochemicals.

The result showed that about 22% of the farmers did not obtain sufficient help, or none at all, from the information read from the labels on the agrochemical's containers towards a better understanding of the process of agrochemical application and utilization.

CONCLUSION

The packaging and labeling of agrochemicals sold to farmers though adequate in most cases, provided room for adulteration and deterioration due to direct exposure to climatic/environmental influence. To compound the problem, some of the agrochemical products did not have visible and legible labels on the packaging containers to provide adequate and accurate information for proper and effective application. In view of these issues some of the farmers could not obtain sufficient information to help them in the process of the correct and proper chemical utilization in their farms. It is therefore necessary machinery to be put in place to monitor agrochemicals sold on the open market to ensure that farmers derive the desired benefit from applying them.

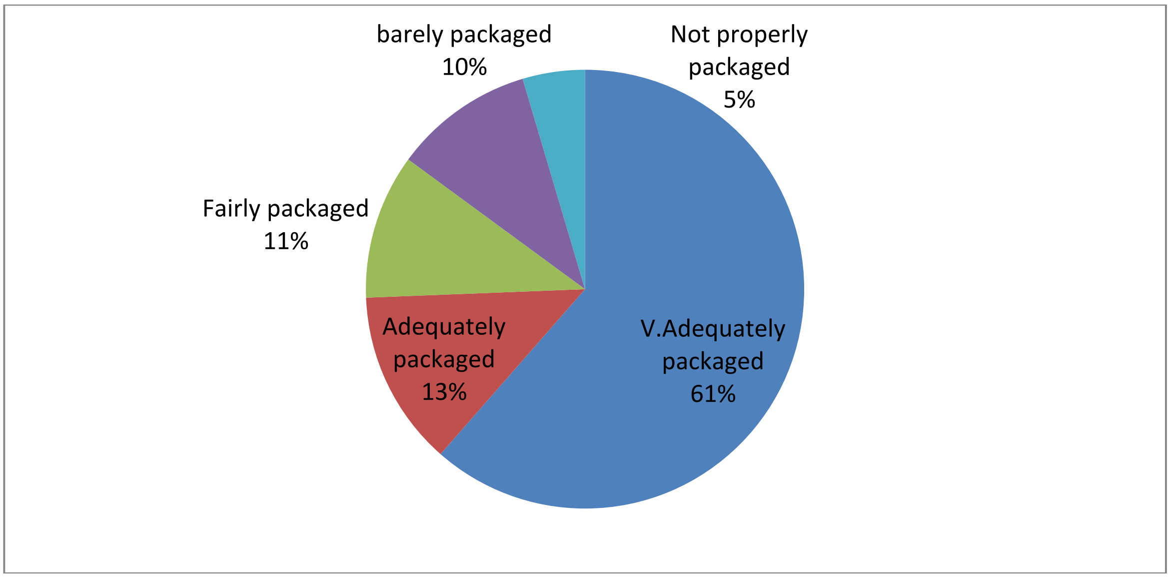

Fig 1: The Adequacy of packaging of Agrochemicals used by farmers on the Jos Plateau, 2015

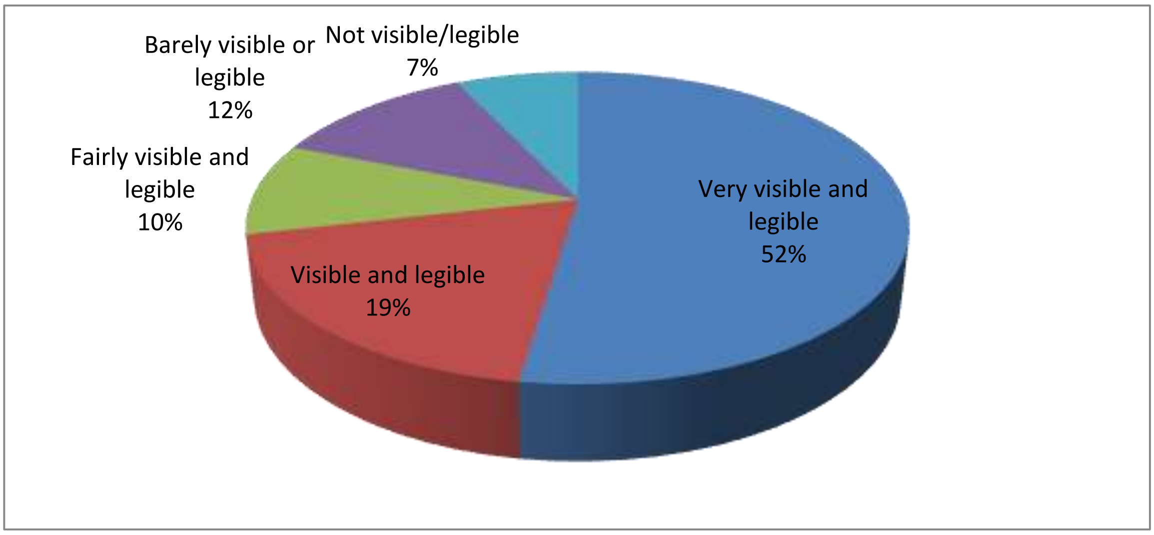

Fig 2: The visibility/ legibility of instructions on the containers of agrochemical used by farmers in Jos.

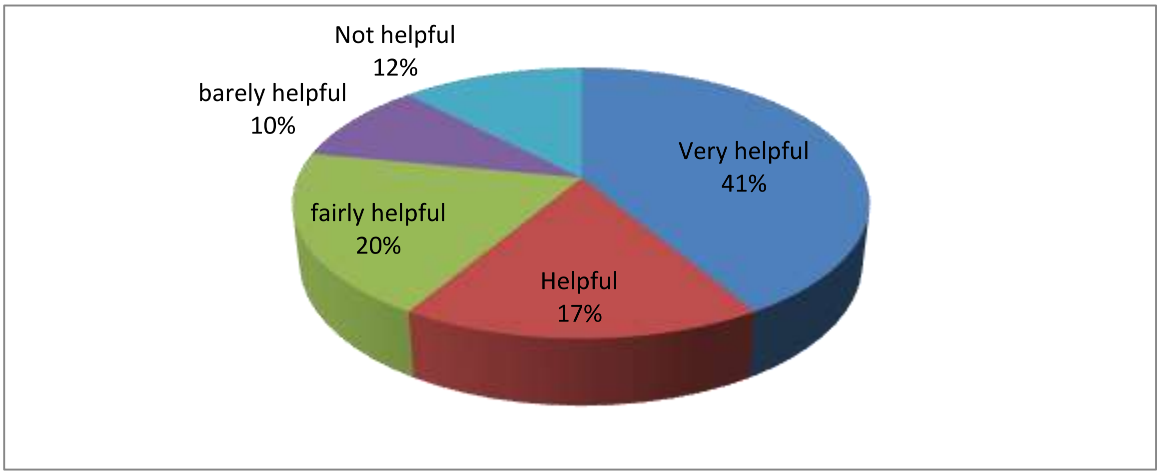

Fig 3: The degree of help received from the information on the labels of agrochemical used in Jos.

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ANALYSIS OF THE FRUITS AND VEGETABLE MARKET CHAIN IN SHOMOLU LOCAL GOVERNMENT AREA OF LAGOS STATE, NIGERIA

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ABSTRACT
The study was carried out to analyze the fruit and vegetable market chain in Shomolu Local Government Area of Lagos state. A survey of fifty marketers randomly selected in Bariga and Bajulaye markets in the area formed the sample used. A descriptive research design was used in the study and data were collected using oral interviews and a well-structured questionnaire. Data were analyzed using frequency counts, percentage, market margins, marketing channel analysis and linear regression model to identify existing marketing channels used by vegetable marketers, determine the profitability of fruit and vegetable and isolate factors that affect quantity supplied of fruit and vegetable along the market chain. The study revealed that majority (74%) of the marketers are females. The average age of the fruit and vegetable respondent was (35.5). Local government harassments, lack of support from government, poor market stall, high cost of transportation and inadequate finance were the most perceived problems of marketing by the fruit and vegetable respondents. Channels that included local markets had high total gross margins. The regression analysis showed that quantity of fruit and vegetable supplied, price of fruit and vegetable, access to market information, access to internet service and distance from the market are factors that influenced supply of fruit and vegetable in the markets. Among other things, measures that easy access to credit, reduce multiple taxes and permit on sellers are recommended.
Keywords: Marketing channels, Fruit and vegetable, Regression analysis

INTRODUCTION

Vegetable constitute the most important and inexpensive component of a balanced diet, which people now realize due to their high nutritive values indispensable for the body. Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 1,000BC to 7,000BC, when new agricultural way of life developed and fruits and vegetables are produced seasonally, but the market requires products throughout the year. As technology improved and consumer incomes increased, it became possible to provide fresh produce year-round.

Fresh tropical fruits are on winning ground in world markets as to recent statistical figures (Babatola, 2004.). Its production has risen by 7% annually since 1997 and the bulk of these fruits (98%) are grown in developing countries. The main reason for increase in demand of tropical fruits is the growing familiarity of consumers with tropical fruits; their taste, nutritional value and cooking qualities.

The knowledge of domestic consumers of the benefits of fruits and vegetables is confined to very few varieties of fruits and vegetables. Hence, domestic demand with the exception of few widely known tropical fruits is generally small and various studies show that people generally consume fruits and vegetables on a daily basis without considering them as basic.

Abay (2007) stated that the production of fruits and vegetable is seasonal and price is inversely related to supply. During the peak supply period, the prices decline. The situation is worsened by the perishability of the products and poor storage facilities. Along the market channel, 25% of the product is spoiled. According to UNESCO (2005), lack of concerted public support, scanty information, poor understanding of how the market chain works and lack of systematic documented knowledge are main threats that hampered the benefit of the sector. Thus, comprehensive data collection along the chain is a must to envisage the direction of input-output flows. If these jeopardy are not well addressed right onwards, it is obvious the country's competitiveness would trail far behind the existing stage. Even though fruit and vegetable are economically and socially important, fruits and vegetable marketing channel and their characteristics have not yet been studied and analyzed for local markets in Lagos state. Hence, the focus of the study to investigate fruits and vegetable market chains and factors affecting fruit and vegetable supply in Shomolu Local Government Area (SLGA). The outcomes here, hopefully will narrow the information gap on the subject and will contribute to better understanding on improved strategies for reorienting marketing system for the benefit of small farmers and traders.

The main purpose of the study is to analyze the fruits and vegetable market chain and investigate the factors that influence the supply of fruit and vegetable in Shomolu local government area of Lagos state. Other objectives include to isolate the problems of fruits and vegetable marketing in the study area; to identify the major fruits and vegetable marketing channels; to identify the factors affecting the quantity of fruits and vegetable supplied to the market.

METHODOLOGY

Study Area

Shomolu is a Local Government Area in the Ikeja division of Lagos State. It is one of the sixteen LGAs of metropolitan Lagos. It is located in the northern part of Lagos city. According to 2006 population census, it has 402,673 inhabitants. Most of its inhabitants are Yorubas. It is a major nerve center for commercial printing activities in Lagos. Also because of its enormous population, it has attracted huge commercial and industrial activities. Shomolu local government area harbours several industrial and commercial enterprises. The town is plagued by problems of overcrowding, poor housing and inadequate sanitation. Other articles of trade here is the marketing of agricultural produce such as rice, fruits, beans, garri, meat, vegetables, fish etc.

Data Collection and Sampling Techniques

Survey research design was used. All the fruit and vegetable marketers in the two main markets within the local government area namely, *Bajulaye* and *Bariga* formed the population for the study. The sample for the study comprised 50 fruit and vegetable sellers from the two markets randomly selected using the Simple random sampling.

Method of Data Analysis

The data collected were summarized using frequency counts and percentages, while the marketing margin analysis was used to determine the profitability of fruit and vegetable along the market chain. A simple linear regression analysis was used to estimate the factors that affect the supply of fruit and vegetable.

2.3.1 Gross Market Margin Analysis:

TGMM= $$\frac{Cprice - Pdprice}{Cprice} X100$$

GMMp = $$\frac{Cprice - MGM}{Cprice}$$

Pdshare = $$\frac{Pdprice}{Rtlprice}$$

Where:
TGMM = Total gross marketing margin
GMMp = Producer's gross marketing margin
MGM = Marketing gross margin
Csprice = Consumer's price
Pdprice = Producer's price
Rtlprice = Retail price
Pdshare = Producer's share

2.3.2 The regression model was specified as follows:

$$Y_i = \alpha_i + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_i X_i + \upsilon_i \text{ ------------------------ (1)}$$

Where: Yi = quantity of fruit and vegetable supplied to market
α_i = Intercept
$ß_i$=Coefficient of the ith explanatory/independent variable
X_i = Vector of explanatory variables
U_i = disturbance term

Hence, the equation for the quantity of fruits and vegetables supplied is: Quantity of fruits and vegetables Supplied = α_i+ $ß_1$Gender + $ß_2$Age+ $ß_3$Household size + $ß_4$Edu + $ß_5$Distance + $ß_6$ Experience + $ß_7$Quantity Supplied + $ß_8$Price + $ß_9$Internet + $ß_{10}$Market Information + $ß_{11}$ credit + Ui

RESULTS AND DISCUSSION

Problems of Fruit and Vegetable Marketing in the Study Area

The Table 1 reveals that local government harassments (74%), lack of support from government (74%), poor market stall (68%), high cost of transportation (56%) and inadequate finance (46%) were the highest problems of marketing faced by the fruit and vegetable respondents while lack of market information (28%), high costs of fruit and vegetable (28%), insufficient supply of fruit and vegetable (28%), low demand of fruit and vegetable (26%) and inadequate storage facilities (22%) were the lowest problems of marketing faced by the fruit and vegetable respondents.

Fruit and Vegetable Marketing Channels and Margins

Figure 1 presents channels through which fruit and vegetable move from the production site until they reach the final buyer. According to Teka (2009), a marketing channel involves a series of intermediaries through which fruit and vegetable pass from producers to consumers. As Figure 1 shows, the 2nd channel- Producer-local market-consumer has the highest rank. It also means that the local market will have the largest share from the sales because the goods will be sold at a price that will bring about high income.

Four marketing channels were identified for fruit and vegetable in the study area as indicated in Table 3 The results revealed that most of the fruit and vegetable goes through channel-2, followed by channel-3 and channel-4. Channel-1 accounted for the least of the fruit and vegetable in the market. The possibility here is that the producer does not make enough profit from channel-1.

Factors affecting quantity supplied of fruit and vegetable in the SLGA

In this section the factors that influence the supply of fruits and vegetable are presented and discussed. A simple linear regression models were employed to analyze the factors that affect the supply of fruit and vegetable.

Table 3 presents the determinants of the supply of fruit and vegetable. The result shows that among the eleven hypothesized determinants of market supply of fruit and vegetable, five variables were found significant. These are quantity of fruit and vegetable produced, price of fruit and vegetable, access to market information, access to internet service and distance from the market. The coefficient of multiple determinations (R^2) was estimated (0.876) and adjusted R^2 value was 0.846. This means that 87.6% of the variation in the dependent variable is explained by the explanatory variables included in the model. Furthermore, the adjusted R^2 of 84.6% which is significant further consolidated the goodness of the model. The result in table 4 shows that the quantity produced is significantly and positively related to marketed supply of fruit and vegetable at 1% significance level. The value of the coefficient for production of fruit and vegetable implies that an increase in production of fruit and vegetable by one unit per hectare resulted in an increase in farm level marketable supply of fruit and vegetable. Similarly, the result shows that the price of fruit and vegetable is significantly and positively related to marketed supply of fruit and vegetable at 10% significance level. This complied with the law of supply that price and quantity supplied are directly related. Thus as the price fruit and vegetable increase in the market, farmers will supply more quantity of fruit and vegetable to the market to get better returns for the products. A priori, access to market information is positively related to market supply of fruit and vegetable at 10% significance level. As hypothesised access to internet service affected the marketed supply of fruit and vegetable positively and significantly at 5% significance level. This might be because internet service enables the traders to have better knowledge about how to get better production and productivity, and creates awareness about new technologies. Distance from the market is significantly and negatively related with the marketed supply of fruit and vegetable at 1% significance level. As the distance from the production area to market place become farther and farther, the producers supply lesser quantity of fruit and vegetable to the market. This is might not be unconnected with the nature of the product (i.e. perishability) and the costs which are related with transportation and handling.

CONCLUSION AND RECOMMENDATIONS

This study investigated the fruit and vegetable marketing chains in Shomolu Local Government area of Lagos with the of unravelling the routes through which fruit and vegetable reached consumers in this area, the problems being faced by their sellers, the returns and factors which affect the supply of fruit and vegetable to the two prominent market in the Local Government area. The study reveals that the channel with high total gross marketing margin obtained was through producer-local market- final consumer. It also shows that quantity of fruit and vegetable produced, price of fruit and vegetable, access to market information, access to internet service and distance from the market influenced quantity of fruit and vegetable supplied to the market. Government should provide adequate market stall for the marketers to store and display their goods. Excess taxes are spread on price thus escalating prices and reducing demand/ sales, government should help streamline multiple permits and taxes imposed on fruit and vegetable sellers. Finally, Policies that ease access to loan and financial support to agribusiness should be promoted.

Table 1: Summary of problems faced by fruit and vegetable respondents

Problems	Agree (%)	Disagree (%)
Inadequate finance	23 (46.0)	27 (54.0)
Inadequate storage facilities	11 (22.0)	39 (78.0)
High cost of transportation	28 (56.0)	22 (44.0)
Insufficient supply of fruit and vegetable	14 (28.0)	36 (72.0)
Poor market stall	34 (68.0)	16 (32.0)
Local government tax collectors harassments	37 (74.0)	13 (26.0)
High costs of fruit and vegetable	14 (28.0)	36 (72.0)
Low demand of fruit and vegetable	13 (26.0)	37 (74.0)
Lack of support from government	37 (74.0)	13 (26.0)
Lack of market information	14 (28.0)	36 (72.0)

Source: Field Survey, 2015

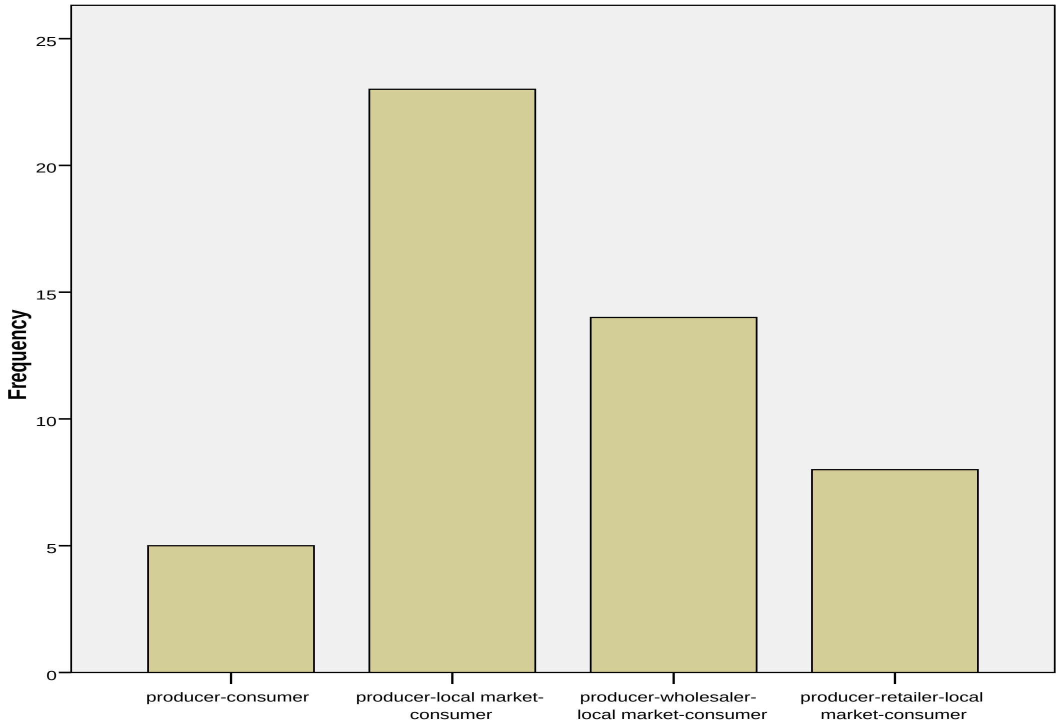

Figure 1: Fruit and Vegetable Marketing Channels

Table 2: Market channels and marketing margin analysis for fruit and vegetable

Market Actors	Marketing Measures	Fruit and Vegetable market channels			
		CHA-1	CHA-2	CHA-3	CHA-4
Producer	Price	**13,750.00**	**13,750.00**	**13,750.00**	**13,750.00**
Local market	Price		**62,750.00**	**62,750.00**	**62,750.00**
	Gross margin		**3,202.82**	**3,202.82**	**3,202.82**
Wholesaler	Price			**42,000.00**	
	Gross margin			**3,440.21**	
Retailer	Price				**22,000.00**
	Gross margin				**3,019.91**
Total Gross Marketing Margin		**14,405.17**	**73,664.92**	**48,162.95**	**24,159.28**

Source: Field Survey, 2015; Note: CHA=channel
Ranks of channels by producer's share
Channel-1 Producer→consumer; Channel-2 Producer→localmarket→consumer
Channel-3 Producer→wholesaler local market→consumer
Channel-4 Producer→retailer→localmarket→consumer

Table 3: Factors affecting the supply of fruit and vegetable

Variables	Coefficients	Std.Err.	t	P-value
Constant)	-0.267	0.981	-0.273	0.786
Gender	0.100	0.185	0.543	0.589
Age (in years)	0.001	0.009	0.098	0.923
Education	0.011	0.078	0.134	0.893
Quantity produced	0.732***	0.024	30.825	000
Price of F & V	0.003*	0.002	1.756	0.084
Household size	0.054	0.042	1.286	0.203
Years of experience	0.002	0.027	0.091	0.928
Access to market information	0.125*	0.069	1.81	0.073
Access to internet service	0.522**	0.199	2.620	0.011
Distance from the market	-0.170***	0.060	-2.820	0.006
Access to credit service	0.033	0.186	0.178	0.895
$R^2$0.876				
Adjusted R^2 0.846				

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ANALYSIS OF NIGERIAN AGRICULTURAL EXPORT PERFORMANCE

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ABSTRACT
The study examined the export performance of Nigeria in the following agricultural commodities: palm oil, rubber, cocoa, cotton, palm kernel and groundnut exports. The Symmetric Comparative Export Performance Index (SCEP) was employed as analytical tool using time series data set of Food and Agricultural Organisation (FAO) that ranged from 1970-2012. The outcome of the analysis revealed that Nigeria has a high export performance in the exportation of cocoa and groundnut based on their (SCEP) indices. As such, the study recommends that priority should be accorded to the production of these crops so as to increase the quantities of these commodities available for export.
Keywords: Export performance. Competiveness. Performance Index. Agricultural Commodities

INTRODUCTION

Agricultural sector has been the foundation for development in Nigeria through food production and export of its products. According to Boansi (2014), this has influenced both domestic and international markets through forward (product market) and backward (factor market) linkages. This revealed that the agricultural sector still remains one major source of foreign earning, aside the oil sector that has played prominent role in supporting capital development projects. Akpaeti *et al* (2014) opined that prior to the deregulation of the financial sector, Nigerian economy depended solely on agricultural exports. Agriculture was the dominant sector contributing a significant proportion of the Gross Domestic Product in the 1960s. Cash crops such as cocoa, cotton, palm oil, palm kernel, groundnut, rubber and timber were the major export crops in the country.

Following oil discovering in the 1970s, the sector became neglected. Consequently, agricultural GDP fell from 63 percent in the 1970 to 20.6% in 1980 and declined further to 23.3% in 2003 (Central Bank of Nigeria, 2005). This steady decline and instability in the agricultural exports as a result of oil boom in the country has been described by the term "Dutch Disease" by researchers like (Harberger, 1983; Pinto, 1987 and Bakare, 2011). World Bank attributed this decline to the oil shocks of 1973-1979, which gave way to large receipt of foreign exchange and neglect of agriculture in Nigeria (World Bank1989). During this period, Daramola *et al* (2007) reported that agricultural exports were negligible and represented about 0.2% of total exports while an estimate of 6% of Nigerians were employed in the rural sector.

Unquestionably, Nigeria's agricultural exports have been unstable since the discovery of oil in mid 1970s with decline in agricultural output by 24.2%. From 1980, output performances has not only slowed down, but have been highly unstable (World Bank, 1989). This, coupled with the collapse of the Commodity Board affected export commodity prices, distorted macroeconomic and agricultural policies prevailing in the environment and resulted in declining agricultural outputs, dismal export performances thereby rendering Nigeria a net importer of agricultural products (Bakare, 2011, Akpaeti et al., 2014). But to what extent do can export performances be measured so as to ascertain that the agricultural outputs are declining? This brings about the question, what is export performance? Latruffe (2010), defines export performance as the ability to sell products that meet demand requirements (price, quality, quantity) and, at the same time, ensure profits over time that enable the unit under study (nation or firm) to thrive. As a relative measure, the most used index amongst the lot that comes to mind at the mention of export performance is the Balassa index (Balassa, 1965). By its original definition, the Balassa index (RCA – revealed comparative advantage) measures normalized export shares, with respect to exports of the same industry in a group of reference countries. However, definition of the index has been revised and modified such that a plethora of measures now exist (Ferto and Hubbard, 2003).

But the Balassa index was marked with flaws by deviation in the index value observed as the set of countries used as reference changes, thereby making the outcome context and reference specific and sensitive to reference definition such as (i) well susceptible to double counting between pairs of countries (ii) does not measure comparative advantage in the rigorous sense instead reflects comparative advantage based on real factor induced or distortionary induced developments in export shares (Siggel, 2007). To address the flaws in RCA of being sensitive to reference, Volratti (1991) offered three alternative specifications in its stead. These were the relative trade advantage (RTA), logarithm of the relative export advantage (ln(RXA)) and revealed competitiveness (RC). Based on these observations, the RXA which holds the same intuition as the RCA and the ln (RXA) have been used frequently in economic and business literature for assessing export performance in spite of their advantage of being less susceptible to distortions, like the RCA index of Balassa, the RXA and ln (RXA) are less informative on the performance statuses of countries in exports of respective commodities due to the respective narrow bounds.

It is upon these flaws that Boansi (2014) in his study: Comparative Performance of Agricultural Export Trade: During and Post-Agricultural Diversification Project in Ghana proposed a more appropriate technique for effectively assessing export performance. Although the suggested approach was indirectly applied by Ferto and Hubbard (2003), through the use of seven-year mean indices (for 1992-1998) in assessing Revealed Comparative Advantage of Hungary with respect to the EU, the bounds (binary) used were as well very narrow thereby being less informative. Appropriate bounds/thresholds, which are robust to minor improvements in the cardinal measures (index values) were proposed by Boansi (2014). In assessing export performance, this study will make use of that proposed by Boansi (2014), Comparative Export Performance Index (CEP), the Symmetric Comparative Export Performance Index (SCEP) and the logarithmic form of CEP. These indices are almost similar by definitions to the RXA and ln(RX) indices proposed by Vollarth (1991), with the SCEP being asymmetric form of the CEP. Although under different names, by definition, the CEP index and the SCEP have been used in past research works (including Boansi, 2013; Nwachukwu, Agwu, Nwaru and Imonikhe, 2010 and Boansi and Crentsil, 2013). In view of the significant contribution and export capacity of Nigeria in the world market, it is pertinent to analyse the export performance of these commodities. The above formed the major thrust of this paper.

MATERIALS AND METHODS

The study employed time series data on the export of palm oil, palm kernel, cocoa, rubber, cotton and groundnut for Nigeria and the world and were obtained from the database of the Food and Agricultural Organisation (FAO). The values of export were converted from US dollars to Naira, using the exchange rates for respective years. The exchange rates were elicited from Central Bank of Nigeria (CBN) Statistical Bulletin. The Data spanned from 1970 to 2012. In the analysis of the export performance of Nigeria in palm oil, rubber, cocoa, cotton, palm kernel and groundnut trade, the symmetric comparative export performance index (SCEP) as a symmetric measure of comparative export performance (CEP) was used following the method of Boansi, 2014 and stated as follows:

$$CEP = \frac{(X_{jB}/X_B)}{(X_{jA}/X_A)} \qquad (1)$$

Where:

X_{jB} = total value of export of agricultural commodity (j) from Nigeria.

X_B = total value of agricultural exports from Nigeria.

X_{jA} = total value of world exports of agricultural commodity (i).

X_B = total value of world agricultural exports.

The Symmetric Comparative Export Performance index as specified by Boansi (2014) is consequently defined as follows:

$$SCEP = \frac{(CEP - 1)}{(CEP + 1)} \qquad (2)$$

ln (CEP) = log (CEP) (3)

Among these three measures of competitiveness, the SCEP (as asymmetric measure of CEP) is perceived to provide the best picture on performance of a country by setting boundaries between -1 and +1. The closer a given country is to +1, the higher its export performance and vice versa. With a similar intuition as the [RXA and ln(RXA)], values of CEP of at least +1 and ln(CEP) give a clear definition or explanation of the terms) of at least 0 reveals competitive advantage in export.

RESULTS AND DISCUSSION

To analyse the international Competitiveness and Export Performance of Nigeria in palm oil, rubber, cocoa, cotton, palm kernel and groundnut trade, the symmetric comparative export performance index (SCEP) as a symmetric measure of Comparative Export Performance (CEP) is perceived to provide the best picture on performance of a country by setting boundaries between -1 and +1. The closer a given country is to +1, the higher its export performance and vice versa. Therefore, this study made used of the SCEP index instead of CEP index with cocoa (5.810) and groundnut (389.615) values respectively which were above +1. Table 1 reveals that, among the six commodities used in this study, only cocoa (0.706) and groundnut (0.997) indicated high export performance based on their SCEP values, which is closer to +1. From the results, it could be observed that Nigeria is highly competitive in the export of cocoa and groundnut over the period under studied. In the case of cocoa export, this is however not surprising because (Erelu, 2008) reported that at present, the production capacity of cocoa in Nigeria has reached about 385,000 metric tons per annum, an increase of 215,000 metric tons from year 2007 production level. This disposition places Nigeria as the fourth highest cocoa producing nation in the world after Ivory Coast, Indonesia and Ghana, and by implication, Nigeria competes favourably with other frontline producing nations in supplying the world market. This finding supports the finding of Nwachukwu, Agwu, Nwaru and Imonikhe (2010) in a similar study who reported that Nigeria has a high comparative advantage in the exportation of cocoa and, as such, is highly competitive.

In the case of groundnut this could probably be due to the fact that there was an upward trend in the production of groundnut in Nigeria for the period 1970-2008 according to Daramola (2007). This could be the reason why it indicated a high export performance. For the remaining four crops, which indicated low export performance by reason of their SCEP values, it shows that Nigeria has lost its market share for the export of these commodities (palm oil, palm kernel, rubber and cotton) in the world market, which has resulted in weak competitiveness of these commodities. This finding supports the work of Ijirshar (2015). It is worthy to note that Ln (CEP) could not be used to ascertain the export performance of these commodities due to its very large bounds that the values must be at least zero in order for the commodity to be said to have high export performance. From the result in Table 1, it shows that all the commodities have a high export performance which might not be true. This is why the SCEP index is chosen because it gives the best picture of a country with highest export performance by setting boundaries between -1 and +1.

CONCLUSION

The study has revealed that Nigeria has a high export performance in the exportation of cocoa and groundnut and as such is highly competitive. It is therefore absolutely necessary that Nigerian government should give these commodities top priority and farmers should be encouraged to increase their production so as to increase quantities of these commodities available for export. This will help to sustain and even increase export quantity, earn more foreign exchange and strengthen the purchasing power of our currency.

Table 1: Export performance of selected agricultural export commodities (1970-2012)

Commodities	CEP	SCEP	Ln (CEP)
Palm oil	0.048	-0.908	1.357
Rubber	0.480	-0.351	1.067
Cocoa	5.810	0.706	0.628
Cotton	0.131	-0.768	0.906
Palm kernel	0.279	-0.564	1.084
Groundnut	389.615	0.997	1.128

Source: Author's computation with data from FAOSTAT (Agricultural Trade Database)

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EFFECT OF STORAGE CONDITIONS AND PACKAGING MATERIALS ON THE MOISTURE CONTENT OF LOCALLY GROWN CUCUMBER (*CUCUMIS SATIVUS*) IN OWERRI, IMO STATE

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ABSTRACT
Locally grown Cucumber (Cucumis sativus) fruits were evaluated to highlight the benefits of storage conditions and packaging materials on the moisture content, with a view to extending the shelf life and quality. The experiment was carried out in a 3 x 4 factorial arrangement with parent completely randomized design (CRD), using three different storage conditions – wet river sand; refrigeration and the control – ambient condition; and four (4) packaging materials, namely, perforated polyethylene bags, perforated corrugated cartons, perforated plastic containers and the control (no packaging) for three (3) weeks with three (3) replications. After two (2) weeks of storage, fruits stored in corrugated cartons with wet-river sand performed significantly better ($p<0.05$) than the fruits stored with wet river sand in plastic containers (89.990 % and 89.590 % respectively). The least moisture content (85.887 %) was exhibited by fruits stored at ambient temperature in cartons. After three (3) weeks of storage, fruits stored in paper cartons with wet-river sand performed significantly better ($p<0.05$) than the fruits stored with wet river sand in plastic containers with moisture content of 89.193 % and 88.267 % respectively. The least moisture content (83.557 %) was exhibited by fruits stored at ambient temperature without packaging. Fruits stored at ambient atmospheric condition were unmarketable after 14 days of storage as there were serious defects like large yellow patches, wrinkles due to moisture loss, with undesirable off taste. All cucumber fruits stored at refrigeration conditions refrigerated were also unmarketable three (3) weeks of storage as they were frozen and had off taste due to chilling injury. The best marketable cucumbers were those stored in wet river sand in paper cartons. They remained dark green after three (3) weeks of storage, resulting in the best visual appearance of cucumber fruits. The atmosphere modification provided by wet river sand condition resulted in the enhanced and acceptable market quality of the fruits after three (3) weeks of storage.
Keywords: Cucumbers, storage conditions, packaging materials, moisture content

INTRODUCTION

According to Bruhn (1995), eating quality of a fruit or vegetable is a combination of characteristics, attributes and properties that lead to enjoyment in horticulture; while consumers say that appearance and freshness are most important in initial purchase of any horticultural produce. They select products that are the appropriate colour, size and shape with proper firmness and consumers also expect horticultural produce on sale to be safe with desirable taste. Appropriate colour, shape and size are important quality criteria developed from adequate postharvest handling. A characteristic taste is desirable, as it indicates ripeness and reflects eating quality. Scars, scratches mark lower quality rating.

Attitude studies indicate that consumers tend to prefer locally grown produce, both due to perception of higher quality and to support the local economy (Zagory, 1999). Horticultural produce is viewed as a healthy food choice. In each of the last 10 years, 70 % or more consumers responding to Food Marketing Institute's annual survey indicate that they have increased produce consumption to obtain a healthier diet (Bruhn, 1995). Consumers view fruits and vegetables as good sources of vitamin, minerals and fiber; helpful in calorie control a possible cancer preventative.

Kader (1983) pointed out that losses in quantity and quality affect cucumber between harvest and consumption. The magnitude of postharvest losses in fresh cucumber is an estimated 5 to 25% in developing countries, depending upon the cultivar and handling condition. To reduce these losses, producers and handlers must first understand the pre-harvest, biological and environmental factors involved in deterioration; and secondly use the postharvest techniques that delay senescence and maintain the best possible quality.

Fresh cucumbers are living tissues that are subject to continuous change after harvest. While some changes are desirable, most are not. Postharvest changes in fresh cucumber cannot be stopped, but they can be slowed within certain limits. Senescence is the final stage in the development of plant organs, during which a series of irreversible events lead to breakdown and death of the plant cells. Fresh cucumbers are high in water content and are subject to desiccation (wilting, shriveling) and to mechanical injury.

Storage temperature and humidity are most important as they influence the senescent phases of fresh vegetables by regulating the rate of all associated physiological and biochemical processes (Salunkhe and Desai, 1984). The objectives of this study was to evaluate the optimum storage conditions, vis-a viz the packaging materials, for the extension of the shelf-life of locally grown cucumbers.

MATERIALS AND METHODS

Experimental site – Cucumbers (*Cucumis sativus*) were grown from January to April in a sandy loam shallow soil at the Horticultural Farm of Imo State Ministry of Agriculture and Natural Resources Owerri; with a monthly rainfall of 200-270cm per annum, minimum temperature of 21.14°C, maximum temperature of 29.49°C with relative humidity of 89-93% and soil pH was 6.0-7.0.

Agronomic History of Study Area – The soil had unconsolidated parent material within 1m of the soil surface. Formerly cultivated with cassava, the soil was left grass fallow for one year. The soil was treated against nematodes with Furadan 3G after which basal fertilizer application of poultry manure was applied after making the beds. Seeds were sown in well prepared raised beds with width of 100cm at spacing of 50 by 50cm^2. Cucumbers were harvested early in the morning, packed unwashed and transported the same morning to the laboratory.

Cucumbers used in the experiment were manually graded and sized with an average weight, length and diameter of 80.4 g, 136 mm and 29.4mm respectively. The fruits were sorted to eliminate bruised, punctured and damaged ones after which they were washed with clean water and air dried. There were later packaged in perforated polythene bags.

Experimental Design – the experiment was carried out in a 3 x 4 factorial arrangement with parent completely randomized design (CRD), to test the effects of the treatments on the moisture content of cucumber fruits during storage for three (3) weeks with three (3) replications.

2.3 Treatments – the cucumber fruits were subjected to three different storage conditions – wet river sand (temp. 20-25°C; RH. 85 – 90%); refrigeration (temp. 4-5°C; RH. 90 – 95%) and the control (ambient condition – temp. 30 – 35 ^{0}C; RH. 70 – 80 %); using four (4) packaging materials, namely, perforated polyethylene bags, perforated corrugated cartons, perforated plastic containers and the control (no packaging).

2.4 Data Collection – Data on moisture content were collected on a four (4) day interval. Moisture content was determined according to the methods in Abdel-Razek *et al*. (2005), using the formula:

$$\% \text{ Moisture Content} – \frac{\text{Difference in weight x 100}}{\text{Weight of sample}}$$

Analysis of variance (ANOVA) was carried out using Genstat (2000) statistical analysis software. Data interpretation was based on Wahua (1999), where significant differences were observed at 5% level of probability. Least significant difference (LSD) was used to separate and test the means for differences.

RESULTS AND DISCUSSION

Table 1 shows the effect of packaging materials and storage medium on moisture content of cucumber fruits during a three (3) weeks storage period. At the commencement of the storage, there was no significant difference between the storage or packaging materials; neither was there any between the interactions. After one (1) week after storage, fruits stored in paper cartons with wet-river sand performed significantly better ($p<0.05$) with highest moisture content (90.883 %) than fruits stored with polythene in the refrigerator (90.807 %). The least moisture content (88.500 %) was exhibited by fruits stored at ambient temperature with no packaging. After two (2) weeks of storage, fruits stored in paper cartons with wet-river sand performed significantly better ($p<0.05$) than the fruits stored with wet river sand in plastic containers with moisture content of 89.990 % and 89.590 % respectively. The least moisture content (85.887 %) was exhibited by fruits stored at ambient temperature in cartons. After three (3) weeks of storage, fruits stored in paper cartons with wet-river sand performed significantly better ($p<0.05$) than the fruits stored with wet river sand in plastic containers with moisture content of 89.193 % and 88.267 % respectively. The least moisture content (83.557 %) was exhibited by fruits stored at ambient temperature without packaging.

Postharvest practices include the management and control of variables such as temperature and relative humidity, the selection and use of packaging, and the application of such supplementary treatments as fungicides (FAO, 2009). According to El-Ramady *et al*. (2015), all fruit-vegetables, except peas and sweet corn, are susceptible to chilling injury if exposed to temperatures below 5 °C e.g., cantaloupe, lima bean, snap bean, 7.5 °C e.g., pepper, 10 °C such as cucumber, soft-rind squash, eggplant, okra, chayote, or 12.5 °C e.g., tomato, muskmelons other than cantaloupe, pumpkin, hard-rind squash. This explains why the fruits stored in paper cartons with wet-river sand performed significantly better because even though cucumber storage is best in a condition that adopts low temperature and high humidity (Abdul *et al.*, 1999), the average temperature and humidity combination offered by the refrigerator did not favour the storage quality of the cucumber but rather subjected it to chilling injury due to the temperature.

The temperature and humidity combinations offered by the wet river sand in carton ensured that the fruits stored in that condition remained fresh till the third week of storage especially because of the temperature.

The variation observed in moisture contents among the cucumber fruits in different packaging materials and storage media may be due to different humidity regimes provided by these storage media and packaging materials. According to Gorny (2001), due to the high moisture content of cucumber fruits, there is the tendency for large amounts of water loss, wilting, dryness, sensory quality decline and loss in edibility when they are placed in circumstances of relatively low humidity under the action of moisture evaporation. Although Gorny *et al*. (1998) suggested that fresh produce must be kept in a moist atmosphere as low as possible to prevent water loss; the rate of water loss depends on temperature and duration of storage and exposure to lower O_2 and or high CO_2 concentrations.

CONCLUSION

Low temperature reduces the cucumber metabolism and the high humidity keeps the moisture content of cucumber so as to keep the cucumber fresh. It is an important means to maintain the fruit and vegetable quality. Storage medium greatly affected quality of cucumber. However, among the treatments investigated in this work, the best low cost and available postharvest treatment combination for managing cucumber quality was provided by storage in perforated cartons with wet river sand. The fruits subjected to this treatment had good visual appearance, good taste and low moisture loss; they were of high quality and good marketability.

Table 1: Effect of Packaging Materials and Storage Medium on Moisture Content of Cucumber fruits during a three (3) weeks storage period

	Packaging Materials				
Storage Medium	**No Packaging (Control)**	**Carton**	**Plastic**	**Polythene**	**Mean**
At 0 Week After Storage					
Ambient temperature (Control)	91.593	91.593	91.593	91.593	91.593
Refrigerator	91.593	91.593	91.593	91.593	91.593
Wet River Sand	91.593	91.593	91.593	91.593	91.593
Mean	91.593	91.593	91.593	91.593	
LSD $_{(0.05)}$ for S. Med.	NS				
LSD $_{(0.05)}$ for P. Mat	NS				
LSD $_{(0.05)}$ for Interaction	NS				
At 1 Weeks After Storage					
Ambient temperature (Control)	88.500	89.193	88.853	89.247	88.948
Refrigerator	90.253	90.450	90.580	90.807	90.522
Wet River Sand	89.867	90.883	90.567	90.307	90.406
Mean	89.540	90.176	90.000	90.120	
LSD $_{(0.05)}$ for S. Med.	0.2098				
LSD $_{(0.05)}$ for P. Mat	0.2422				
LSD $_{(0.05)}$ for Interaction	0.4195				
At 2 Weeks After Storage					
Ambient temperature	85.947	85.887	86.370	86.033	86.059
Refrigerator	89.347	88.367	87.147	89.007	88.467
Wet River Sand	88.467	89.990	89.590	88.613	89.165
Mean	87.920	88.081	87.702	87.884	
LSD $_{(0.05)}$ for S. Med.	0.1245				
LSD $_{(0.05)}$ for P. Mat	0.1437				
LSD $_{(0.05)}$ for Interaction	0.2490				
At 3 Weeks After Storage					
Ambient temperature (Control)	83.557	84.880	84.787	84.623	84.462
Refrigerator	87.033	86.133	86.440	86.287	86.473
Wet River Sand	86.447	89.193	88.267	87.407	87.828
Mean	85.679	86.736	86.498	86.106	
LSD $_{(0.05)}$ for S. Med.	0.3590				
LSD $_{(0.05)}$ for P. Mat	0.4145				
LSD $_{(0.05)}$ for Interaction	0.7179				

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EFFECT OF VALUE ADDITION ON THE POVERTY PROFILE OF AGRIBUSINESS POULTRY ENTREPRENEURS IN ABIA STATE, NIGERIA

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ABSTRACT
The effect of value addition on the poverty profile of agribusiness poultry entrepreneurs was carried out in Abia state, Nigeria. Abia state consists of three major agricultural zones which are Umuahia, Ohafia and Aba and they were chosen because majority of the entrepreneurs found in these zones are poultry operators. The study adopted multi-stage sampling technique in the collection of data using well-structured questionnaires and 120 (one hundred and twenty) agribusiness poultry operators were studied. Simple descriptive tools, poverty line analysis and t-test were employed in the data analysis. Results from the analysis showed that value addition in the poultry value chain significantly reduced the poverty status of the households. The study recommends that government at all levels should sit up and face the challenge so as to harness the abundant economic potentials of this sector especially in raising the standard of living of the populace through wealth and employment creation.
Keywords: Value addition, poverty profile, agribusiness, poultry entrepreneurs

INTRODUCTION

The problem of poverty has been a long standing issue in Nigeria. This is indicated by the low social status of poor living conditions of the inhabitants. The problem has been made worse over the years by the development pattern which has favored the urban modern sectors to the detriment of the traditional rural sectors (World Bank, 1996).

A recent poverty assessment survey has shown that over 70% of the Nigerian population is living on less than a dollar per day and over 50% are living below the national poverty line. The survey also revealed that poverty is especially higher in rural areas where majority of the population are resident and derive their livelihoods from agriculture (FAO, 2006). The World Bank poverty assessment on Nigeria has shown that the nature of those in poverty can be distinguished by some characteristics such as education, age, gender, employment status of the head of households, household size and the share of food in total expenditure.

In view of this, agriculture remains the best opportunity for the estimated 1.5 to 2 billion people worldwide living in smallholder households to work and trade their way out of poverty. About 85 percent of the world's farms are run by small-scale farmers, whose output supports a population of roughly 2.2 billion people (Singh, 2008). About three quarters of the world's poor (small-scale farmers or producers and wage laborers) are based in rural areas. Study show that growth generated by agriculture is up to four times more effective in reducing poverty than growth in other sectors (Bage, 2008). For example, studies have revealed that the Nigerian livestock resources consist of 13,885,813 Cattle, 34,453,724 Goats, 22,092,602 Sheeps, 3,406,381 Pigs and 104,247,960 Poultry (RIM, 1992). From these figures, poultry is about 58.72 percent of the total livestock production, which indicates the place of poultry sub-sector in the livestock industry. Poultry meat and eggs play a very useful role in bridging the protein gap in Nigeria. They are palatable and generally acceptable. This acceptability cuts across nearly all cultural religion boundaries in Nigeria. The poultry industry plays important roles in the development of Nigerian economy. It is a major source of eggs and meat which have a high nutritional value particularly in the supply of protein. Eggs are also important in the preparation of confectionary and vaccines. The poultry industry also provides employment opportunities for the populace, thereby serving as a source of income to the people. However, the poultry industry in Nigeria, as well as other developing countries of Africa, is continually characterized by low production levels (Okoli, 1991).

The importance of poultry to the national economy cannot be overemphasized, as it has become a popular industry for the small holders that have great contribution to the economy of the country. The profession has assumed greater importance in improving the employment opportunity and animal food production in Nigeria. Recognition of this fact has brought agriculture back into the international development agenda. Linking smallholders with well-functioning local or global markets ranging from local 'street markets' to formal global value chains-plays a critical part in long-term strategies to reduce rural poverty and hunger.

The value addition in agriculture derives from the value chain which encompasses all activities involving agricultural input and production, processing, storage, marketing and distribution, household and industrial consumption and export. All along the chain many problems and constraints persist. Agricultural input constraints include those relating to availability and quality of supply (e.g. land, seed, fertilizer etc). Production problems include those related to scarcity and high cost of inputs, technical production problems (low yield, pest and diseases problems) and unstable agro-climatic conditions that aggravate farmers' production risks. Others include socio-economic problems (low level literacy, pervading poverty and aging farming population).

Among approaches applied in poultry related projects and programs, micro-financing poultry value chain appears to be one of the efficient methods allowing all actors of the chains to perform smoothly and acquire necessary input and technology for their activities (production, business or trading); providing them with necessary financial source for initial investments, or working capital to start or upgrade their production and business; increasing the voice of each actors of the chain, especially the small ones, as well as of the poultry value chain as a whole. It is paid much attention to, not only by the local and national projects, but also by the international ones.

In view of the importance of poverty and the need to analyze the effect of value addition on poverty reduction, this work is set up.

METHODOLOGY

This research work was carried out in Abia state, Nigeria. The state lies between the latitude 50 03ºN to 50 07ºN and longitude 70 17ºE to 70 24ºE and it is located in the tropical rainforest zone of Nigeria. The climate is consistently hot with maxima typically being about 31ºC and minima around 24ºC with evenly distributed rainfall in moderate manner ranging from 2,000mm to 2,500mm annually (World Bank, 2000). The state covers a land area of 5,243.7 square kilometers. It has a total population of 2,845,380 comprising 1,430,298 males and 1,415,082 females (NPC, 2006).

Multistage sampling procedure was adopted in this study. The first stage involved the purposive selection of three local governments (Ikwuano, Bende and Aba-South local government areas) from each of the agricultural zones (Umuahia, Ohafia and Aba) respectively based on their relatively high involvement in poultry and poultry related activities. The second stage involving drawing a list of poultry operators from each of the local governments and followed up by the selection of 40 operators from the same, thus, the sample size of this study is 120 respondents. Simple descriptive statistics, poverty line model and t-test were employed in the data analysis.

The poverty line is given as:

PL = 2/3 * MPCHE………………..…….(1)

PCE = TCE/HHS………………...……....(2)

MPCHE = THHE/TNR……………..…...(3)

Where:

PCE = Per Capita Expenditure

TCE = Total Consumption Expenditure

HHS = Household Size

MPCHE = Mean Per Capita Households Expenditure

TNR = Total Number of Respondents

THHE = Total Households Expenditure

Households whose mean consumption expenditure falls below the poverty line are regarded as being poor while those with their expenditure above the benchmark are non-poor.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Poultry Operators

Table (1) indicated that majority of the poultry operators are more of adults who fall within the age range of 40 years and above, representing 71%. This was followed by those within the age range of 20 - 29 representing 20%. This result indicates that youths' participation in poultry operation is not encouraging possibly due to the ever-growing rural-urban drift leaving agriculture in the hands of the aged few.

Majority of the poultry headed households are males, representing 63% while the remaining 37% are females. The marital status reveals that most of the poultry operators are married. This is shown in the table as 72%. Family size 1 - 5 had the highest representative (71%) indicating that poultry activities would be to a minimum scale. The least was between 11 and above representing only 3% of the entire population. From the result presented above, a greater proportion of 59% of the poultry operators acquired secondary and tertiary education. This implies that due to high education attainment in the state, poultry operation would be efficient and profitable. 63% of the respondents belonged to cooperative societies while the remaining 37% did not belong to any cooperative society. 37% of the respondents had business experience of 6 to 10 years which accounted for the majority. On a general case, it could be said that the respondents are reasonably experienced.

Distribution of Poultry Operators According to their Earnings

Table (2) showed that poultry operators were moderate earners. Majority of the operators earned between ₦41,000 to ₦79,000 representing 38%. This was followed by ₦80,000 to ₦119,000 representing 29%. The least was ₦1,000 to ₦40,000 representing 7%. The implication of this result is that the operators did not earn much indicating that they are low scaled.

Distribution of Respondents According to Capital Investment (Amount Invested)

The distribution of the respondents by the amount of capital initially invested in the poultry value chain business showed that a majority of the respondents representing about 71% invested less than ₦200,000 as startup capital. This was followed by those who invested between ₦200,000 and ₦299,000 representing only 13%. The least was 3% which included poultry operators who invested ₦500,000 and above. This finding shows that poultry operators are small-scaled owing to the amount of investment. This however does not preclude the fact of expanding the business considering the high demand for poultry products in the nation at large.

Analysis of Poverty Status of Poultry and Livestock Farming Households

The poultry value chain operators' households' poverty status in the state were analyzed using the three indicators- Prevalence of Poverty (Po), Poverty Depth (P_1) and Severity of Poverty (P_2). Prevalence of poverty indicates the percentage of the households falling below the poverty line; poverty depth shows the amount by which the poor fall short of the poverty line and severity of poverty is the sum of the square of poverty depth divided by the number of poor households in the sample. The result of the analysis is presented in Table 4. The prevalence of poverty among the farm households in Abia state was (0.4900) representing 49 percent of the poultry households with consumption expenditure level below the poverty line. The poverty depth was 0.0701 representing 7% whose average consumption expenditure was below the poverty line. This gap represents the percentage of expenditure required to bring poor households below the poverty line up to the poverty line. The severity of poverty index was 0.221 which represents the poorest among the poultry value chain 'operator' who require the attention of policy makers in the distribution of the standard of living indicators such as health care services, clean water and income generating activities. This finding contradicts that of Adekoya (2014) who carried a similar work in Ogun state. Prevalence of poverty was accounted for by about 78% of the farm households in comparison with the greater number of farm households which were poorer in Ogun state than in Abia state. This was further buttressed by the poverty depth and severity of poverty in the two areas which stood at 55% and 43% respectively for Ogun state and 7% and 22% respectively for Abia state. This indicates that poverty status in the study area is lower in comparison to other areas of the state, where there are less poor people.

CONCLUSION

The study showed that poultry farmers were moderate earners. Majority of them earned between ₦41,000 and ₦75,000. They also invested an average of ₦200,000 in their businesses showing that they were medium-scaled operators. The study further revealed that about 51% of the poultry operators lived above the poverty line. The results further confirmed that operators who added value to their products had higher and significant incomes in comparison to those who did not add value. From the foregoing, it is clear that value addition in the poultry value chain significantly reduced the poverty status of the households. The study recommends that government at all levels should sit up and face the challenge so as to harness the abundant economic potentials of this sector especially in raising the standard of living of the populace through wealth and employment creation. Availability of credit affected farmers' decision to add value. This is because the operators could not assess credit at affordable rates. Government in this regard should make frantic efforts in ensuring that poultry value chain operators get these credits at reduced costs. This will enhance efficiency as well as break the ravaging vicious cycle of poverty experienced by the operators.

Table 1: Socio-Economic Characteristics of Poultry Operators

Age (Years)	Frequency	Percentage
20 – 29	24	20
30 – 39	10	8
40 – 49	58	48
50 – 59	18	15
60 and above	10	8
Total	**120**	**100**
Female	44	37
Male	76	63
Total	**120**	**100**
Marital Status		
Single	20	17
Married	86	72
Divorced	14	11
Total	**120**	**100**
Household Size		
1 – 5	85	71
6 – 10	31	26
11 and above	4	3
Total	**120**	**100**
Education		
No formal	15	13
Primary	35	29
Secondary	55	46
Tertiary	15	13
Total	**120**	**100**
Cooperative Membership		
Yes	75	63
No	45	37
Total	**120**	**100**
Experience (Years)	**Frequency**	**Percentage**
1 – 5	13	15
6 – 10	33	37
11 – 15	26	29
16 – 20	12	13
21 – 25	6	6
Total	**120**	**100**

Source: Field survey, 2015.

Table 2: Distribution of Poultry Operators According to their Earnings

Household Earning per month	Frequency	Percentage
₦1,000 – 40,000	9	7
₦41,000 – 79,000	45	38
₦80,000 – 119,000	35	29
₦120,000 – 149,000	16	14
₦150,000 and above	15	12
Total	**120**	**100**

Source: Field survey, 2015.

Table 3: Distribution of Respondents According to Capital Investment (Amount Invested)

Amount Invested (₦)	Frequency	Percentage (%)
1,000 – 99,000	55	46
100,000 – 199,000	30	25
200,000 – 290,000	15	13
300,000 – 399,000	10	8
400,000 – 499,000	6	5
500,000 and above	4	3
Total	**120**	**100**

Source: Field survey, 2015.

Table 4: Poverty Gap Status of the Poultry Farm Households

Poverty Indices	Abia State
Prevalence of poverty (P_1)	0.4900
Poverty Depth (P_1)	0.0701
Poverty Severity (P_2)	0.221
Mean household per capita expenditure per month = ₦17,374.46	**Poverty line = ₦12,231.84**

Source: Field Survey Data, 2015.

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ACCEPTABILITY OF WHEAT-SOY BISCUIT BY SCHOOL CHILDREN IN IBARAPA CENTRAL LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

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ABSTRACT
Enriching locally available snacks can be a viable means of alleviating temporary hunger and improving nutrient intake, thus contributing to pupils' learning capacity. this study examined acceptability of formulated snack by school children in ibarapa central local government area, oyo state. the cross sectional study involved a four-stage sampling procedure to select 520 pupils from eight schools in the study area. biscuit was prepared with wheat-soy flour in the ratios of 100:0 (control), 90:10, 80:20, 70:30 for products a, b, c and d, respectively. the snacks were subjected to sensory evaluation tests for acceptability. mean scores for overall acceptability were 4.45±0.948, 4.50±0.945 and 4.40±1.098 for products b, c and d respectively. product c (20% soyflour) with highest score and least variability was considered most acceptable. it is concluded that wheat-soy biscuit is well accepted among school children and is therefore recommended that the developed snack should be commercialized to improve nutrient intake of school children.

INTRODUCTION
Poor nutrition has been variously responsible for absenteeism from school, inattention and poor motor and cognitive development (Van, 2005; Gomez-Pinilla 2008).Under-nutrition is one of the leading causes of childhood morbidity and mortality in many developing countries. It is described as both a cause and consequence of poor human health, development, and achievement across the lifespan (Buhl, 2010; West, *et al.*, 2006). Evidence of high levels of nutritional deprivation among school children has spurred increasing global interest in their nutrition and health (Ndukwu, *et al*., 2013). Fortification of commonly consumed foods is one of nutritional intervention needed to improve micronutrient status. Biscuits are a rich source of nutrients produced off-site that is easy to pack, store, and transport. They can be served as a breakfast particularly in full-day schools, in which case they are given early in the day to alleviate short-term hunger. (Bundy, et al 2009) They are cheaper and easier to distribute than meals, and often aim to act as an incentive for increased school access, but they are less substantial and their financial value to families is lower.
The **soybean** (*Glycine max*) is a species of legume widely grown for its edible bean which has numerous uses. Fat-free (defatted) soybean meal is a significant and cheap source of protein for animal feeds and many pre-packaged meals; Soybeans produce significantly more protein per acre than most other uses of land and soybeans contain significant amounts of phytic acid, alpha-linolenic acid, and isoflavones, Soy flours are products obtained by finely grinding full-fat dehulled soybeans or defatted flakes made from dehulled soybeans. To be called soy flour, at least 97% of the product must pass through a 100-mesh standard screen.

METHODOLOGY
The study was carried out among school children in predominantly rural Ibarapa Central Local Government Area of Oyo state having its headquarters at Igbo-Ora. There are two main towns in Ibarapa Central Local Government namely Igboora and Idere consisting of ten wards. The age group of children studied was 6-12 years (being the ages of children in primary classes 1-6). The study was carried out in one school-term.
The sampling frame for this study comprised of eight schools selected from the four Local educational zones using systematic sampling technique wherein the first and seventh schools on the list provided by the LGEA were chosen for further sampling and treatments.

Product Development
Nutrient-dense biscuits were produced using rubbing-in method. The biscuits were prepared from the blend of full fat soy flour at 0, 10, 20 and 30% substituted for refined wheat flour that is 100, 90, 80, 70% refined wheat flour. The process for production of nutrient-dense Snack (biscuits) consisted of rubbing-in 150 ml vegetable oil into 1000g of flour with 0.05g salt, 35.16g baking powder, 25g sugar, 20g cocoa powder. All dried ingredients were mixed together, vegetable oil was rubbed into the flour and six eggs beaten well with 200ml water were added. All ingredients were weighed accurately by weighing balance and mixed, kneaded and rolled out into uniform sheet 1/2cm thickness and cut into round shapes with a properly shaped cutter. They were later arranged on greased trays and baked at 170 - 180^{0}C.

Determination of Acceptability of Snack Using Sensory Evaluation
In order to determine the acceptability of the new product, it was necessary to conduct a sensory evaluation using the organs of the body for taste, smell, touch and sight to evaluate the perception of respondents. (Reau

2011).The product was produced and served to the school children who form the panel of evaluators across their tiers and age groups. The choices of the pupils were depicted by "smileys" (i.e. the face scale) which is a form of hedonic scale. The designed smiley was a 5-point hedonic scale wherein the extent of acceptability is graduated in terms of liking and not liking the products.

DISCUSSION OF RESULTS

The results of the organoleptic tests showed that the Colour of Sample C (having 20% of soy flour) with a mean score of 4.73 was highest of the treatments; followed by Sample B (having 10% soy flour) with a mean score of 4.72; and lastly, Sample D (having 30% soy flour) with a mean score of 4.71. For taste, sample C had the highest value among the treatments with a mean score of 4.52; followed by Sample D with mean score of 4.49; and lastly, Sample B with a mean score of 4.48. All these samples scored lower than the control, which had a mean score of 4.60.

The Texture of sample D had the highest mean score of 4.484 which was even higher than that of the control, with a mean score of 4.48. This was followed by Sample C having a mean score of 4.48. Lastly, the mean score of Sample B was 4.41. The Aroma of Sample B had the highest mean score in the experiment group with a mean score of 4.46; followed by Sample C with a mean score of 4.45; and lastly, Sample D with a mean score of 4.41. All these treatments scored lower than the Control with a mean score of 4.49. The Appearance of Sample C had the highest score among the treatment group with a mean score of 4.45; followed by Sample D with a mean score of 4.4; and lastly, Sample B with a score of 4.36. The Control had the highest score of 4.47.

For overall acceptability, Sample C was highest with a mean score of 4.5; then sample B with a mean score of 4.45; and lastly, Sample D with a mean score of 4.40. Thus, in all Sample C (20% soy flour) emerges the most acceptable of the three enrichments. For Overall Acceptability, Sample C has the least standard error and shortest range with its convergence around the option "like a lot." It can then be safely concluded that sample C had the most Overall Acceptability.

CONCLUSION

This study concludes that under-nutrition and food insecurity was prevalent among the school children in Ibarapa Central Local Government of Oyo State, Nigeria and that biscuit is the most frequently consumed snack. Therefore biscuits were formulated and developed using locally produced food commodities wheat and soy flour at a ratio 100:0, 90:10, 80:20, 70:30 respectively The developed products were acceptable to the pupils in terms of the sensory features of taste, colour, texture, aroma and appearance. In terms of relativity, Product C ranked first in evaluating consumer acceptance of products taste, third in colour, second in texture, first in aroma and third in appearance. The overall acceptability indicated that Product C, having 20% soyflour improvement ranked first. Thus, it was considered the most acceptable

Table 1: Survey Summary

S/No	Schools	No. of Questionnaire Distributed	No. of Questionnaire Returned	Percentage Returned
1	Roman Catholic Mission School II, Igboora	75	73	97.33
2	Baptist School II, Pako	62	62	100.00
3	Methodist School I, Oke Agogo	65	61	93.85
4	Nawarudeen United Demonstration School I, Igboora	102	99	97.06
5	Nawarudeen United Demonstration School II, Oke Odo	53	52	98.11
6	Isale Oba Community Primary School Igboora	82	80	97.56
7	Baptist School, Idere	43	43	100.00
8	Islamic School I Idere	38	38	100.00
	Total	**520**	**508**	**97.69**

Sensory Evaluation (Descriptive Mean Scores)

Table 2:

SAMPLE	COLOUR	TASTE	TEXTURE	AROMA	APPEARANCE	ACCEPTABILITY
A	4.77	4.60	4.48	4.45	4.47	4.59
B	4.73	4.48	4.41	4.46	4.36	4.45±0.95
C	4.73	4.52	4.47	4.45	4.45	4.50±0.94
D	4.71	4.49	4.48	4.41	4.40	4.40±1.09

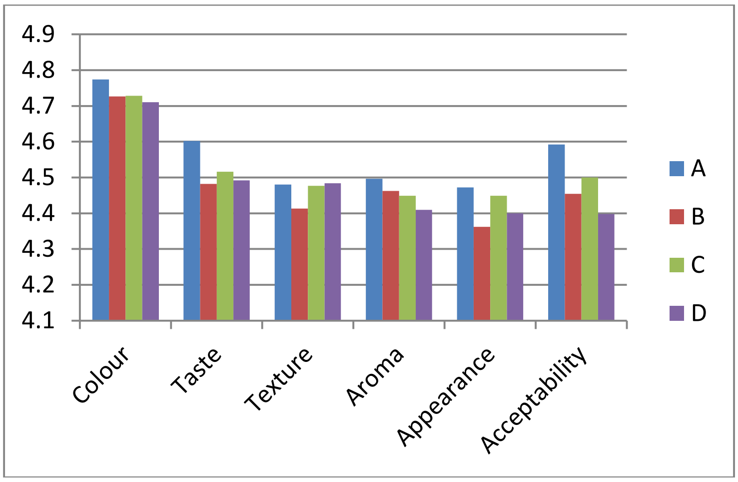

Figure 1: Organoleptic Test Results

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SWOT ANALYSIS OF CASSAVA VALUE CHAIN IN SOUTH EASTERN NIGERIA

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ABSTRACT
The Presidential Initiative on Cassava, launched in Nigeria in 2003, brought cassava and its potential to the national limelight. The Initiative had as its goal the promotion of cassava as a viable foreign exchange earner and also the development of the production system to sustain the national demand. The Presidential Initiative focused its intervention on the development of production, processing, and marketing of the processed products. The study was designed to analyze the Strength, Weakness. Opportunities and Threats of cassava value chain in Anambra and Imo states. The study was purposively carried out in Anambra and Imo States based on the intensity of cassava production in the south east zone of Nigeria. Two local government areas (LGAs) and 30 respondents were selected from each of the LGAs, making it a total of 120 respondents comprising of producers, processors and marketers. Primary and secondary data were used for the study. Information was derived from secondary data and respondents using focused group discussion and interview schedule Data were analyzed descriptively and by SWOT analyses. The result of the SWOT Analysis depicted that cassava production has increased over the years due to technological advances in research but processed products are of inferior quality due to inefficient processing equipment. Diversification of cassava utilization has encouraged the development of cassava value chain and lack of mechanization contributed to drudgery in cassava production and increased utilization of labor.
Key intervention areas will involve provision and execution of adequate policy on quality of raw material and finished products and then provision of infrastructural facilities in order to promote cassava value chain development in the study area.

INTRODUCTION
Nigeria is the largest production of cassava in the world with an estimated annual production of about 54 million metric tons (FAOSTAT, 2013). About 90% of this is however consumed as food in form of garri, lafun and fufu and also 70% of cassava produced in Nigeria is processed into garri (Onabalu, 1997).Across the country, cassava production has witnessed a tremendous increase for different reasons mainly due to introduction of high-yielding and disease-resistant varieties among other factors This increase in production between 2004 and 2006 came about as a result of the interventions of the Nigerian Government and some developmental agencies. The Nigerian Government facilitated the development of new disease-resistant cassava varieties by the joint efforts of International Institute of Tropical Agriculture (IITA), National Root Crops Research Institute (NRCRI), Root and Tuber Expansion Program (RTEP), and the Federal Ministry of Agriculture, in conjunction with State Agricultural Development Programs and cassava farmers. (Sanni *et al*, 2009) The Presidential Initiative on Cassava, launched in Nigeria in 2003, brought cassava and its potential to the national limelight (Sanogo and Adetunji 2008). The Initiative had as its goal the promotion of cassava as a viable foreign exchange earner and also the development of the production system to sustain the national demand. The Presidential Initiative focused its intervention on the development of production, processing, and marketing of the processed products. The cassava market in Nigeria can be classified into two broad categories based on the nature of demand namely: the traditional food-oriented market and the industrial market. The former refers to the demand for food consumption by individuals and households while the latter is the demand for cassava for industrial purposes (Knipscheer, et al, 2007).There is increasing demand for cassava product due to rapid population increase, high rate of urbanization and increased use of cassava products in the livestock, confectionery and starch industries. A value chain process involves all the activities that are undertaken in transforming raw materials into a product that is sold and consumed (Vermeuleu *et al.*, 2008).According to World Bank (2007) ,Value chain analysis (VCA) can be defined as a method of accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users Value chain activities include direct functions of primary production, collection, processing, wholesaling and retailing as well as the support functions. In value chain system, value is added at each point in the chain .Ananmbra and Imo states produce cassava in large quantity. In-depth value chain study in the states is scanty; the study assessed the Strengths, Weakness, Opportunities and Threats of cassava value chain in the two states.

METHODOLOGY
A purposive multistage sampling technique was used in selecting states and respondents. Two states Anambra and Imo states were chosen from the five states in south eastern Nigeria based on intensity of cassava production. Two Local Government Areas were selected from each state, Awka North and Oyi for Anambra state, Ohaji

Egbema and Owerri North for Imo State respectively.30 respondents were selected from each LGA making a total of 120 respondents comprising producers, processors and marketers. Information was derived from secondary data and respondents using focused group discussion and interview schedule Data were analyzed using SWOT analyses.

DISCUSSIONS

STRENGTHS

- Available land area:
  There are available land areas for cassava production
- Adaptability:
  Cassava can adapt to different soil conditions.
- Climate:
  Conducive climatic condition leads to increased cassava production.
- Demand:
  High demand for cassava products for domestic and international markest.
- High yielding varieties:
  High yielding varieties which are early maturing and disease resistant increase output.
- Human resources:
  Over 70% of the Nigerian populace is involved in one form of agriculture or another in the rural areas
- Research and development:
  Specialists in cassava production, courtesy of NRCRI and IITA.
- Staple:
  Cassava is the staple food of most people in the study area. It can be eaten in different forms-gari, fufu, etc
- Available local resources for appropriate technology:
  Local materials are used in fabricating equipment for cassava processing.

WEAKNESS

- Fragmentation of land:
  Subsistence farming is practiced due to land tenure system that gave rise to fragmentation of land.
- Non-mechanization
  Apart from tractors that are used in farming, most operations in the farm are carried out manually and this makes farming to be strenuous and laborious resulting to low and inferior output.
- Poor infrastructural facilities:
  Poor access roads, inadequate stall and power supply hampers value chain development. Energy cost is very high and unstable
- High cost of input/ raw materials:
  Agricultural inputs are costly and when available are untimely supplied. Costs of raw materials are equally high due to poor delivery systems such as poor networks and high transportation costs.
- Inefficient market information:
  A wide gap exists between the farmers, processors and end users across the value chain. Farmers are not able to get adequate information regarding supply by the processors and vice versa. This situation results to either glut or scarcity due to imbalance between demand and supply across the value chain.
- Lack of commitment and sustainability:
  Most of the processors are not duly committed to the work. Some are on part time basis. They are usually engaged in one other work or another. This leads to decline in processing activities and eventually closure of factory.

OPPORTUNITIES:

- Development of Human Resources/ Employment
  Restive youths are skillfully developed and some other rural dwellers are employed across the value chain.
- Availability of research institute, NRCRI, is an asset for all agricultural development projects in the south east of the country.
- Production of food
  Cassava is the main staple for people in the zone and as such to makes food available to them.
- Diversification of cassava.
  Cassava can be used for different purposes such as food and industrial raw material

- Increased output
  Due to research intervention there are high yielding varieties.
- Government policy.
  Government policy of cassava initiative and 10% inclusion of cassava flour for bakery products are advantageous in increasing cassava demand.
- Urbanization
  Increased urbanization has resulted to increased demand for cassava value added products
- Collaboration and donor Agencies in cassava projects:
  This has resulted to several cassava investments.

THREATS

- Competitiveness:
  There is need to strive to compete favourably with other cassava producing zones.
- Unstable government policies:
  This thwarts the efforts of industrialists
- Need to meet domestic and industrial demand:
  Due to diversified use of cassava, the demand has increased.
- Drudgery:
  Due to non-mechanization of agricultural activities, manual labour is used and thus makes work laborious and strenuous.
- Misplacement of identity
  Most farmers are not recognized. Farmers association hsas been hijacked by politicians who described themselves as farmers.
- Poor quality products:
  Most of the agricultural products are poor in quality and thus command low market prices
- Inadequate market information:
  It leads to glut and distressed sales.
- Increased population.
  Most available lands for agriculture are used for residential building.

CONCLUSION

The study analyzed the Strength, Weakness. Opportunities and Threats of cassava value chain in Anambra and Imo states. The result of the SWOT Analysis depicted that cassava production has increased over the years due to technological advances in research but processed products are of inferior quality due to inefficient processing equipment. Diversification of cassava utilization has encouraged the development of cassava value chain and lack of mechanization contributed to drudgery in cassava production and increased utilization of labor. Key intervention areas will involve provision and execution of adequate policy on quality of raw material and finished products and then provision of infrastructural facilities in order to promote cassava value chain development in the study area

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EFFECT OF COCOYAM VALUE ADDITION TECHQUES ON THE LIVING CONDITION OF RURAL WOMEN IN OHAFIA AGRICULTURAL ZONE, ABIA STATE

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ABSTRACT
The study assessed the effect of cocoyam value addition techniques on the living condition of rural women in Ohafia agricultural zone, abia state, Nigeria. A well structured questionnaire was used to collect data from one hundred and twenty women beneficiaries of cocoyam value addition techniques in the study area. Simple random sampling was used to select 120 women beneficiaries of cocoyam training programme. Simple descriptive statistics such as mean, tables, percentages etc and student Z-test was used to analyze the data. Result showed that there is a significant effect of the training programme on the general living condition of the rural women after the training. The mean income of the respondents before the training programme was ₦9, 073. 63 and after the training programme the mean income of the respondents increased to ₦21, 930.00 implying a significant effect of the training programme on the income of the respondents. Based on the findings, government should increase the fund allocation to the National Root Crops Research Institute, Umudike for expansion of the Cocoyam Value Addition Manpower Training Programmne, increased food production and sustainability.
Keyword: cocoyam, training, programme, value addition, techniques

INTRODUCTION
Nigeria is the world's largest producer of cocoyam (FAO, 2006). The average production figure for Nigeria is 5,068,000mt which accounts for about 37% of total world output of cocoyam (FAO, 2007). Cocoyam (Xanthosoma and colocasia spp) is an important staple crop cultivated in the southern part of Nigeria (Ojiako *et al*., 2007). Being an important food security crop in Nigeria, it is variously grown by resource poor farmers, mostly women who intercrop cocoyam with yam, maize, plantain, banana, vegetables and rice (Ikwelle *et al.*, 2003). Colocasia esculenta otherwise known as taro is more popular than xanthosoma sagittaifolium, otherwise known as tannia. Cocoyam is not only used as source of food for man, industrially, cocoyam is used for production of alcohol, medicines, flour, starch and feed for livestock (Eke and Oti, 2005).
Despite the economic importance of cocoyam, its potentials have not only been overlooked but also under exploited. In order to enhance the production and consumption of cocoyam in Nigeria, the National Root Crop Research Institute (NRCRI) Umudike, Abia State, Nigeria developed nine cocoyam cultivars. They include: NX5001, NX5OO2, NX5003, NX5004, NCE002, NCE 003, NCE 004, NCE 005, and NCE 006 (Mbanaso *et al*., 2008). Enhancing the production and consumption of cocoyam will help fight food insecurity in the country. There is worsening food insecurity, even with massive food importation as evidenced by rising food import bill (Okoye, *et al.,* 2008). The National Root Crops research Institute; Umudike has had several trainings on cocoyam value addition to enhance the production and consumption of cocoyam in Abia State.
Cocoyam can be processed into several forms such as flour for soup thickening is a common practice in the food systems of South-Eastern households. Presently, the flour is finding its way into the supermarkets in beautiful packages as an emerging globalized food. It can also be consumed as chips prepared by deep fat frying like the popular potato chips. Cocoyam chips are so much delighted by children and youths as school snacks & take away. Similarly, several confectionaries such as biscuits, chin chin, flakes and balls have been produced from flours of cocoyam through various value addition technologies developed by NRCRI Umudike, Nigeria. By so doing, the consumption of cocoyam has been diversified and increased while new market frontiers are being opened. This paper therefore seeks to take a critical look at the effect of cocoyam value addition techniques on the livelihood activities of rural women in Ohafia Agricultural zone, Abia State, Nigeria.

METHODOLOGY
The study was carried out in Ohafia Agricultural zone. Ohafia agricultural zone is located in the northern part of Abia State and is made up of five locations government areas namely Arochukwu, Bende, Isuikwuato, Uzuakoli and Umunneochi. Ohafia zone was chosen for this study because it has vast and fertile land for cocoyam production. Politically, it is referred to as Abia North Senatorial zone. The zone shares a common boundary with Enugu and Ebonyi States in the north, Akwa Ibom and Cross River Sates in the east, Anambra and Imo States in the West and Umuahia Agricultural zone in the south. Ohafia Agricultural Zone is made up of five blocks namely; Arochukwu, Bende, Isuikwuato, Uzuakoli and Umunneochi. All the five blocks were purposively selected because the five blocks (Arochukwu, Bende, Isuikwuato, Uzuakoli and Umunneochi) are the major

cocoyam producing blocks in the Zone under study. From the ADP Extension Agent supervising each of the selected blocks, the list of trained women cocoyam farmers was obtained. Twenty four (24) women cocoyam value addition trainees were randomly selected from each Block making a total of 120 respondents for the study. Primary data were used for the data. A well structured questionnaire was used to collect data from 120 respondents in the study area. Both descriptive and inferential statistics were used for the study.

RESULTS AND DISCUSSION

General Living Standard

Type of Housing

From Table 1, it could was observed that before the intervention, 17% of the respondents lived in single detached room, 23% of them lived in room and parlor, 28% lived in flat with water closet and 32% of them lived in flat without water closet while after the intervention, it was observed that 13% of the respondents lived in single detached room, 21% of them lived in room and parlor, 31% lived in flat with water closet and 35% lived in flat without water closet. It is glaring that there was a clear distinction between the trainee's general standard of living in terms of housing before the intervention and the type of house they were occupying after the intervention. The simple reason being that the intervention has been well entrenched as to influence the type of house they would want to live in.

Types of Building Materials

Furthermore, 48% of the respondents lived in mud building with zinc roof while before the intervention while the percentage reduced to 20% after the intervention. While 22% of the respondents lived in block houses with zinc roof before the intervention and after the intervention the percentage increased to 55%.

Toilet facilities

The result showed that after the training, there was a reduction in the percentage of the trainees who defecated in the bushes from 27% to 17%. Those who used bucket type reduced from 15% to 14%. The reduction in the percentage of the users of bucket type and those who defecated in the bushes brought an increase in the percentage of the respondents who used pit toilets and water system from 34% to 39% and 40 % to 45% respectively. This indicated that there is an improvement and clear difference in the respondents' general living standard.

Sources of Drinking Water

As an important measure of standard of living, source of drinking water was assessed. About 25% of the trainees get drinking water from tap water before the training, while the number increased to 33% after the training. Also, there was an increase in the number of the respondents who use bore-hole from 34% to 48%. The use of well and stream/spring water was drastically reduced. There is obviously marked difference between the trainees' source of drinking water both before and after the training.

Health Service Provider

It was observed that the majority of the respondents (47% as against 33%) received medical treatments from the Clinic/Hospital/Health Centre, followed by healing through prayers by their Churches which recorded 18% as against 8% before the training. There was drastic percentage reduction in patronizing itinerant drug sellers from 17% to 4%, and consulting the traditional healers by the trainees from 17% to 5%, to attend to their health needs. Hence there was positive change observed between the trainee's health service provider before and after the NRCRI Extension Staff cocoyam value addition training programme.

Source of Lighting

Majority (46% and 35%) of the trainees have electricity and kerosene lamps as their source of lighting after the intervention respectively. This implies that the intervention influenced the living standard of the trainees since the trainee's living standards registered a remarkable improvement.

Effect of the cocoyam training programme on the Income Level of Trainees before and after the Programme

In assessing the effect of the cocoyam value addition training programme on the income of the trainees before and after the training the paired z-test was used. From Table 2, the mean income of the trainees (After) was ₦21, 930.00 while the trainees income (Before) was ₦9, 073.67 with a paired mean of N12, 856.33. This implies that the incomes of the trainees after the NRCRI Extension training on value addition are higher than their incomes before the training. Given that the variables were significant at 1% level of probability, it shows that there is a significant difference in the incomes of the respondents after the training programme. It could be inferred that the intervention impacted positively on the incomes of the trainees. This approach has been employed successfully by Ezeh (2004) and Nwachukwu (2009).

CONCLUSION

There mean income of the trainees after the training was ₦21, 930.00 while the trainee's income before the training was ₦9, 073.67, with a paired mean of N12, 856.33. This implies that the incomes of the trainees after the NRCRI Extension Staff manpower training on value addition are higher than their incomes before the training. Given that the variables were significant at 1% level of probability, it shows that there is significant difference between their incomes.Finally, it could be inferred that the intervention impacted positively on the incomes of the trainees after their training.

Table 1: Distribution of Respondents According to their General Living Standard (n = 120)

	Trainee (Before Intervention)		**Trainee (After Intervention)**	
Variables	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Type of housing				
Single Detached Room	20	17.00	16	13.00
Room and Parlor	28	23.00	26	21.00
Flat with water closet	34	28.00	36	31.00*
Flat without water closet	38	32.00	42	35.00*
Type of Building Material				
Mud with thatched roof	34	28.00	20	17.00
Mud with zinc roof	48	40.00	24	20.00*
Block with thatched roof	12	10.00	10	8.00
Block with zinc roof	26	22.00	66	55.00*
Toilet Facilities				
Water cistern	40	34.00	45	37.00*
Pit Toilet	34	28.00	39	32.00*
Bucket Type	18	15.00	16	14.00
Bare ground/Bush	28	23.00	20	17.00
Source of Drinking water				
Tap water	30	25.00	42	33.00*
Bore hole	40	34.00	48	40.00*
Well	48	40.00	24	20.00
Stream/spring	2	1.00	6	5.00
Health Service provider				
Clinic/ Hospital/ Health Centre	40	33.00	56	47.00*
Patent medicine dealer/chemist shop	32	26.00	35	29.00
Traditional healers	20	17.00	6	5.00*
Church	8	7.00	18	15.00*
Itinerant Drug sellers	20	17.00	5	4.00*
Source of Lighting				
Electricity	50	42.00	42	35.00
Kerosene Lamp	42	35.00	40	33.00
Candle	10	8.00	8	7.00
Oil Lamp	18	15.00	30	25.00*

Source: Field Survey (2010).

Table 2: Paired Samples Test on the effect of cocoyam value addition training programme on the Income of the beneficiaries before and after (n = 120)

Variables	**Mean**	**Paired Mean**	**95% Confidence Interval of the Difference**		**t-test**
			Lower	**Upper**	
Trainees' Income After the Intervention	21,930.00	12,856.33	9,771.02	15,941.64	8.338***
Trainees' Income Before the Intervention	9,073.67				

Source: Computed from Field Survey (2010)

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FACTORS INFLUENCING INCOME LEVEL OF BENEFICIARIES OF COCOYAM VALUE ADDITION TRAINING PROGRAMME BY NATIONAL ROOT CROP RESEARCH INSTITUTE, UMUDIKE IN ABIA STATE

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ABSTRACT
The study examined the factors influencing the level of income of beneficiaries of cocoyam value addition training programme by the National Root Crops Research Institute, Umudike in Ohafia Agricultural zone of Abia State, Nigeria. Primary data were collected using a well structured questionnaire which was administered on 120 respondents that were selected randomly from the list of cocoyam value addition trainees collected from ADP. Result showed that 36% of the respondents were within the age bracket of 46-55 years, 36% of them attended secondary education, 58% of them were full time farmers, 67% of them had income ranging from N50,000-69,999, 60% of them had farming experience ranging from 21-30 years and 88% of them were married. The result of the regression result showed that double-log function was chosen as the lead equation having satisfied most of the apriori expectations. Age, educational level, household size, cooperative membership and frequency of visit were the factors affecting the income level of beneficiaries in the study area. It was therefore recommended farmers should be encouraged to get basic education as this will enhance the productivity of the farmer, thereby increasing their income level.

INTRODUCTION
Cocoyam (*colocasia* and *xanthosoma* spp) is an indispensable root crop which constitutes the major staple foods of some 60 per cent of Nigerians (Oji, 1983). It plays a crucial role in the sociological, nutritional and economic development of the country (Eke-Okoro *et al.*, 2004). Cocoa yam has been in existence in Nigeria for many decades, farmers have not been enjoying good pricing of the crop. This was because people regard cocoyam as poor man's food, and there was little or no processing of this crop to make it valuable. Hence, farmer's earnings were not commensurate with the efforts they put in cocoyam production. In an effort to guide against poor earnings and encourage people to eat cocoyam, the present administration in Nigerian came up with "Cocoyam Rebirth Programme". The purpose of which is to promote the new and improved forms of processing and utilization of cocoyam for sustainable food production, income generation, increased source of medicine for diabetic patients and possible foreign exchange earnings in the country (Aniedu, 2004).

Cocoyam (*colocasia* and *xanthosoma* spp) is consumed in different forms. Cocoyam can be consumed fresh as tuber after cooking; used as soup thickener, processed into "*Achicha*", pounded as fufu, roasted in fire, and can also be fried into chips. Cocoyam has different varieties. For example, the *Colocasia Spp* is used mainly for "*Achicha"* and as soup thickener, while other *SPP's* are used, cooked pounded and roasted (NRCRI, 2004). Cocoyam varieties are rich in vitamins and may be used also as cash crop, snacks; feed for livestock or as industrial crop for production of alcohol and medicines. They are good source of carbohydrates for diabetic patients and convalescents, and fortified food for infants (Imoh 2002). Even though the nutritional quality of cocoyam compares favorably with other root crops, the status of cocoyam in its use at home is quite low. The reason for this low status range from cultural bias to the prejudice is that cultivation of cocoyam is seen as a woman's job, (NRCRI, 2010).

With this tuber crop (cocoyam) as part of the mandate crop of National Root Crops Research Institute (NRCRI), Umudike, Nigeria has become the largest producer of cocoyam in the world, and accounted for an annual production of about 587 thousand metric tonnes (FAO, 2010). The nutritional, sociological and economic relevance of cocoyam to both man and livestock cannot be overemphasized.

National Root Crop Research Institute (NRCRI), Umudike recently developed several cocoyam value added technologies aimed at addressing the high perishability of cocoyam tuber (or corms & cormels) as well as diversifying the use of cocoyam. These technologies make it possible for an array of secondary products like Bread, Biscuit Cake, Chin-Chin, Doughnut, Chips, Salad cream etc. to be derived from cocoyam flour (NRCRI News Bulletin, 2006).

Furthermore, through various processing and utilization techniques alternative uses of cocoyam have resulted in the emergence of wide array of food recipes through value addition. Thus all practices involved in diversifying the processing and utilization of cocoyam roots are termed value adding technologies. According to Aniedu (2004) these emerged as a result of rising demand for making cocoyam products available in more widely and readily usable forms. This study was therefore to examine the effect of cocoyam value addition training programme on the livelihood activities of the beneficiaries.

METHODOLOGY

The study was conducted in Abia state of Nigeria. Abia is a state in the south eastern part of Nigeria. The capital is Umuahia and the major commercial city is Aba. The commercial hub, Aba was formerly a British colonial government outpost in the region. Abia state was created in 1991 from part of Imo State. It is one of the constituent states of the Niger Delta region (Hoiberg, 2010). Abia State, which occupies about 5,834 square kilometers, is bounded on the north and northeast by the states of Anambra, Enugu, and Ebonyi. To the west of Abia is Imo State, to the east and southeast are Cross River State and Akwa Ibom State, and to the south is Rivers State. Farming in the state is determined by the seasonal distribution of rainfall. The main food crops grown are yam, cassava, rice, cocoyam and maize while the cash crops include oil-palm, rubber, cocoa, banana and various types of fruits.

There are three agricultural zones in Abia State; Ohaofia, Aba and Umuahia agricultural zones. Ohaofia agricultural zone was purposively selected because of the it is a major cocoyam producing zone in the state. Two out of five blocks in Ohafia Agricultural Zone, namely Arochukwu and Bende were purposively selected because of their involvement in cocoyam production. From the ADP Extension Agent supervising each of the selected blocks, the list of trained cocoyam farmers was obtained. Sixty (60) cocoyam value addition trainees were randomly selected from each Block making a total of one hundred and twenty respondents for the study.

ANALYTICAL TECHNIQUES

The analytical tools used were descriptive statistics such as mean, frequency, tables and percentages and multiple regression models. The models are specified as follows;

In implicit form, the model is specified as

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6,)$………………………………………………….. (1)

Where;

Y = income of beneficiaries (₦)

X_1 = Age (years)

X_2 = Sex or gender (male=1, female=0)

X_3 = Years of formal education (years)

X_4 = Family size (Number of persons in a household)

X_5 = Frequency of contact by extension agents (Regular= 1, Not regular=O)

X_6 = Income level (₦)

U = error term

RESULTS AND DISCUSSION

Socio-economic Characteristics

The result in table 1 showed that 36% of the beneficiaries were within the age bracket of 46-55 years. This implies that majority of the respondents belong to the middle-aged group and are known for their physical ability, productiveness and mental alertness in learning new technologies than older farmers (Agwu, 2004). Majority (36%) of the respondents attended secondary education. According to Okoye *et al.*, (2009), educated farmers are expected to be more receptive to improved techniques while farmers with little or no education are less receptive to improved technologies. About 58% of the beneficiaries were full time farmers. This is not surprising because full-time farmers tend to be less amenable to income diversification than their part-time counterparts. Majority (60%) of the respondents had farm sizes of 9-12 persons. This is in line with the perception of Sabo, (2006) who posited that large family size necessitated respondents to learn new technologies for increasing their returns, to sustain their families. About 67% of the respondents had income ranging from N50, 000- N69, 999, 60% of them had farming experience ranging from 21-30 years. Obinne (1991) observed that experience is a major factor in the adoption of technologies and should serve as an advantage for increased investment and technology utilization. Majority (88%) of the respondents were married. This implied that majority of the beneficiaries were married. This must have been necessitated based on the need to argument family incomes in addition to their traditional roles in the family as mothers and home makers.

Factors influencing the Income Level of the Beneficiaries of Cocoyam Value Addition Training

To analyze the factors influencing the income level of beneficiaries of cocoyam value addition training, multiple regression models were estimated. The four functional forms functional forms of the regression models were tried and the lead equation was selected based on statistical and econometric criteria such as number and signs of significant variables, their conformity with a prior expectation, magnitude of R^2 and F-ratio. The result is presented in Table 2. The double-log function was chosen as the lead equation because of the number and levels of significant variables. The result showed that age, educational level, family size, membership of cooperative and frequency of contact were the significant factors influencing the income level of the beneficiaries of cocoyam value addition training of the NRCRI. Household size, membership of cooperative and frequency of contact was significant at 1% level of probability and were all positively related to the income level of the beneficiaries of the cocoyam value addition training in the study area. Age was significant at 10% level and was negatively related to the income level of the beneficiaries. Educational level of the respondents was significant at 5% level and was positively related to the income level of the beneficiaries. Age of the respondents was negatively related to the income level of the respondents, this implies that the older the beneficiaries in age, the lower the income level of the beneficiaries. This is in consonance with the findings of Odoemenem and Obinne (2010) who found that older farmers are less willing to try new innovations or take risk. Educational level of the respondents was positively related to the income level of beneficiaries in the study area. This implies that the higher the educational level of the beneficiaries, the higher their income level. The result further implied that farmers that participated in the training programme had good educational qualification.

Family size was positively related to the income level of the beneficiaries. The result implies that beneficiaries with reasonable household size could hire less labour and make use of family labour which will not attract much cost in the production of cocoyam value addition products; this will in turn increase the income level of the beneficiaries. Membership of cooperative and frequency of visit by the extension agents were positively related to the income level of the beneficiaries. This implies that being a member of a cooperative will increase the income level of the beneficiaries and frequency of visit by the extension agents will increase the income level of beneficiaries in the study area.

CONCLUSION

Based on the findings of this study, it was concluded that age, educational level, family size, cooperative membership and frequency of contact were the factors influencing the income level of the beneficiaries of cocoyam value addition training programme by the NRCRI, umudike. Education enhances participation of beneficiaries in the training programmes, hence, affecting positively the income level of the beneficiaries. Farmers should be encouraged to acquire basic education in order to enhance their productivity. Extension agents should increase their visit to farmers to enhance their access to information on value added cocoyam products.

Table 1: Distribution the Respondents According to their socio-economic profile of the Respondents (n=120)

Variables Age (years)	Frequency	Percentage
26-35	23	19.00
36-45	32	27.00
46-55	42	36.00
56-65	23	19.00
Education (years)		
No. Formal Education	24	20.00
Primary Education	25	21.00
Secondary Education	44	36.00
Tertiary Education	27	23.00
Occupation		
Full time farming	70	58.00
Part time farming	50	42.00
Family Size		
1 – 4	16	13.00
5 – 8	32	27.00
9 – 12	72	60.00
Income (Naira)		
10,000 – 29,999	32	27.00
30,000 – 49,999	36	30.00
50,000 – 69,999	52	67.00
Experience (years)		
1 – 10	12	10.00
11 – 20	32	27.00
21 – 30	72	60.00
31 – 40	4	3.00
Marital Status		
Married	106	88.00
Single	14	12.00

Table 2: Regression Results of the Factors influencing the Level of Income of Beneficiaries of Cocoyam Value Addition Training in the Study Area

Variables	Linear	+Double Log	Exponential	Semi Log
Constant	34.254**	8.121**	4.367***	71.546
	(2.555)	(3.279)	(7.615)	(-.756)
Age	-0.441	-1.013	-.016	-29.499
	(-0.928)	(-1.904)*	(-1.444)	(-1.334)
Education	1.968	.801	.074	20.227
	(2.399)**	(2.989)**	(3.364)***	(1.997)*
Family Size	2.818	1.000	.032	7.964
	(1.617)	(5.712)***	(.737)	(2.811)**
Income	5.562	-.077	-5.356	1.975
	(7.578)***	(-.468)	(-3.310)***	(.305)
Experience	-.361	.034	-.005	1.503
	(-.578)	(.214)	(-.352)	(.205)
Marital Status	2.271	.036	.106	-.612
	(.205)	(.137)	(.404)	(-.056)
Membership of	-14.685	.958	.910	-12.745
Cooperative Society	(-1.853)	(4.715)***	(-4.396)***	(-5.990)***
Frequency of Contact	-.976	.880	.008	1.143
	(-.506)	(5.506)***	(-.185)	(-.170)

Source Computed from Field Survey (2010)
+ = Lead equation
*****, ** and * denote significance at 1%, 5% and 10% levels of probability.**

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ADOPTION OF CASSAVA -VALUE -ADDED PRODUCTS AMONG FEMALE AND MALE FARMERS IN IMO STATE NIGERIA

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ABSTRACT
This study carried out in Imo State in 2014 investigated the socioeconomic characteristics influencing the adoption of cassava - value - added products (CVAP) by male and female farmers in Imo State. The specific objectives were to identify CVAPs disseminated to both groups of farmers in the study area and determine factors affecting their decision to adopt CVAP. Multi-stage random sampling technique was used in the selection of male and female cassava farmers. Sample size of 150 cassava farmers comprising 75 male and 75 female who have benefited from training in value addition to cassava organized by either government or private organizations in the state were involved in this study. Instrument for data collection was a set of structured and pre-tested questionnaire. Descriptive statistics such as frequencies, means and percentages were used to analyze the socioeconomic profile of the farmers while probit regression analysis was employed to analyze factors affecting decision to adopt cassava value addition products. Result obtained show that eight major CVAPs disseminated were Garri, cassava fufu flour, high quality cassava flour, cassava chin-chin, cassava starch, cassava cake, cassava chips and cassava bread. The most adopted CVAP among the male cassava farmers in the study area was garri, with a mean adoption score value of 3.68, which was followed by cassava chips ($\bar{x}$ = 3.37) and High quality cassava flour ($\bar{x}$ = 3.34). Also, garri and cassava fufu flour, with a mean adoption score values of 4.05 and 3.18 respectively were the most adopted CVAP by the women farmers in the study area. The result of probit regression revealed that age, household size, farm size had significant influence on female farmers' decision to adopt CVAP, while age, education, farm size, farm income and membership of farmers association significantly influenced decision of male farmers to adopt CVAPs. Since these socioeconomic characteristics influenced adoption of CVAPs governments should empower farmers through provision of massive training and extension of these products, increasing access to farmland and encouraging farmers to form cooperative societies.
Keywords: value addition, cassava, probit

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the world's most important food crops grown principally for its roots (Allem, 2002). Unfortunately, cassava roots are perishable, bulky and notorious for their short shelf-life due to post-harvest physiological deterioration. Consequently, over 50 percent of the harvested produce is wasted due to production and post-harvest inefficiencies (Ezedinma *et al*. 2006).

In order to reduce this wastage, it is necessary to process cassava roots into value added products within few days after harvest. However, cassava processing and value addition activities are labour intensive and productivity is usually low. The drudgery associated with traditional processing is enormous and the products from traditional processing methods are often contaminated with undesirable extraneous matter, making some of the products unhygienic and attract poor market value (Okorji *et al*., 2003). Many improved cassava value addition products and products have been developed by both national and international research centres (Aniedu *et al*., 2012). These products are aimed at increasing food forms and adding values to the crop (Nwakor *et al*, 2011). These value added products include gari, fufu, tapioca, chips, pellets, flour, alcohol, starch, high quality cassava flour (HQCF) and others (Adebayo, 2009).

These products have been extended to rural cassava farmers through direct training by specialists from research centres or through extension agents that have been trained by research centres. Aniedu, (2006), reported that such trainings have been conducted in Imo State since 2005, while Women in Agriculture (WIA) Unit of Imo State ADP have been conducting such training since 1991.

Many extension and research programs which disseminate cassava value addition products are gender sensitive, focusing more on the women, or on the other hand the family head that is usually the husbands. The presumption is that men are less economically efficient than women in post-harvest activities. Men's contributions are usually under estimated and not accorded proper recognition because of women dominance in cassava processing and value addition (PIND, 2011).

There have been studies on awareness and adoption of cassava value addition products and products in Imo State (Aniedu *et al*., 2012,) but none have looked at gender issues involved in these adoptions. Consequently there is a paucity of empirical data to support policy formulations on the subject under study. This paucity of empirical data necessitated this study on adoption level of improved cassava value addition products by both male and female farmers/processors in Imo state, Nigeria. The aspect of this study that dealt with socioeconomic characteristics that influence gendered adoption of CVAPs is presented in this paper.

METHODOLOGY

The study was carried out in Imo state. The choice of the state is purposive in the sense that it is among the states in this country that benefited from the massive training and extension of products of new and improved food forms of root/tuber crops extended to rural farmers/women groups from 2005 to date by the National Root Crops Research Institute (NRCRI), Umudike, and Imo State Agricultural Development Project (IMADP). The study adopted a multistage random sampling technique in the selection of farmers. In the first stage, two Local Government Areas (LGAs) were selected randomly from each of the three agricultural zones of the state, two communities from each of the Local Government Areas and then 14 cassava farmers were chosen randomly from each community such that 7 were male, and the other 7 were female giving a total of one hundred and sixty eight (168) cassava farmers consisting of eighty four (84) female and eighty four (84) male cassava farmers sampled for the study. However, 150 respondents' questionnaires (from 75 males and 75 females) were used for analysis. The population for the study consisted of farmers who had benefited from training in cassava value addition organized by either government or private organizations in the state.

Primary data were obtained by the use of pre-tested and structured questionnaire. The data of interest included socio economic profiles of the respondents, membership of associations, cassava value addition products disseminated and level of adoption of cassava value addition products. Descriptive statistics such as frequencies, means and percentages was used to analyze the socioeconomic profile of the farmers while probit regression analysis was employed to analyze factors affecting decision to adopt cassava value addition products.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

The distribution of male and female cassava farmers who participated in cassava value addition technology according to their socioeconomic characteristics is presented in Table 1. This result indicated a rather increasing number of the very old and aged respondents especially the female cassava farmers, while the male cassava farmers were mostly middle aged that were within the active productive work force. Age is known to be a primary latent characteristic in adoption decisions. The ability of a farmer to bear risk and be innovative has been reported to decrease with age (Nwaru, 2004). Also this has implication on agricultural production because of the ability of this segment of the population to effectively withstand the rigours, strain and stress involved in agricultural production.

The distribution of respondents according to marital status is shown in Table 1. The table revealed that majority (69.33% and 76.0%) of the male and female cassava value addition trainees respectively were married. It was observed that the married class does have access to extra financial, moral and physical supports from their spouses that could go a long way improving their production activities.

86.67% and 89.33% of male and female cassava value addition trainees respectively received formal education ranging from primary school education to tertiary school education. Acquisition of higher education by farmers would enhance improved technology adoption hence increased farm income. Education has the capacities to influence people to accept new technology and change their attitude to the desired technology. Patrick and Edna, (2002) reported that the problem of widespread of illiteracy among farmers who cannot read would hinder the understanding of information at their disposal.

The table shows that 32.0% and 36.0% of male and female cassava farmers had between 21 and 30 years of experience in cassava production. This implies that both groups of respondents were established and knowledgeable in cassava production. Farming experience affects farm managerial know-how and decision-making process. Obviously, an experienced farmer will most likely identify the relative advantage of cassava value added products. Khanna (2001) also noted that higher farming experience attainable through increased years of farming leads to higher rates of adoption of new agricultural product.

Table 1 also revealed that a good proportion (43.42%) of male cassava value addition trainees in the study area had household size of between 5 and 8 persons while a good proportion (42.67%) of female cassava value addition trainees had household sizes of between 1 and 4 persons. High cost of labour was found to be a major constraint to adoption of improved technology (Anyaegbunam *et al*, 2009). Therefore, the availability of substantial family labour may reduce the cost of labour, thereby increasing the chances of the adoption of improved products.

The mean farm size of male and female cassava value addition trainees were 1.32 hectares and 1.53 hectares respectively indicating that the respondents in the study area were mostly subsistent farmers that operated mostly on small sized farm lands. Meanwhile, Bankole *et al*., (2012) was of the view that a farmer may have positive behavior to a new technology but might have limitation due to insufficient or non – availability of farmland.

Majority (72.0% and 65.33%) of the male and female cassava value addition farmer trainees belonged to farmers' cooperative societies while 28.0% and 34.67% of both groups of respondents did not belong to farmers association. This result implies high innovativeness among the respondents due to influence of group dynamics

(Anyiro and Oriaku, 2011). Farmers communicate most frequently and effectively with those who are most similar to them. These farmers are more likely to obtain information from and be influenced in their farming practices and adoption decision by other farmers. Table 1 also shows that majority (61.33% and 69.33%) of the male and female farmers value addition trainees respectively had less regular (irregular) extension visits, 17.33% and 24.0% of them had regular extension contact while 21.33%and 6.67% of both group of respondents (male and female cassava value addition trainees) had very regular extension contact. The more, the regularity of extension contact between farmers and the extension agent, the more the farmers' awareness of recommended practices, because the agent supplies information on the mode of application or use of recommended products. Frequent contact is likely to minimize doubts among farmers (Ekpe and Obeten, 2002).

A good proportion of respondents that obtained their training on cassava value added products from Agricultural Development Programme (ADP and National Root Crop Research Institute Umudike thus confirming their statutory agenda and contribution towards massive training and extension of products of new and improved food forms of root/tuber crops to rural farmers in the country. Also the good proportion of both respondents that obtained information and training on cassava value added product from their farmers' association.

Cassava value addition products disseminated to both groups of farmers

Table 2 shows that various types of cassava value added products were introduced to both the male and women cassava farmers in the study area. Eight major types were identified which include; Garri, cassava fufu flour, high quality cassava flour, cassava chin chin, cassava starch, cassava cake, cassava chips and cassava bread. Specifically, cassava fufu flour, garri, high quality cassava flour, cassava chips and cassava starch were the most important cassava value added products disseminated to the male cassava farmers as attested by 70.7%, 82.7%, 73.0%, 68.0% and 62.7% of them respectively. The least cassava value added products extended to the male farmers were cassava chin-chin (33.33), cassava cake (38.67%) and cassava bread (49.3%).

Similarly, the most highly disseminated cassava value added product among the women farmers were Garri, cassava fufu flour, high quality cassava flour and cassava chips. Between these value added products, they were also introduced in ascending order to the following cassava value added products: cassava starch, cassava chin chin, cassava bread and cassava cake. This result implies that the predominant cassava value added products extended to farmers in the area was due to the active promotion of such products by NRCRI and ADP in the State and in alignment with major diets of the respondents.

CONCLUSIONS AND RECOMMENDATION

The work had shown that the most adopted cassava value added product among the male cassava farmers in the study area was garri, followed by cassava chips and High quality cassava flour while, garri and cassava fufu flour, were the most adopted cassava value added product by the female cassava farmers in the area. The findings further show that age, household size and farm size had significant influence on female farmers' decision to adopt cassava value added product, while the factors that influenced male cassava farmers' decision to adopt cassava value added product were age, education, farm size, farm income and membership of farmers association. Since these socioeconomic characteristics influenced adoption of CVAPs it is therefore recommended that governments should empower farmers through provision of massive training and extension of these products, increasing access to farmland and encouraging farmers to form cooperative societies.

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Table 1: Distribution of Male and Female Cassava Value Addition Trainees in Imo State according to socioeconomic characteristics

	Male farmers		Female farmers	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Age (years)				
30-40	23	30.67	14	18.67
41-50	24	32.00	30	40.00
51-60	19	25.33	24	32.00
Above 60	9	12.00	7	9.33
Marital status				
Single	17	22.67	8	10.67
Married	52	69.33	57	76.0
Widowed	6	8.0	16	21.33
Educational status				
No formal Education	10	13.33	8	10.67
Primary education	37	49.33	31	41.33
Secondary education	22	29.33	30	40.00
Tertiary education	6	8.0	6	8.0
Farming experience (years)				
1-10	17	22.67	8	10.67
11-20	20	26.67	22	29.33
21-30	24	32.00	27	36.0
31-40	14	18.67	18	24.0
Household size				
1-4	27	36.0	32	42.67
5-8	33	43.42	30	40.0
9-12	15	20.00	13	17.33
Farm size (hectares)				
<1	35	46.67	25	33.33
1-2.0	31	41.33	44	58.67
2.1-3.0	9	12.00	6	8.0
Membership of farmers assoc				
Yes	54	72.0	49	65.33
No	21	28.0	26	34.67
Extension contact				
Less regular contact	46	61.33	52	69.33
Regular extension contact	13	17.33	18	24.00
Very regular extension contact	16	21.33	5	6.67
Sources				
Tv/radio	9	12.0	4	5.33
ADP	23	30.67	28	37.33
Farmers organization	15	20.00	21	28.0
Friends	9	12.0	6	8.0
NRCRI	19	25.33	16	21.33

Source: Field Survey data, 2014

Table 2: Cassava value added products disseminated to male and women cassava farmers in Imo State, Nigeria.

	Male farmers		Female farmers	
Cassava value added products	Frequency*	Percentage	Frequency*	Percentage
Garri	62	82.7	69	92.0
Cassava fufu flour	53	70.7	60	80.0
High quality cassava flour	55	73.3	47	62.7
Cassava chin chin	25	33.3	31	41.3
Cassava starch	47	62.7	42	56.0
Cassava cake	29	38.67	25	33.3
Cassava chips	51	68.0	47	62.7
Cassava bread	37	49.3	32	42.7

* Multiple responses recorded: n=75 *Multiple responses recorded: n=75

Source: Field Survey, 2014

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Jatropha Curcas: A MULTIPURPOSE TROPICAL OIL SEED CROP FOR SUSTAINABLE INDUSTRIAL USES: A REVIEW

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ABSTRACT
Jatropha curcas, a multipurpose, drought tolerant, perennial plant is one of the most important industrial plants belonging to the family Euphorbiaceae is gaining lot of importance for the production of biodiesel, income, employment and soil restoration. It is a tropical plant that can be grown in low and high rainfall areas in the farms as a commercial sole crop or intercropped or on the boundaries as a hedge to protect fields from grazing animals and to prevent erosion. This paper reviewed the importance of exploring Jatropha as an industrial crop plant to enhance diversification of the use of fossil fuel. The taxonomy, botanical description of the plant, its origin and distribution and ecological adaptation are discussed. Various propagation methods including tissue culture to get disease-free plantlets of Jatropha are reviewed. The possibilities on the exploitation of Jatropha potential for various applications have been reviewed. The paper advocates massive production of Jatropha plant to restore degraded land (waste lands) as well as reducing greenhouse emission. The paper gives an overview on the benefits of Jatropha if properly harnessed.
Keywords: Jatropha, multipurpose, oil seed, sustainable and industrial use

INTRODUCTION

Industrial crop could be referred to as crop grown for the production of raw materials and other products in the production sector, rather than food for consumption. Industrial crops when fully harnessed and utilized, impact the economy by providing raw materials and products which lessens the need for imports, increase income of the farmer and the farm sector enterprises, provide economic development activities of the rural arears.

The use of biomass to provide energy has been fundamental to the development of civilization. Biomass contributes a significant share of global primary energy consumption and its importance is likely to increase in future world energy scenarios (Vasudevan *et al*., 2005). Improved agronomic practices of well-managed biomass plantations will also provide a basis for environmental improvement by helping to stabilize certain soils, avoiding desertification, which is already occurring rapidly in tropical countries like Nigeria. *Jatropha* is a multipurpose species with many attributes and considerable potential. Nearly 40% of the land area in Nigeria is wasteland due to erosion and desertification. Importance should be given on the plantation of *Jatropha* species on wastelands, for the protection of the environment and fulfilling future energy and industrial requirements.

The wood and fruit of *Jatropha* can be used for numerous purposes including fuel. The seeds of *Jatropha* contain viscous oil, which can be used for manufacture of candles and soap, in cosmetics industry, as a diesel/paraffin substitute or extender. This latter use has important implications for meeting the demand for rural energy services and also exploring practical substitutes for fossil fuels to counter greenhouse gas accumulation in the atmosphere. These characteristics along with its versatility make it of vital importance to developing countries (Foidl and Kashyap, 1999). Jatropha, as an energy crop that grows seeds with high oil content, requires low labour inputs, does not compete with food crops and is tolerant to pests and diseases (Ogunwole *et al*, 2007, Li Guo, 2002, Baumgart, 2007, Francis *et al*, 2005). These potentials coupled with the fact that the seed oil can easily be processed to partially or fully replace petroleum-based diesel fuel (Saikia *et al*, 2009), clearly makes *Jatropha curcas* a wonder bio-fuel crop, alleviate soil degradation, erosion and desertification, soap production and environmental protection as well as increase rural income sustainability and poverty alleviation. The roots recycle nutrients and reduce possibility of erosion as well as improve soil structure and quality.

In Nigeria, desert encroachment and soil erosion are serious environmental challenges facing the nation. In a bid to ameliorate the problems, government embarked on massive tree planting campaign throughout the country and more in the northern parts (Koyejo *et al*, 2010). The fact that it takes minimum of about 4-6 years for a tree to mature enough to begin to play the intended role of windbreak, erosion control, frustrates government effort (Omolaiye, 2005).

The purpose of this review is to provide information about its potential and current development in the field of *Jatropha* research.

Geographical Distribution and Ecological Adaptation

Jatropha is believed to have originated from the Caribbean Central America and the Northern parts of South America particularly Mexico. *Jatropha* was probably distributed by Portuguese seafarers via the Cape Verde

Islands and Guinea Bissau to other countries in Africa and Asia (Heller, 1996). It is assumes that the Portuguese brought the physic nut to Asia. It is well adapted to arid and semi-arid conditions. *Jatropha* grows almost anywhere except waterlogged lands, even on gravelly, sandy, saline and stony soils. The leaves shed during the winter months form mulch around the base of the plant. The organic matter from shed leaves enhances earthworm activity in the soil around the root-zone of the plants, which improves the fertility of the soil.

Regarding climate, *Jatropha* is a warm crop found in the tropics and subtropics requiring heat, although it does well even in lower temperatures and can withstand a light frost. It will grow under a wide range of rainfall regimes from 250 to over 1200mm per annum (Katwal and Soni, 2003). In low rainfall areas and in prolonged rainless periods, the plant sheds its leaves as a counter to drought, to reduce transpiration loss. Rainfall induces flowering and, in areas of unimodal rainfall, flowering is continuous throughout most of the year. Higher precipitation is likely to cause fungal attack and restricts root growth if the soil is not well drained (Openshaw, 2000).

Jatropha Propagation Methods

Jatropha grows readily from seeds or cuttings. However, trees propagated by cuttings show a lower longevity and possess a lower drought and disease resistance than those propagated by seeds (Heller, 1996), this might have been due to trees produced from cuttings do not produce true taproots (hence less drought tolerant), rather they produce pseudo-taproots that may penetrate only 1/2 to 2/3rd the depth of the soil as taproots produced on trees grown seed. The advantage of using cuttings over seeds is their genetic uniformity, rapid establishment and early yield. The disadvantage is the scarcity of material, and the cost of harvesting, preparation, transport and planting of the woody stems compared to seeds.

There are various methods to cultivate *Jatropha*, which vary from region to region and also on climatic conditions. These are: direct seeding, pre-cultivation of seedlings (nursery raising), transplanting of spontaneous wild plants and direct planting of cuttings. Wider spacing (3m×3m) is reported to give larger yields of fruit, at least in early years (Heller, 1996).

In better rainfall or good moisture condition, the plantation could also be established by direct seeding. When establishing a physic nut crop, the survival rate can be influenced by the choice of cultivation method. Two factors are generally responsible for sprouting: the age of the plant from which cuttings are taken and the position of the cutting within the plant, it might have been due to declines of rooting ability of many woody plants with age, when the source is a seedling derived mother plant. Distal portion of the stock plants are first to exhibit this reduced rooting potential, while cuttings from the lower or juvenile regions of the plants generally maintain a higher rooting capacity than those from the upper regions (Hartmann and Kester, 1983). Jatropha can be propagated using tissue culture method to enhance seed yield per plant. Tissue cultures have been developed for the propagation and storage of selected genotypes of tropical plants (Engelmann, 1991). The tissue gets disorganized and broken down into cells which further develop into cell and finally into plantlets having roots and shoots

Utilization of Jatropha Products

Jatropha is a multipurpose plant species with many attributes and potential applications as non-energy Sources, hedge Plant, soap Making, pesticide,green Manure and Organic Fertilizers, food/Feed and as medicinal uses.

Medicinal uses

All parts of Jatropha (seeds, leaves and roots) have been used in traditional medicine and for veterinary purposes for a long time (Duke, 1985b; Duke, 1988). Uses of various parts of *Jatropha* in the treatment of disease have been presented in Table 2. Some compounds (Curcacycline A) with antitumor activities were reportedly found in this plant (Van den Berg *et al*., 1995). Substances such as phorbol esters, which are toxic to animals and humans, have been isolated and their molluscicidal, insecticidal and fungicidal properties have been demonstrated in lab-scale experiments and field trials (Nwosu and Okafor, 1995; Solsoloy and Solsoloy, 1997). The seed oil can be applied to treat eczema and skin diseases and to soothe rheumatic pain (Heller, 1996). The 36% linoleic acid (C18:2) content in *Jatropha* kernel oil is of possible interest for skincare. Furthermore, Goonasekera *et al*, (1995) showed that various solvent extracts of *Jatropha* have an abortive effect.

The oil has a strong purgative action and is also widely used for skin diseases and to soothe pain such as that caused by rheumatism. The oil is used as a cathartic purgative (Jamalgota) and for the treatment of skin ailments (Duke, 1988). The leaves and latex are used in healing of wounds, refractory ulcers, and septic gums and as a styptic in cuts and bruises. A proteolytic enzyme (curcain) has been reported to have wound healing activity in mice (Nath and Dutta, 1997; Villegas et al., 1997).

As an Energy Source

The oil from Jatropha is regarded as a potential fuel substitute. The type of fuels, which can be obtained directly from the Jatropha plant are biodiesel, charcoal, Cooking/Lighting fuel from Jatropha oil/Fuel wood

Potential conservation benefits/ Summary of Economic importance

The primary conservation benefits to be derived from production of *Jatropha* relate to improved soil restoration and management. The findings of Kumar et al. (2008), have shown that the heavy metal contaminated soil can be restored by using combination of industrial wastes and suitable bioinoculants strain (*Azotobacter*). *Jatropha* in addition to protecting crops from livestock, it reduces wind erosion and pressure on timber resources and increases soil moisture retention. Nevertheless, *Jatropha* does mine soil nutrients. *Jatropha* oil projects are expected to provide income and organic fertilizer to increase crop yields, as well as being an ecologically friendly source of alternative energy to rural farmers. However, the summary of Jatropha economic importance is presented in Fig. 1

CONCLUSION

Jatropha curcas has a great potential as a locally available and environmentally friendly source of income, fuel, manure, employment and can be used to combat other environmental hazards such as reclamation of degraded land. Although currently growers are unable to achieve the optimum economic benefits from the plant, especially for its various uses, the markets of different products from this plant have not been properly explored or quantified. Consequently, the actual or potential growers including those in the subsistence sector do not have an adequate information base about the potential and economics of this plant to exploit it commercially. It is, therefore, timely to examine the potential role that *Jatropha* can play in meeting some of the needs for energy services for rural communities and also creating avenues for greater employment opportunities.

Table 1: Alternative propagative methods

Parent materials	Advantages	Disadvantages
Seed–sown directly in the field	• Cheapest method, good taproot development	• Lower survival rate of seedlings. • Least successful method of propagation. • Poor uniformity of growth. • Variable productivity of the progeny • More weeding required in the field.
Seed–nursery raised in poly-bags	• Control of seedlings environment. • Fewer losses • More uniform plants • Disease – free seedlings selected	• Higher costs than direct seeding • Variable productivity of the progeny • Seedlings taproot development may be impaired by the poly-bags
Seed–nursery raised in seed bed	• As above • No restriction of taproot • Lower transport costs.	• Higher costs than direct seedling • Variable productivity of progeny • Higher losses at planting - out of bare root seedlings
Vegetative cuttings: ○ Planted directly in the field	• As above • Fewer losses and more uniform plants. • Mini – cutting may be done where parent materials is scare	• As above • Higher costs than planting cutting directly
Vegetative cutting ○ Nursery raised in seedbed	• As above • Lower transport costs from nursery to field	• As above • Higher losses when planted – out
Tissue culture	• Clonal • Uniform productivity • Develop taproot • Rapid multiplication of new plants	• High cost of production • Newly developed protocol not yet commercially viable

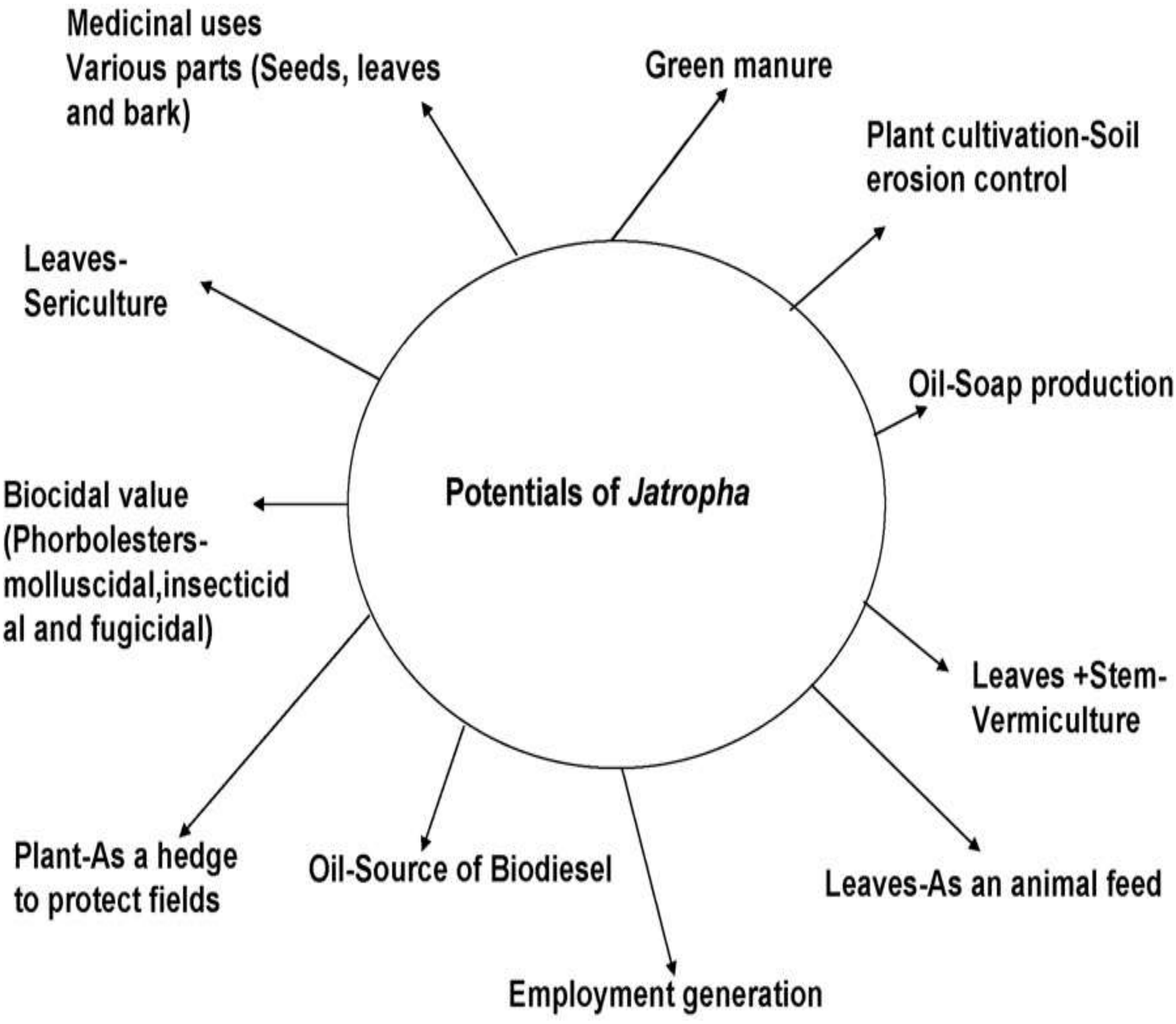
Source: Ginwal *et al*, 2005; Kaushik *et al*, 2007

Table 2 – Uses of different parts of *J. curcas* in medicines

Plant part used	Diseases
Seeds	To treat arthritis, gout and jaundice
Tender twig/stem	Toothache, gum inflammation, gum bleeding, pyorrhea
Plant sap	Dermatomucosal diseases
Plant extract	Allergies, burns, cuts and wounds, inflammation, leprosy, leucoderma, scabies and small pox
Water extract of branches	HIV, tumor
Plant extract	Wound healing

Source: (Heller, 1996; Kaushik and Kumar, 2004)

Fig. 1 Jatropha Economic importance



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PERCEPTION ON BREAD MADE FROM CASSAVA-INCLUDED WHEAT FLOUR AMONG HOUSEHOLDS IN IBADAN METROPOLIS, OYO STATE, NIGERIA

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ABSTRACT
The study investigated the perception on bread made from cassava-included wheat flour in Ibadan metropolis, Oyo State. Multistage sampling technique was used to sample 120 respondents. Data were analyzed using descriptive and inferential statistics. Results revealed that 46.5% of the respondents have household size of 4-6 persons. Majority (65.8%) were aware of the existence of bread made from cassava-included wheat flour. Radio and Television provided information for 38.3% of the respondents on cassava-included bread. Most (61.7%) of the respondents disagree or strongly disagree that bread made from cassava-included wheat flour is dangerous to human health. There was no significant relationship ($p>0.05$) between age, education, household size and income of the respondents and their perception on cassava-included wheat bread.
Keywords: cassava, wheat flour, bread, perception, household

INTRODUCTION
Nigeria spent N635 Billion Naira (US$=₦156) on the importation of wheat in 2010 alone. This amounts to spending nearly N1.8 billion naira daily for wheat importation (Momoh, 2011). Nigerian wheat importation is growing at the rate of 13 percent per year and could reach 17 million metric tons by the year 2020 (Olanrewaju, 2012). Presently, Nigeria imports about 15 million metric tons of wheat flour yearly for the production of bread (Ogunbanwo *et al.*, 2008). The effect of this import on Nigeria include loss of employment to foreign nations, food insecurity, increase in food prices, trade imbalance, loss of foreign exchange over dependence on foreign goods, high domestic price of bread etc. Nigeria is planning to reduce these negative trends by partially substituting wheat with cassava for the production of composition bread. Composite flour is the name given to wheat that has been diluted with other flours (Sanni *et al.*,2004).Giami *et al* (2004) and Akubundu (2006) cited by Eddy *et al* (2007) reported that up to 20% substitution of wheat flour with cassava flour had no adverse sensory or organoleptic effect on bread. Bread with 10% and 20% of cassava flour were not significantly different in most sensory attributes. Bread baked with 10% and 20% cassava flour was rated higher in aroma, colour, general acceptability and preference to buy than wheat flour.

METHODOLOGY
The study was carried out in Ibadan metropolis, Oyo State. Ibadan lies within longitude 070 021 and 070 40E and Latitude 030 351 and 40 101 N. Ibadan is 128km Northwest of Lagos and 345km southwest of Abuja, the Federal capital territory (Udo, 1994).The study population comprise of households in Ido, Ibadan South west and Ibadan north west local government areas of Ibadan metropolis. Data were collected through the administration of structured questionnaires; multistage sampling technique was used in the first stage to purposively select three (3) local government areas to represent urban, semi-urban and rural areas. They were Ido, Ibadan North West and Ibadan South West Local Government Areas. In the second stage, five (5) communities were randomly selected from each L.G.A to give a total of fifteen (15) communities. In the third stage, eight (8) households were randomly selected from each of the communities selected for the study, giving a sample size of 120.

RESULT AND DISCUSSION
Table 1 shows the results of the socio-economic characteristics of the respondents. 53.3% were female. Many (50.8%) of the respondents had secondary education. Another 30.0% had tertiary education. Majority (69.2%) earn monthly incomes of 0-30,000 naira and were mostly self employed (60.8%).
Result of awareness and source of information on bread made from cassava-included wheat flour (Table 2) indicates that 65.8% of the respondents were aware of this bread type. This could be attributed to the high literacy level of the respondents. The electronic media (Tv/Radio) provided information to 38.3% of the respondents on cassava-included wheat flour bread.
Table 3 looked at respondents perception on bread made from cassava-included wheat flour. Most of the respondents were undecided when asked if cassava included bread gives higher calories(46%), is as good as only wheat flour bread(37.5%),is robed of protein content(39.2%). Results also show that 45.0% disagree that bread made from cassava-included wheat flour is dangerous to human health. This finding agree with report by Chukwu (2012) that, the National Agency for Food and Drug Administration and Control (NAFDAC) after considering the nutrients and health implications of cassava, concluded that the inclusion of cassava flour in

bread production is wholesome. 35.8% of the respondents were undecided if bread made from cassava included wheat flour can be kept for a very long time while 27.5% agree that it cannot be kept for long. This implies that bread made from cassava wheat flour has a short shelf life. This findings corroborates UNIDO/FGN (2006) who reported shorter shelf life of bread made from cassava-included wheat flour and mentioned this to be the reason for the failure of previous cassava inclusion in bread policy in Nigeria. Many (58.3%) of the respondents were undecided if bread made from cassava-included wheat flour is an alternative solution for celiac disease patients. This indecision is not a surprise as the respondents mostly do not have medical background. However, cassava flour by having no gluten has been of interest for many researchers for the production of non gluten bread that can be used by celiac disease patients. According to Lundin *et al.*, (1993), celiac disease is most probably an immunological disease precipitated in individuals by ingestion of wheat gliadin and recatal proteins from other cereals. Also, 49.2% of the respondents were undecided if bread made from cassava-included wheat flour can increase glycemic index. Cassava inclusion in composite flour has a positive effects on glycemic index. A recent study indicated that cassava flour had a lower glycemic index of 59.34 compared to wheat flour with a glycemic index of 70.10 among 10 diabetics patients (Fasande and Anyakudo, 2007). Majority (75.0%) of the respondents displayed favourable perception of bread made from cassava-included wheat when they disagreed or strongly disagreed that it was made for the poor. The policy of cassava inclusion in wheat was intended to put more money into the pockets of Nigerians by promoting price stabilization of bread, creation of new markets for cassava farmers, new job opportunities in the high quality cassava flour (HQCF) industry and most importantly, the reduction of amount spent on importation of wheat by about ₦335 billion annually (Gbola, 2012, Layi, 2012).
Table 4 shows the result of PPMC analyzing the relationship between selected socio-economic characteristics of the respondents and their perception on bread made from cassava-included wheat flour. There was no significant relationship ($p>0.05$) between the age, educational level, household size, and income of the respondents and their perception on bread made from cassava included wheat flour.

CONCLUSION

Majority of the respondents are aware of the existence of cassava-included wheat bread. Most of the respondents have positive perception on bread made from cassava included wheat flour. However, the presence of so many `undecided` response on data retrieved indicate lack of information and knowledge to make informed decisions by the households on technical issues such as the relationship between cassava bread, safety issues surrounding it and possible effects on the health of consumers. There is therefore the need to sensitize the general public on the obvious benefits of eating cassava-included bread, as doing so will be of immense benefit to the Nigerian economy.

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Table 1: Respondents socio-economic characteristics

Variable	Frequency (F)	Percentage (%)	Mean
Age			
20-40	94	78.4	
41-60	20	16.7	33.9
61-80	6	5.0	
Sex			
Male	56	46.7	
Female	64	53.3	
Educational level			
No formal education	5	4.2	
Primary education	17	14.2	
Secondary education	61	50.8	
Tertiary education	36	30.0	
Household size			
1-3	54	45.0	
4-6	56	46.7	3.61
7-9	9	7.5	
> 9	1	0.8	
Income (₦/month)			
0-30,000	83	69.2	
30,001-60,000	22	18.3	
60,001-90,000	4	3.3	
> 90,000	11	9.2	
Occupation			
Unemployed	27	22.5	
Self employed	73	60.8	
Public sector employed	16	13.3	
Private sector employed	4	3.3	

Source: Field survey, 2015.

Table 2: Awareness and sources of information on bread made from cassava-included wheat flour

Awareness	Frequency (F)	Percentage (%)
Yes	79	65.8
No	41	34.2
Information source	**Frequency (F)**	**Percentage (%)**
Friends	22	18.3
Newspapers/magazine	19	15.8
Tv/Radios	46	38.3
Workshops/Conferences	5	4.2
Neighbor	24	20.0.
Workship centres	4	3.3

Source: Field Survey, 2015

Table 3: Respondents Perception on bread made from cassava-included wheat flour.

Perception	Strongly Agreed	Agreed	Undecided	Disagreed	Strongly Disagreed
Bread made from cassava-included wheat flour is dangerous to human health.	8(6.70)	15(12.5)	23(19.2)	54(45.0)	20(16.7)
Bread made from cassava-included wheat flour is difficult to produce.	5(4.2)	22(18.3)	52(43.3)	28(23.3)	13(10.8)
Bread made from cassava-included wheat flour is for the poor.	9(7.5)	15(12.5)	6(5.0)	56(46.7)	34(28.3)
Bread made from cassava-included wheat flour is unavailable.	16(13.3)	37(30.8)	15(12.5)	36(30.0)	16(13.3)
Bread made from cassava-included wheat flour is not good for diabetic patient.	13(10.8)	35(29.2)	35(28.3)	26(21.7)	12(10.0)
Bread made from cassava-included wheat flour is not as good as only wheat flour bread.	11(9.2)	45(37.5)	32(26.7)	19(15.8)	13(10.8)
Bread made from cassava-included wheat flour is not cheaper than the non-included version.	6(5.0)	32(26.7)	39(32.5)	29(24.2)	14(11.7)
Bread made from cassava-included wheat flour cannot be kept for a very long time.	7(5.8)	33(27.5)	43(35.8)	25(20.8)	11(9.2)
Bread made from cassava-included wheat flour is an alternative solution for celiac disease patient.	3(2.5)	18(15.0)	70(58.3)	19(15.8)	10(8.3)
Bread made from cassava-included wheat flour has bad flavor.	6(5.0)	11(9.2)	47(39.2)	37(30.8)	18(15.0)
Bread made from cassava-included wheat flour can increase glycemic index.	9(7.5)	23(19.2)	59(49.2)	18(15.0)	11(9.2)
Bread made from cassava-included wheat flour gives higher calories.	9(7.5)	28(22.3)	56(46.7)	22(18.3)	5(4.2)

Source: Field Survey, 2015.
Figures in parentheses are in percentage.

Table 4: Correlation analysis for relationship between respondents selected socio-economic characteristics and their perception on bread made from cassava-included wheat flour.

Variable	r-value	p-value	Decision
Educational level	0.111	0.768	Not significant
Household	0.046	0.618	Not significant
Income	0.026	0.780	Not significant
Age	0.057	0.534	Not significant

S- significant ($p<0.05$); NS – Not significant ($p>0.05$)

DETERMINANTS OF YOUTH EMPLOYMENT IN CASSAVA VALUE ADDITION ENTERPRISES IN ABIA STATE, NIGERIA

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ABSTRACT

The study assessed youth employment status in cassava value addition enterprises in Abia State, Nigeria. The specific objectives were to examine the socio-economic characteristics of cassava processors, determine the number of youths employed in cassava value addition enterprises, analyze the determinants of youth employment in cassava value addition enterprises, discriminate the constraints and benefits of youth involvement in cassava enterprises or other enterprises and examine the cost benefit of participating in major cassava by-products value addition. In the study area, A multistage random sampling technique was employed to selects sample technique was employed to select a sample size of 90 respondents in the study area. Data were collected through a well-structured questionnaire and analyzed using descriptive statistical tool and multiple regression. Education and availability of machines in the cassava value addition enterprises. The researcher, therefore, recommend that government should provide mechanized farm implement at a reduced rental and purchase price to encourage the youths to participate in cassava production and other farm practice in the study area.

INTRODUCTION

Cassava value addition enterprises is aimed at upgrading traditional cassava products such as garri, fufu and high quality cassava flour for domestic and international market and to develop industrial market and to develop industrial market linkages for processed cassava flour as a low cost substitute for confectionary wheat flour. Cassava value addition enterprises seek to create a new generation for cassava farmers, oriented towards to commercial production and farming as a business and to link them up to reliable demand either from processors or guaranteed minimum price scheme of the government. The activities of cassava value addition enterprises are strategized to turn the cassava sub sector in Nigeria economy into a major player in local and international starch, sweeteners, ethanol and dried chips industries by adopting improved production and processing technologies and organizing producers and processors into efficient value added chains (Nweke *et al.*, 2002). Cassava value chain activities require energy which only the youth can offer especially in the areas of planting, harvesting, peeling etc. The youth involvement in the development of cassava value chain activities becomes imperative for a sustainable sector to raise rural incomes, permit the transition of subsistent cassava farming system to a sustainable market-driven system and standardize products supply lines in West Africa.

Rural youths play a central role in cassava production processing and marketing, they are responsible for cassava production which provides additional income earning opportunities and enhances their ability to contribute to household food security (Ojuekaiye, 2001). Youth's participation in cassava production in Nigeria reduces unemployment status in the country and increases revenue generation as well as provision of raw materials for industrial development.

Youth's involvement in the cassava value addition enterprises is vital to facilitate the production of food and the improvement of nutrition, the roles of which rural youths in cassava value addition can play include a mobilization tool through which rural youth can produce both for themselves and for the communities. (Seynes, 1964), argues that such mobilization could enhance the orientation of the mind of young rural people by promoting positive attitude towards the worthy and dignity of labour, it would also promote the status of farming by giving young people opportunities, profitable enterprises and improving community through service projects execution.

The broad objective of the study is to determine the youth employment status in cassava value addition entrepreneurs in Abia State, Nigeria. The specific objectives are to:

i. Examine the socio-economic characteristics of cassava processors.
ii. Determine the number of youths employed in cassava value addition enterprises.
iii. Analyze the determinants of youth employment in cassava value addition.

METHODOLOGY

This work was carried out in Abia State, Nigeria. Abia state is a State created in 1991 was carved out from Imo State. The state is approximately within latitudes 4°, 41^{I} and 6°, 14^{I} north of the equator and longitudes 7°, 10^{I} and 8^{I}° east of the Greenwich meridian. It has seventeen Local Government Areas that are divided along three agricultural zones namely Ohafia, Umuahia, and Aba (ABSEEDS, 2005). This state share common boundaries with Ebonyi State, Rivers State, Crossriver State, Imo State, Anambra State and Akwa Ibom States . The state is selected for this study from many others because of numerous agribusiness enterprises located in the rural, suburb and urban areas.(Nto *et al.*, 2011). The multi-stage sampling technique was employed in the study. The stage was purposely selection of three (3) local government area (Umuahia North, Ikwuano ,Umuahia South L.G.A) This is because cassava production is one of their major economic activities based on a fact finding visit by the development of agriculture of those selected local government areas and the favourable climate of these zones encourage cassava production activities in cassava value addition enterprises. The second comprising of thirty (30) youth producers of cassava value added products, purposely selected from each of the three (3) local government areas; this aggregated ninety (90) respondents which formed the sample size for this study. Data for this study was collected from primary sources. The primary source is through the administration of a well-structured questionnaire which was given to the sampled youth producers of cassava value added products in Abia State.

Model Specification

Multiple regression is used thus:

$Y= b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8X_8+\ldots+b_nx_n +ei$

Y	=	Number of youths employed
X_1	=	Age (years)
X_2	=	Educational level (years of education)
X_3	=	marital status
X_4	=	Location (urban=1, rural=0)
X_5	=	enterprise size in number both youth and others
X_6	=	experience in years
X_7	=	Access to capital (in naira)
X_8	=	processing method (automated=1, traditional=0)
X_9	=	number of machines available
X_{10}	=	number of value addition activities the youths participate
b_0	=	Constant
Ui	=	Error term
b_0	=	Constant
U_i	=	Error term.

RESULTS AND DISCUSSION

Number of Youths Employed In Cassava Addition Enterprises

The number of youth employed were analyzed and presented in Table 1, the result, shows that the majority (511.1 %) of cassava processors employs between the range of 7.11 youths in their enterprises.

Determinants of youth employment in cassava value addition were analyzed and presented in Table 2. The regression result reveals that the coefficient of determination (R^2) of 0.622, which shows that 62% variations in the independent variables. The F-ratio of 7.9761 shows that the model is positively but statistically significant. The regression parameters of the model also show the location and processing method were significant at 10% and positively related to youth participation in the cassava value addition enterprise. Most of the cassava enterprises are located in the rural and suburbs which attracts most youths with the increasing level of unemployment in the urban centres. The presence of cassava value addition enterprise in the rural areas attracts the timing youths that could have migrated to the urban centres in search of jobs. Enhanced processing methods attract most youths to participate in the cassava value addition enterprise. Youths enjoys working in an environment that promotes labour efficiency, so with the aid of machines and enhanced processing techniques youths will be employed in cassava processing enterprises. This accounts for the positive significance of availability of machines at 5% to aid and make cassava value addition lucrative for the youths.

Education and training level of the youths wets the appetite to participate in cassava value addition enterprise. Education which was statistically significant at 1% and positively related to the youth's participation in cassava enterprise enables the youths to acquire the necessary skills needed in the cassava enterprise. Number of activities youth participates in had a negative effect in youth employment in the cassava enterprises. This implies increase in labor with increase in the number of activities youths participate.

CONCLUSION

Based on the findings, the study concludes that youths I the study area participated actively in cassava production especially in the areas of planting of cassava cutting and harvesting. The study also concludes that the youths engaged in these activities for the purpose of food security, poverty reduction and income generation but were constrained by high cost of transportation, pest and disease infestation and insufficient capital.

Based on the findings of this work, the following were recommended;

1. Education of the youths should be the priority of the policy of the government.
2. Provision of credit facilities, water and other necessary infrastructure in the rural areas should be facilitated to encourage the growth of cassava value addition
3. Fabrication of cassava processing machines should be encouraged by establishment of a scheme to fabricate such machines and distribute same to cassava enterprises.

Table 1 Number of youth employed

Number of youth	Frequency	Percentage
2.6	42	46.7
7.11	46	51.1
12 and above	2	2.2
Total	90	100

Source; field work 2016

Table 2: Determinants of youth employment in cassava value addition

	Coefficient	Std error	t-ratio	p-value	
Const	1.92937	0.586102	3.2919	0.00150	**
Gender	-0.387338	0.152633	-25377	0.01315	**
Age	-0.0055018	0.0277405	-01983	0.84330	
Marital status	-0.0826749	0.335903	-0.2461	0.80623	
Educational status	0.0848633	0.0183292	4.6299	0.00016	***
Location	-0.27429	0.15734	-1.7433	0.08522	*
Enterprise size	-0.0677739	0.084142	-0.8055	0.42300	
Experience	-0.0196499	0.0361581	-0.5434	0.58838	
Processing meth	-0.274415	0.143972	-1.9060	0.06033	*
Access to capital.	0.0537157	0.160248	0.3352	0.73837	
Machines available	0.127496	0.0385716	3.3054	0.00143	**
Number of activities Participated	-0.350833	0.177776	-1.973	0.04407	*
R^2	0.622207				
Adjusted R^2	0.526620				
F-ratio	7.9761				

4. Source; result of regression from field survey, 2016. * significant at 10%,** Significant 5% &*** Significant at 1%

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EFFECT OF PRODUCT PACKAGING ON CONSUMER BUYING DECISION OF SWEET POTATO CHIPS IN UMUAHIA METROPOLIS, ABIA STATE, NIGERIA

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ABSTRACT
The study assessed the effect of product packaging on the consumer's buying decision of sweet potato chips and the problems affecting the buying choice of the product. The study was carried out in Umuahia Metropolis of Abia State. Data were collected from 60 consumers through questionnaire by using random sampling method. The data were analysed with descriptive statistical tool and probit regression analysis. The result of the study showed that the coefficient of income (0.001), packaging (0.159), taste (0.043) and education (0.043) were positive and significant. This indicates that these parameters had positive influence on the consumer's buying decision of packaged potato chips. Conversely, the variable, cost (-0.003) was negatively signed, implying that cost influenced the consumer negatively on the buying decision of the packaged potato chips. The result revealed that the serious problems affecting the consumer's buying decision of packaged sweet potato chips were poor packaging, consumer's income, taste, poor marketing strategy and consumer's attitude as the means of these parameters were equal or more than 2.0. The implication of the findings is that producers and processors should be encouraged to properly package their products as this gives value addition to the goods, generate more income and help to maintain consumer's confidence on the safety of the product for consumption.

INTRODUCTION
Sweet potato (*Ipomoea batatas* L) is one of the food security crops that are gradually gaining prominence in the rural and urban markets in Nigeria. It has been found to have economic potentials in both rainforest and derived savanna zones of Nigeria (Asumugha, 1999). Globally, Nigeria is the third largest producer with China leading (106,197 million mt) followed by Uganda (2.6 million mt) (FAO, 2004). It is a major source of income to farmers especially during extended harvest period. The market values vary according to local prices. The crop is grown for both human and animals. The potato tuber can be boiled, steamed, baked, fried, chipped, canned, frozen, made into flour and starch and processed into a good number of products (Takeda *et al*, 1986a, Wolfe, 1992). The root is good source of carbohydrate as well as raw materials for the manufacturing of industrial starch, glucose and alcohol (Udo *et al*, 2005). Some important nutrients of sweet potato include carotene, vitamins B_2 and C, polyphenols, thiamins, phosphorus, niacin, iron, calcium and carbohydrate (Islam, 2006). Even the leaves are used as vegetables for human being and fodder for livestock, as they are source of protein (Onunka *et al*, 2003). Sweet potato also has the effects of protecting soil, preventing soil erosion and is used as weed suppressant in the mixture of other crops and also improves nitrogen economy of the soil (Nwaigwe *et al*, 2010).

The potato crop is used in various ways and it has been found to be economically viable, but the problems with this crop are the shortage of its life, perishability of the tubers and unstable price due to seasonality in both supply and demand. Producers and processors are making efforts in order to address the perishability of the tubers and its seasonality by adding value to the product through the processing of the tubers into potato chips and packaging of the product so that it becomes appreciable to consumers. The conversion of the potato into chips and the proper packaging are the appropriate, suitable and convenience ways of preventing deterioration of the tubers during storage. In the process of making the chips, the processors clean the potato tuber, thereafter, peel, rinse, slice, add colour protection, stew, dehydrate, blend, mould, bake and finally package them (www.potatochipsmachinery.com/new/sweetpotato-chips-machinery.htmml. Retrieved on 27th November, 2015). The dried and packaged chip can be stored up to six months or more.

The primary purpose of packaging the chip is to protect it, keep it in good condition and preserve the flavor until it reaches the consumer. The journey from the processor to the ultimate consumer may be a long one, but the product must reach the consumer with good freshness, flavor, attractiveness and appearance unimpaired (Kordylas, 1991, Mustapha *et al*, 2014). The packaging reduces the total waste of the food, promotes the products handling, visibility and differentiates it from similar products (Anikweze and Ugwuona, 2011).

Good and attractive packaging creates market value, while poor packaging can dissuade the customer from buying the product irrespective of its quality. This is because consumers most times are attracted at the first sight to the packaging style of a product and it creates value by helping customers decision making process (Terblanche, 2006, Best, 2002). Also packaging imparts unique value to products, helps consumers to choose from wide range of similar products and stimulates buying behaviour (Silayoi and Speece, 2004). Even package standing on shelf affects the consumer buying decision. In recent years, civilization has invented synthetic materials such as tin can, aluminum, foil, cellophane paper, glass, plastic etc, these make the product easier and presentable (Mustapha *et al.*, 2014). These materials are with vivid colours which convey appeals to customers; hence consumers are tempted to buy the product due to the attractive nature of the package.

Sweet potato is sold in urban markets, but the tuber of the crop is bulky, with high moisture content and deteriorates rapidly after harvest thereby resulting to losses and high marketing cost. In terms of consumption, the potato is sweet. The sweetness of the tuber often makes it undesirable for consumption; dissuade the consumers from buying the product and thereby causing low demand of the good. These characteristics make the processors to process the tuber into chips and package them for longevity. These enhance the palatability of the product, increase demand, facilitate the marketing of the sweet potato and encourage the farmers to sustain their production. Hence, this study was carried out to assess the effect of the product packaging on the consumer's buying decision of potato chips and the problems affecting the buyer's choice of the product.

MATERIALS AND METHOD

The study was conducted in Umuahia Metropolis. Umuahia is the capital of Abia State and is located in the south east geopolitical zone of Nigeria. The state capital lies between latitudes 5^0 32/ N and 5^0 53/N of the equator and longitudes 70 29/ E and 7^0 48/ E of the Greenwich meridian (en.wikipedia.org/wiki/umuahia, Retrieved on November 27, 2015). Umuahia metropolis is made up of two local government areas, namely; Umuahia North and South LGAs with a population of about 359,230 (NPC, 2006). Umuahia being an urban area has many markets, shops, highway traffic points, schools and supermarkets where sweet potato chips and many consumers of the potato chips are likely to be found.

Purposive and random sampling methods were used to select the respondents of the study. Purposive sampling was used to select the markets and shops where the potato chips are mostly sold. This is because it is not all the markets and shops in Umuahia metropolis can get the chips. The markets selected were Ubani ultra modern markets, Onu-imo market and Orie Ugba markets respectively while the supermarkets selected were Capital, Ihechukwu and Blessed supermarkets. Ten respondents were selected from each of the markets, giving a total of 60 consumers that were used for the study. Field assistants and the shop owners assisted the researchers to administer the questionnaire, the concept of the respondent was gotten before the questionnaire was administered and collected at the spot. The data were collected through questionnaire and also oral interview was used to source information from the respondents.

The data collected were analysed with descriptive statistics and probit regression model. In order to determine the factors that influence the consumer's buying decision, the probit regression model was applied. The model is stated thus:

Probit (Y^*) = $X_i\beta + \mu$

Where X

Y^* = 0 or 1 (Dummy variable index representing consumer's buying decision)

Y = Consumer's buying decision (positive = 1, negative = 0), X_i = Vector of the independent variable, X_1 = Age (years), X_2 = Sex (Male = 1, female = 0), X_3 = Marital status (Married = 1, 0 = otherwise), X_4 = Level of education (years), X_5 = Income (₦), X_6 = Packaging (Good packaging = 1, poor packaging = 0), X_7 = Cost (₦), X_8 = Taste (Good taste = 1, bad taste = 0), X_9 = Marketing strategy (Good marketing strategy = 1, poor marketing strategy = 0). In order to ascertain the problems affecting the respondent's buying choice; statistical three point scale mean was used. A three point scale was used to determine the mean. A mean score of 2.0 was taken as base of judgment. Very serious = 3, Serious = 2, Not serious = 1 and Benchmark mean = 3.0.Decision: $\geq$ 2.0 indicates serious; $\leq$ 1.9 indicates not serious

RESULTS AND DISCUSSION

The result of the probit regression analysis as presented in the Table 1.0 indicates that the chi-squared showed the overall goodness of fit of the model as it was statistically significant. The result showed that among the determinants, five variables out of nine were significant at 1.0% and 10.0% levels of significance. The detailed result showed that income, packaging and taste were positive and significant at 1.0% level of significant while education was also positive and significant but at 10.0% level of significant. This implies that these factors have positive influence on the consumer's buying decision of packaged potato chips. Therefore, the coefficients of income, packaging, taste and education 0.001, 0.159, 0.043, and 0.032 respectively means that controlling the effects of other variables, the consumer's decision to buy packaged potato chips increased by 0.01%, 15.9%, 4.3% and 3.5% for each unit increase in income, packaging, taste, and education. The positive sign in education indicates that as a consumer becomes more educated, he recognizes/appreciates the importance of packaging of products which implies that the food becomes safer for consumption as the package protects the food from chemical, physical and biological influences (Anikweze and Ugwuona, 2011). Also the positive sign shown by good packaging and taste conforms to the study by Lifu (2012) which indicated that good product packaging resulted to increase in consumer's buying decision to buy the product while good taste makes the consumer to buy more of the product. Conversely, the variable, cost was negatively signed at 1.0% level of significant. This implies that cost has a negative influence on the consumer's buying decision. It indicates that a unit increase in the cost of the packaged potato chip decreases the buying decision of the consumer by 0.3%. This result corroborates with the findings of Lenka *et al* (2010) that high cost of potato was a significant barrier to potato consumption. On the problems affecting the consumer's buying decision of packaged potato chips, the results as shown in Table 2.0 indicated that poor marketing strategy ($\bar{X}$ = 2.37), cost of potato chips ($\bar{X}$ = 2.22), taste of the chips ($\bar{X}$ = 2.15), consumer's income ($\bar{X}$ = 2.08), poor packaging ($\bar{X}$ = 2. 03) and consumer's attitude ($\bar{X}$ = 2.0) were found to serious problems affecting the consumer's choice of packaged potato chips as the mean of all the parameters were 2.0 and above. On the other hand, the problem of lack of information ($\bar{X}$ = 1.95) was not seen as a serious problem affecting the consumer's buying decision of the packaged chips in Umuahia metropolis of Abia state.

Table 1.0 Probit Regression on the Determinants of Consumers Buying Decision

Parameters	Estimate	Standard Error	Z – Value
Intercept	3.866	.416	9.300***
Age	0 .002	.006	0.251
Sex	0 .114	.159	0.713
Marital status	-0.120	.117	-0.678
Education	0.032	.016	1.975*
Income	0.000	.000	4.468***
Packaging	0.157	.155	3.019***
Cost	- 0.003	.001	-2.750***
Taste	0.043	.159	2.740***
Marketing strategy	0.020	.152	0.130
Chi-square	107.593		
Df	50		
P < 0.01	0.000		

Source: Field Source, 2015
Key: * Significant at 10%, * Significant at 1%**

Table 2.0 Problems Affecting the Consumer's Buying Decision

Problems	Very serious		Serious		Not serious		∑X	$\bar{X}$
	F	%	F	%	F	%		
Poor packaging	22	36.7	18	30	20	33.3	122	2.03
Cost of potato chip	25	41.7	23	38.3	12	20.0	133	2.22
Taste of potato chip	25	41.7	19	31.7	16	26.7	129	2.15
Consumer's attitude/behavior	14	23.3	30	50.0	16	26.7	118	2.0
Lack of information on potato chip	19	31.7	19	31.7	22	36.7	117	1.95
Poor marketing strategy	31	51.7	20	33.3	9	15.0	142	2.37
Consumer's income	22	36.7	21	35.0	17	28.3	125	2.08
Grand mean								**2.1**
N = 145								

Source: Field Survey, 2015
Key: Very serious = 3, Serious = 2, Not serious = 1 and Benchmark mean = 3.0
Decision: $\bar{X} \geq 2.0$ indicates serious; $\bar{X} \leq 1.9$ indicate not serious

Conclusion

From the result of the study, it is clear that good and attractive packaging of sweet potato chips significantly influence the consumer's buying decision as these serve as advertisement and appeals to consumers. Not only that good packaging appeals to consumers, it protects the food, avoids its deterioration and guarantees the safety of the product for consumption. Therefore, farmers and processors should be encouraged to properly package their products as this gives value addition to the food, generates more income and helps to boost employment. In addition while embarking on good packaging, they should ensure that the quality of the food is maintained to enable them remain in the present day competitive market. Government should make it as a mark of policy that those agricultural products that are to go for a long distance should be properly packaged to ensure safety and the good health of the consumers.

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EXTERNAL MORPHOLOGICAL ASSESSMENT OF THE LEAF OF EXOTIC SWEETPOTATO GENOTYPES FOR SUITABLE FOOD UTILITY TRAITS

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ABSTRACT
External morphology and possible culinary uses of the leaves of some exotic sweetpotato were evaluated. The fresh experimental leaves were botanically characterized and sensory evaluation of the boiled leaves was carried out. Leaves of leafy elite sweetpotato genotypes existing in Nigeria were used as experimental checks. The result of their leaves external morphology characterization showed that about 25% were of simple palmate shape while the rest were simple non-palmate. The sensory panelists observed that the leaves from some of the experimental genotypes including local and International checks (Ex-Igbariam, TIS2532.OP.1.13 and TIS8164 respectively) could be used to replace or substitute some indigenous vegetables in local food preparation. The leaves of TIS8164 can also be used for traditional packaging in the preparation of Ekpan-nkwukwo (a local Nigerian dish). The nice aroma of the exotic Julian leaves could serve as a potential substitute for some indigenous spices in local food preparations.
Key words: *Sweetpotato, edible, leaves, sensory evaluation and exotic.*

INTRODUCTION
The culinary and other attributes for processing the leaf of sweetpotato accessories is very important for end user's acceptability (Rodriguez, 1999). Though the tuberous roots of the crop serve as staples in many Nigerian homesteads, Ukpabi and Oji (1984) found that the cooked leaves were also cherished as leafy vegetables by many local consumers. The leaves serve as side dishes in Taiwan. Young leaves are eaten as leafy vegetable (Abidin, 2004). The leaves are also good sources of vitamin A, C and B2 (FAO, 1990). The leaves contain 2.4mg/100g vitamin C and 709ug/100g vitamin A (Woolfe, 1992).
Recently, National Root Crops Research Institute (NRCRI) Umudike acquired some elite sweetpotato genotypes from CIP. There is need to evaluate the culinary attributes of the elite sweetpotato genotypes.

MATERIALS AND METHODS
Sources of materials:
The experimental materials from fifteen exotic sweetpotato (NASPOT1, NASPOT 2, NASPOT 3, NASPOT 5, Costanero (1870162), Jewel (44031), Julian (440141), Salyboro (187017), Cemsa (40000), Santo-Amaro, Carrot C, CIP-199024.2, CIP-199034.1, CIP-440203, and CIP-440443 and three locals (Ex-igbariam, TIS8164 and TIS2532.OP.1.13) were obtained from National Root Crops Research Institute, Umudike the germplasm plot of Sweetpotato Programme.

Characteristics of the sweetpotato leaves:
The colour and the foliar morphology of the genotypes were visually observed and recorded.

Sensory Evaluation of the Leaves:
The respective leaves were boiled at 100ºC within 10 minutes in glass beaker (Pyrex). Seven trained panelists (graduates of food science and allied disciplines) who were conversant with local leafy vegetables were used for the sensory evaluation with a nine point Hedonic scale (Iwe, 2002). In the scale 9 represented "like extremely", 5 represented "neither like nor dislike" while 1 represented "dislike extremely".
The sensory panelists were further represented to comment extensively on the samples.

Statistical Analysis:
The obtained experimental data were statistically analyzed with the appropriate SAS computer software.

RESULTS AND DISCUSSION
Table 1 shows the foliar characterization of the experimental genotypes (leaf colour, leaf shape/ leaf size) (Dutta, 1981). The result of their leaves external morphology characterization showed that about 25% were of simple palmate shape while the rest were simple non-palmate.
The randomly selected sensory assessors generally found the experimental leaves (exotic and local checks) acceptable (Table 2) as boiled leafy vegetables (with varying degrees of liking). Table 3 shows that the leaves from some genotypes that could replace or substitute the convectional vegetables. In addition, the panelists

reported the nice aroma of Julian genotype and possible use of the leaves of TIS 8164 as a replacement for the wrapping of cocoyam slurry/ paste in the preparation of *Ekpan-nkwukwo*.

Table 1: Foliar characterization of the experimental genotype

Genotype	leaf colour	leaf shape/type	leaf size
NASPOT 1	green only	simple (palmate)	medium
NASPOT 2	green purple variegated	simple (palmate)	medium
NASPOT 3	green purple variegated	simple (palmate)	big
NASPOT 5	green purple variegated	simple (palmate)	big
Julian (440141)	green	simple (sagittate)	medium
Salyboro (187017)	green	simple (cordate)	medium
Cemsa (40000)	green	simple (cordate)	small
Santo-Amaro	green	simple (cordate)	small
Carrot C	green	simple (cordate)	small
CIP-199024.2	green	simple (cordate)	big
CIP-199034.1	green	simple (cordate)	big
CIP-440203	green	simple (cordate)	small
CIP-440443	green	simple (sagittate)	medium
Ex-igbariam	green/purple lines	simple (cordate)	medium
TIS8164	green/purple lines	simple (cordate)	big
TIS2532.OP.1.13	green	simple (cordate)	big

Table 2: Sensory evaluation of the sweetpotato leaves

Sample	Appearance	Taste	General Acceptability
TIS2532.OP.1.13	6.40abcd	5.60cd	6.000bcd
Carrot C	6.40abcd	6.80abc	7.00ab
Santo-Amaro	6.40abcd	6.20bcd	6.00bcd
CIP-440203	5.80bcd	6.40bcd	6.00bcd
CIP-199034.1	6.20bcd	5.80bcd	5.40cd
Ex-igbariam	7.20ab	7.00ab	6.80abc
Salyboro (187017)	6.60abc	6.20bcd	6.20bcd
NSAPOT 2	6.60abc	6.20bcd	6.20bcd
TIS 8164	8.00a	8.20a	8.00a
NASPOT 1	5.80bcd	5.80bcd	6.40bcd
CIP 199024.2	5.40cd	5.20d	5.00d
NASPOT 5	6.20bcd	6.20bcd	5.60b
Cemsa	6.00bcd	5.40cd	5.80bcd
NASPOT 2	4.80d	5.80bcd	5.20d
Julian	6.20bcd	6.60bcd	6.00bcd
LSD	1.606	1.457	1.493

Table 3: Sensory assessors' feedback on sweetpotato that could be used to replace conventional vegetables in the preparation of various food forms

Food forms	**Conventional vegetable**	**Sweetpotato genotype that could replace the conventional vegetable**
Okro soup	Okro	NASPOT 3/ CIP 440203
Ugu/Egusi soup	Ugu (Telfaria)	Ex-igbariam/TIS8164
Ewedu soup	Ewedu	Carrot C/Julian
Yam porridge	Green Amarantus	CIP 199034.1/TIS8164
Ekpang-nkwukwu	Fresh cocoyam/plantain leaves	CIP440203/TIS8164
Jellof rice	Scent leaf	Julian

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

SUB-THEME III:

CROP PRODUCTION, PROTECTION, IMPROVEMENT AND BIOTECHNOLOGY

EVALUATION OF GROWTH PERFORMANCE AND MIXTURE PRODUCTIVITY OF INTERCROPPED SOYBEAN (*Glycine max*) AND *MORINGA OLEIFERA* AND THEIR EFFECT ON SOIL PROPERTIES IN THE GUINEA SAVANNAH ZONE OF NIGERIA

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ABSTRACT
The trial carried out to evaluate the performance of Glycine max and Moringa oleifera under inter cropping situation and their effect on soil properties in Abuja, using a Randomized Complete Block Design with 3 replications, showed that the soil in the area was strongly acidic with pH values of 5.20 prior to planting in 2014 but became moderately acidic after the second trial in 2015 with pH ranges from 5.8 in sole crop plot of Glycine max to 6.8 in Glycine / Moringa inter crop plots. Total nitrogen was significantly reduced after the first cropping season (0.03%) but was significantly improved after the second trial (0.07%), in 2015. Elemental sodium was drastically reduced from 0.90 Cmol^{-1} to 0.38 Cmol^{-1} in Glycine max/ Moringa inter crop plots of 50,000 stands of Glycine and 10,000 stands of Moringa oleifera in 2015. In 2014, the seed yield of soybean was not significantly influenced by Moringa intercropping but in 2015, the seed yield of Glycine max in the inter crop plots was 30% greater than that obtained from the sole crop plot. Highest seed yield (0.68 tha^{-1}) of Glycine max was obtained from inter crop plot of 50,000 Soybean stands + 10,000 stands of Moringa oleifera. LER was maximum in the inter cropping system of 50,000 stands of soybean and 10000 stands of Moringa plants with 23% and 68% more yield in 2014 and 2015 than the sole crop yields of both crops. The relationship between the two plants as assessed by LEC was cordial and complementary.
Key words: Moringa oleifera, Soy bean, Land Equivalent Ratio and Land Equivalent Coefficient,

INTRODUCTION
In the Guinea savannah agro-ecological zone of Nigeria, especially in the Federal Capital Territory (FGT), Abuja, majority of the farmers grow most of their arable crops under sole cropping situation. Continuous sole cropping without adequate fertilization has led to soil fertility depletion and subsequent low crop yields (Esu, 2010). Concerted efforts by the Agricultural Development Programme (ADP) through extension service programmes and short term training occasionally organized by Ministry of Agriculture and International Institute of Tropical Agriculture, (IITA), had increased the awareness of farmers in the FCT, Abuja of the importance of intercropping system. Consequently, over 55% of them (farmers) in the FCT now practice intercropping as the major cropping system in their systems. Therefore, it becomes necessary for the farmers to adopt intercropping as the major cropping system to maximize land use output. (Tariah and Wahua, 1985). Soybean is one of the commonly grown legumes under sole cropping situation in Nigeria (Kamara, 2009). as well as tremendous potential to improve incentive of resource-poor people particularly in a developing country like Nigeria (Danshiell, 1994). Meanwhile Nigeria is the largest producer of soybean in West and Central Africa (Root et al., 1987). Thus as a result of land crises, the productive capacity of the crop in this part of the country may dwindle if the crop is not being intercropped with other crops or fallow species. In some parts of Abuja, farmers grow their crops in alleys of *Moringa oleifera.* The plant, though not a nitrogen-fixing plant, is among the known promising exotic multipurpose tree species recommended for fuel wood, fodder, food, medicinal value, soil fertility improvement, providing semi-shade, and useful in intercropping systems where intense direct sunlight could damage crops Hence, this study was conducted to evaluate the effect of *Moringa* intercropping on the yield and yield components of Soybean, the soil physicochemical properties and mixture productivity of the intercrops.

MATERIALS AND METHODS
Two experiments, one in 2014 and the other in 2014 were carried out at the Teaching and Research Farm of the Faculty of Agriculture, University of Abuja, Nigeria. Randomized Complete Block Design (RCBD) with three replicates was used in the trial. Each replicate, separated from the other by one meter path way, contained five plots. Each plot measured, 5.0 m x 4.0 m and was separated from the other by 0.5m alley. Thus, a total of 15 plots were used in the trials. The treatments of which effects were assessed include; Sole Soybean (40,000 stands/ha), 62,500 stands/ha Soybean + *Moringa*, 50,000 stands/ha Soybean + *Moringa*, 40,000 stands/ha Soybean + *Moringa*, Sole *Moringa* (10,000 stands/ha). Plants of *Moringa* were raised from seedlings. Planting of Soybean (TGX 1440 – 7t) seeds and *Moringa* seedlings was done simultaneously at the first week of August. *Moringa oleifera* seedlings were planted at spacing of 1m x 1m giving a population of 10000 stands ha^{-1} Plant population of soybean was varied; 50cm x50cm (40,000 stands ha^{-1}), 40cm x40cm (62,500 stands ha^{-1}), 50cm x40 cm (50,000 stands ha^{-1}) respectively).The plots were manually weeded at 21 and 47 days after planting.NPK 15 –15 – 15 fertilizer was applied at 200 kg/ha, three weeks after planting. Data on all the parameters collected were

subjected to Analysis of Variance (ANOVA) using Randomized Complete Block Design. Treatment means were separated with Least Significant Difference (LSD). Bar charts and Tables were used to show the trend of the results.

RESULTS AND DISCUSSION

Table 1 shows the soil physicochemical properties of the field prior to planting while Table 2 showed the soil properties after harvest in each cropping season, (2014 and 2015). The soil classified as Alfisols and mostly well drained, (Nwaka, 2012; Esu, 2010), are strongly acidic with pH values of 5.20 prior to planting in 2014 but became moderately acidic after the second trial in 2015 with pH ranges from 5.8 in sole crop plat of *Glycine max* to 6.8 in *Glycine* / *Moringa* inter crop plots. This is an indication that the cropping system was environmentally friendly. The Total nitrogen was reduced after the first cropping season but was significantly improved after the second trial, in 2015,(Tables 2 and 3). The trend was similar for all the basic cations being assessed except the elemental sodium of which value was drastically reduced from 0.90 $Cmol^{-1}$ to 0.38 $Cmol^{-1}$ in *Glycine max/ Moringa* inter crop plots of 50,000 stands of *Glycine* and 10,000 stands of *Moringa oleifera* in 2015. The result on the soil properties of the experimental area indicates that in the first year of planting, the plants did not make significant impact of the soil fertility. Obviously within the first season of planting, the *Moringa oleifera* stands may not have been established enough to contribute significantly to the soil fertility. Any contribution within the short period may have come from the Soybean component Okigbo, and Greenland (1976) had reported that Soybean cultivation has expanded as a result of its nutritive and economic importance, soil fertility enhancement through nitrogen fixation and diverse domestic usage. Shahina *et al.*, 2005) had implicated *Moringa oleifera* in soil fertility improvement and maintenance. The clay, sand and silt composition of the soil was the same even after the experiment, indicating that the physical component of the soil was not affected by the practice. Thus, the crop practice is not only environmentally friendly but sustainably maintains the soil fertility of the experimental area. , Okoruwa, (2001) reported that inter cropping involving legumes reduces soil temperature and moisture loss, which favours multiplication and growth of some soil microorganisms that will enhance foliage multiplication. In 2014, the seed yield of soybean was not significantly ($P>0.05$) influenced by *Moringa* intercropping (Table 4). Except in the intercrop plot of 625,000 stands of soybean/ 10,000 stands of *Moringa*, the seed yield of soybean was fairly the same in both sole crop plots and inter crop plots in 2014. This non significant difference in seed yield of soybean in both cropping systems in 2014 confirmed the fact that the *Moringa* component in the first few months of its establishment was unable to contribute to the soil fertility or its neighbourhood effect on the component crop. However in 2015, the seed yield of *Glycine max* in the inter crop plots was 30% greater than that obtained from the sole crop plot. While the highest ($P>0,05$) seed yield of *Glycine max* was obtained from inter crop plot of 50,000 Soybean stands + 10,000 stands of *Moringa oleifera*, the lowest seed yield was recorded in sole crop plots of soybean in 2015. In both years of cropping, the seed yield of soybean in the inter crop plot of 62,500 of soybean + 10,000 stands of *Moringa* was relatively low, being reduced by 12 % in 2015. This reduction showed that crop competition in the affected plots was very aggressive indicating that a plant population of 72,500 ha^{-1} will encourage serious crop competition for Soybean and *Moringa* inter cropping venture. Mazaheri. (1998) reported that the decrease in the formation of nitrogen at the nodules on soybean roots was attributed to competition and shading effects under inter cropping situation and the phenomenon consequently reduced the seed yield of soybean. The trend of the seed yield of soybean as influenced by *Moringa* inter cropping was the same as those of its growth characters and yield components. In 2015, the seed yield of soybean, irrespective of cropping systems, was 20% greater than that of 2014. During the second year of cropping, the *Moringa* component was well established and the non harvestable portions of it were pruned and spread as green manure. The exercise thus may have improved the fertility status of the soil to the benefit of the companion crop. Meanwhile the biomass yield of *Moringa* oleifera in both cropping systems were fairly the same in both 2014 and 2015 respectively, (Tables 5 and 6). The result on biomass weight was the same as those of the dry matter and crude oil content of *Moringa* plants. The above results on *Moringa* showed that intercropping it with Soybean has no negative effect on its growth and development rather it improved it as shown in the inter crop plots of 50,000 stands of soybean crops and 1000 stands of *Moringa* plants per hectare. Clement *et al*., (1992) and Nabavi and Mazaheri. (1998) reported that intercropping Soybean with other crops produce positive relationship that enhances yield and fixes more nitrogen into the soil. The mixture productivity of soybean and *Moringa oleifera* in the trial is shown in Table 7. The Land Equivalent Ratio (LER) values for intercropping systems (except in 62,500 stands of soybean/ 10000 stands of *Moringa oleifera* in 2014), were greater than unity in all seasons. Ikeorgu et al (1989) reported that intercropping cassava and legumes is more advantageous in terms of land economy and productivity. Averaged over the two seasons, the LER was maximum in the inter cropping system of 50,000 stands of soybean and 10000 stands of *Moringa* plants. Thus, in this cropping system, inter cropping produced 23% and 68% more yield in 2014 and 2015 than the sole crop yields of both crops. This implied that more effective use of the land occurred in this mixture population than others. The poor results obtained under 62,500 stands of Soybean and 1000 stands of *Moringa* mixture showed that competitive pressures among the component crops were high. The evidence of the good performance of the crops under the cropping system,(

50,000 stands of soybean and 10,000 stands of *Moringa*), was shown by their individual Land Equivalent Coefficient, (LEC). LEC is developed to assess the interaction and productivity potential of crop mixtures and formulating proportions, (Anyaegbu 1988). A LEC of 78% as recorded in 50,000 soybean/ 1000 stands of *Moringa* ha^{-1} in 2015 showed that the neighbourhood effects between and among the crops were significantly beneficial and involved full complementarity.

CONCLUSION

The result of the experiment showed that total nitrogen was significantly reduced after the first cropping season (0.03%) but was significantly improved after the second trial (0.07%), in 2015. The trend was similar for all the basic cations being assessed. In 2014, the seed yield of soybean was not significantly influenced by *Moringa* intercropping but in 2015, the seed yield of *Glycine max* in the inter crop plots was 30% greater than that obtained from the sole crop plot. Highest seed yield (0.68 tha^{-1}) of *Glycine max* was obtained from inter crop plot of 50,000 Soybean stands + 10,000 stands of *Moringa oleifera*. LER was maximum in the inter cropping system of 50,000 stands of soybean and 10000 stands of *Moringa* plants with 23% and 68% more yield in 2014 and 2015 than the sole crop yields of both crops. The relationship between the two plants as assessed by LEC was cordial and complementary. Thus, an intercropping system involving 50,000 stands of Glycine max and 10,000 stands ha^{-1} of *Moringa oleifera* is recommended for good seed yield of *Glycine max* and biomass productivity of *Moringa oleifera*

Table 1: Pre-planting physicochemical properties of the soil in the Experimental site

S/No	Elements	Values
1	Clay	40%
2	Silt	17%
3	Sand	43%
4	Textural class	Clay loam
5	pH (ratio 1:2:5)	5.80
6	Organic carbon	2.4%
7	Total nitrogen	0.05%
8	Available phosphorus	19.3ppm
Exchangeable cations ($cmolkg^{-1}$)		
1	Ca	2.60
2	Mg	2.22
3	K	0.63
4	Na	0.90
5	H^+Al	0.95

Table 2: Physicochemical properties of the soil as influenced by Soybean/*Moringa* intercrop after harvest, 2014

Treatments						Elements						
Soybean	Moringa	Clay	Silt	Sand	pH	Organic			Available			
										Mg	K	Na
$Pltsha^{-1}$	$Pltsha^{-1}$						N	P	Ca			
40,000		40	17	43	5.6	2.5	0.04	15	2.0	2.05	0.62	0.74
62,500	10,000	40	17	43	5.6	2.4	0.03	18	2.5	2.12	0.62	0.70
50,000	10,000	40	16	43	5.8	2.5	0.04	15	2.5	2.50	0.65	0.78
40,000	10,000	39	17	43	5.7	2.5	0.05	15	2.0	2.50	0.65	0.70
10,000			17	43	5.8	2.6	0.05	15	2.0	2.00	0.62	0.79

Table 3: Physicochemical properties of the soil as influenced by Soybean/*Moringa* intercrop after harvest, 2015

Treatments						Elements						
Soybean	*Moringa*	Clay	Silt	Sand	pH	Organic		Available				
									Mg	K	Na	Ca
Plts ha^{-1}	Plts ha^{-1}						N	P				
400000		40	17	43	5.8	2.5	0.05	15	4.0	3.05	0.62	0.54
62,500	10,000	40	17	43	6.4	2.8	0.05	18	3.5	3.12	0.62	0.40
50,000	10,000	40	16	43	6.8	2.8	0.07	09	3.5	4.50	0.65	0.38
40,000	10,000	39	17	43	6.7	2.7	0.06	11	4.0	3.50	0.65	0.40
10,000			15	43	6.6	2.7	0.05	18	4.0	4.00	0.62	0.59

Table 4: Growth performance and yield of Soybean intercropped with *Moringa oleifera*, 2014

	Soybean Pop (ha^{-1})	*Moringa* pop (ha^{-1})	No. of leaves/plant	Ht(cm)/ plant	No.of pods/plant	Seed yield ($t\ ha^{-1}$)
	40,000	-----	25.33	44.51	23	0.32
	62500	10000	23.21	38.23	18	0.26
	50000	10000	25.23	45.60	24	0.38
	40000	10000	25.45	45.34	24	036.
	-------	10000	------	-----	----	------
Mean			**24.81**	**43.42**	**23.25**	**0.33**
LSD P >0.05			**1.09**	**2.43**	**1.87**	**0.021**
			2015			
	40000	-----	28.45	45.21	18	0.20
	62500	10000	24.81	34.87	25	0.42
	50,000	10000	27.33	48.45	35	0.68
	40,000	10000	27.67	46.34	35	0,64
	-------	10000	------	-----	----	------
Mean			**27.07**	**43.72**	**28.25**	**0.49**
LSD P>0,05			**1.55**	**1.22**	**4.37**	**0.04**

Table 5: Biomass yield ($t\ ha^{-1}$/harvest) of *Moringa* intercropped with Soybean, 2015

Harvest periods	Soybean Pop (ha^{-1})	Moringa pop (ha^{-1})	Fresh biomass	Dry biomass	Crude protein
	40,000	-----	---	-----	
70 days	62500	10000	3.6	1.27	0.43
	50000	10000	3.6	1.27	0.46
	40000	10000	3.7	1.25	0.52
	-------	10000	3.7	1.25	0.33
Mean			**3.65**	**1.26**	**0.44**
	40000	-----	----	-----	
	62500	10000	5.6	1.24	0.23
115 days	50,000	10000	6.8	2.46	0.42
	40,000	10000	5.3	1.79	0.26
	-------	10000	5.7	1.43	0.20
Mean			**5.84**	**1.73**	**0.28**
	40,000	-------	---		
	62500	10000	5.8	1.33	0.10
160 days	500000	10000	6.9	1.43	0.14
	40000	10000	6,4	1.34	0.12
	--------	10000	4.6	1.36	0.11
Mean			**5.93**	**1.37**	**0.12**
DMRT &>0.05					

Table 7: Mixture productivity of Soybean and *Moringa oleifera* Intercrop in 2014 and 2015

Soybean Pop (ha^{-1})	Moringa pop (ha-1)	2014 LER	2014 LEC	2015 LER	2015 LEC
40,000	-----	1	---	1	---

62500	10000	0.87	0.23	1.12	0.26
50000	10000	1.23	0.45	1.68	0.78
40000	10000	1.25	0.44	1.57	0.65
-------	10000	1	----	1	----

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POTENTIALS OF PITTING TECHNIQUES FOR OPTIMIZING DRY SEASON YAM (*Dioscorea rotundata*) PERFORMANCE UNDER SCHEDULED IRRIGATION INTERVALS AND METHODS

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ABSTRACT
Moisture stress is a limiting factor in dry season crop production and this may be alleviated by manipulation of soil condition and proper irrigation scheduling. This research was conducted to determine some morphological (tuber length and tuber diameter) and yield characteristics of dry season yams produced under different pit depths, irrigation intervals and irrigation methods. The experiment was a split-split plot in randomised complete block design with two irrigation methods (M_1, sprinkler and M_2, furrow), two irrigation intervals (I_1, 3-4 and I_2, 7-day) and three planting pit depths (D_1, 20; D_2, 40 and D_3, 60 cm) as main, sub and sub-sub plot treatments, respectively, replicated thrice. The results indicated that application of all the treatments alone did not significantly affect tuber yield ($P>0.05$) but did so for all tuber morphological characteristics excepting tuber length for irrigation methods. However, there existed a significant ($P<0.05$) interaction effects of the treatments (M x I x D) on all assessed tuber morphological and yield characteristics. Irrigating the yams at a more frequent 3- day intervals under sprinkler method and planting pit depth of 40 cm ($M_1I_1D_2$) maximised tuber yield responses (31.53 t/ha). This however, produced similar yield responses to those obtained by irrigating the yams at a less frequent 7-day intervals using sprinkler method and at the same pit depth of 40 cm ($M_1I_2D_2$) (30.48 t/ha), which gave the highest tuber morphological characteristics. These results suggest that a farmer could enhance his yam yield under this production system by applying either $M_1I_2D_2$ or $M_1I_1D_2$ depending on his economic condition.
Keywords: Pitting techniques, irrigation scheduling and yam tuber characteristics

INTRODUCTION

Yam (*Dioscorea rotundata*) ranks among the major food crops of the world, occupying an area of 5 million hectares with annual production and productivity of about 50 million tonnes and 11 tonnes per hectare, respectively (FAO, 2011). Nigeria is the world's largest producer, accounting for 70 – 76 % of the total world production of yam (Wikipaedia, 2016), with an annual output of 35.017 million tonnes from 2.837 million ha (Cigar, 2011). Moisture stress in arid and semi-arid regions or during dry seasons in humid regions is an important limiting factor in crop production. However, use of irrigation techniques has been found to alleviate water stress during dry periods. Irrigation allows for a higher cropping intensity, increases crop productivity, reduces crop failure rates and guarantees higher level profit than rain-fed production. They also provide increased source of energy and food security during dry season (Onyenweaku, 1994; Pinstrup Anderson et al., 1997). Crop yields may increase by using proper irrigation scheduling and grain yield of fingermillet has been shown to be increased by more frequent irrigation intervals (Vanangamudi et al., 1990). It has been shown that, besides variation in response of applied fertilizers with different methods of irrigation, frequency of water application or more frequent irrigation intervals is different in sprinkler as in conventional furrow irrigation systems. Also, water has been found to be applied frequently in lower amounts in sprinkler irrigation as compared with heavy application under furrow irrigation (Sharma et al., 2012). Furthermore, it has been reported that sprinkler irrigation produced higher yields of potato due to better availability of moisture throughout the growth period (Pawar et al., 2002). Similarly, the "Zai" technique of planting on dug and covered up pits, otherwise referred to as pitting techniques is an indigenous technique from Burkina Faso that has been shown to improve millet yields in smallholder farms during low rainfall years in semi-arid regions (Ouedraogo and Kabore, 1996) as well as conserve soil moisture in steep lands (35 – 60 %) (Martin et al., 1996). Yams are mostly produced under rain-fed agriculture in Nigeria and/or on hydromorphic soils during the dry season mostly on mounds or ridges and scarcely in holes. Yam production under rain-fed scenario is without lots of rainfall unpredictability, especially in this era of global warming and climate change. Therefore, the dream to develop yam-based industries in Nigeria cannot be achieved if production depends on rain-fed agriculture. Dry season yam production is undertaken to complement the main-season, rain-fed production to ensure year round availability of yams in the market to meet domestic demands and encourage export. However, this is equally without lots of unpredictability as moisture stress is one of the major production constraints that constitute a threat to the sustainability of dry season yam production. Attempts at this on hydromorphic soils and suitable ecology was largely successful with water yam (*Dioscorea alata*), achieving a yield of over 24 t/ha, but this resulted in low yields of white yams (*Dioscorea rotundata*), including the hybrid ones across locations in Nigeria (4.04 – 7.39 t/ha) and at Umudike (2.31 to 15.77 t/ha) (Ikeorgu et al., 2007) despite adopting or applying all cultural production practices such as weeding, staking and fertilizer application at the recommended rate and time for ware yam production. There is therefore, the need for irrigation systems and soil manipulative strategies that improve the productivity of yam to a targeted range of 25 – 30 t/ha for meeting yam demands. The objective of this study was therefore to evaluate the potential of pitting techniques for enhancing the productivity of yams grown under different irrigation intervals and methods.

MATERIALS AND METHODS

The study was carried out during the dry season of December – April 2012 and 2013 at the irrigation farm of the NRCRI, Umudike (Lat. 05 ^{o} 29 ^{I} N and Long. 07^{o} 32 ^{I} E at an elevation of 122 m asl), a rainforest agro ecology of Southeastern Nigeria (SEN). White yam (cv Nwagba) seed of sett size of 200 $\pm$ 50 g was planted on 14th November, 2012 on a sandy clay loam at the experimental site that had previously been uniformly watered to field capacity on 12th November, 2012. The soil was a Typic Paleudult (USDA Soil Taxanomy) and exhibited, a very strongly acidic reaction, low in total N and exchangeable K, but high in organic matter content and available phosphorus (P) (data not shown). The experiment was laid out as a split - split plot in a randomised complete block design (RCBD) with three replications. The treatments comprised two irrigation methods (M_1, sprinkler and M_2, furrow), two irrigation intervals (I_1, 3 – 4 and I_2, 7-day) and three planting pit depths (D_1, 20; D_2, 40 cm and D_3, 60 cm) as main, sub and sub – sub plots, respectively. The field was mechanically slashed, ploughed, harrowed and manually detrashed and demarcated into 4m x 4m experimental plots. Planting pits were dug on the crests of the ridges at 1 m spacing and covered before planting the yams. Subsequent scheduled irrigation of the trial plots were conducted between 19th November, 2012 and 6th May, 2013, before allowing the crops to grow to full maturity under rain-fed scenario. Both irrigation methods were scheduled on the irrigation interval based on accumulated evapotranspiration replacement approach using the Modified Pennman equation at the NRCRI, AgroMet weather station. The sprinkler systems were located at the border rows between main plots and the trial plots were irrigated with a semi portable rotating head sprinklers with nozzles spaced at 12 m x 12 m. The yam tubers were harvested on 15th July, 2013 and data were collected on tuber yields and some tuber morphology (tuber length and diameter). Analysis of variance was used to assess treatment effects and means were compared using Fisher's Least Significant Difference (LSD) at 5 % probability level using GENSTAT (2003).

RESULTS AND DISCUSSION

Tuber morphology

Methods of irrigation, irrigation intervals and planting pit depths applied alone, produced significant effects on tuber length and tuber diameter except tuber length under irrigation methods (Table 1). Sprinkler irrigation (M_1) produced about 6 % wider tuber diameter than furrow (M_2) (8.498 cm) and though tuber length obtained in M_1 (29.53 cm) was not significantly (P> 0.05) different from that in M_2 (29.03 cm), it appeared to be slightly higher. The better morphological performance of the yam tubers under sprinkler irrigation could be due to a more precise control of water than furrow that allowed for more accurate management of crop – root zone soil moisture as reported by Feibert et al. (1998). Also, irrigating the yams at 7-day intervals (I_2) gave about 5 and 9 % significantly (P < 0.05 and 0.009) greater tuber length and diameter than irrigating at a more frequent 3 – day intervals (I_2) (28.72 and 8.376 cm, respectively). Similarly, top sol pit depths at 20 cm (D_1) and sub-soil depth at 60 cm (D_3), with non-significant tuber length and diameter differences between them produced about 3 and 4 % and 3 % significantly (P<0.01) greater tuber length and diameter respectively than those at sub-soil depth of 40 cm (D_2). Although D_1 and D_3 exhibited non significant differences among themselves, tuber length (29.69 cm) and diameter (8.873 cm) in D_1 were slightly higher than those (29.61 cm and 8.796 cm, respectively) in D_3. This observation could probably be due to better moisture availability from the high organic matter content (3.1 %) of the top soil (data not shown). Overall, the significant (P < 0.05) tuber length and tuber diameter responses to the independent treatments for the environmental conditions encountered could be due to differential moisture availability that existed in the irrigation intervals and pit depths. On the other hand, application of M, I and D in different combinations (that is, interaction effects of irrigation method x irrigation interval and pit depths) brought significant variation in tuber length and tuber diameter of the yams (Table 1). The highest tuber length (31.81 cm) and diameter (10.703 cm) were obtained in plots that received $M_1I_2D_2$ which was similar (P > 0.05) to those in $M_1I_2D_1$ only in terms of tuber length (31.57 cm). This suggests that sprinkler irrigation at a less frequent 7 – day interval and sub-soil depth of 40 cm produced the highest tuber morphology.

Tuber Yield

There were no significant main effects of the treatments (irrigation methods, irrigation intervals and planting pit depths) on the economic yields of the yam crop. However, interaction between the treatments (M x I x D) showed significant effect on the yam yield (Table 1). Sprinkler irrigation at a more frequent 3 – 4 day intervals and pit depth of 40 cm ($M_1I_1D_2$), which was similar to those (30.476 t/ha) from $M_1I_2D_2$ that maximised tuber length and diameter responses, including those under furrow irrigation at a less frequent 7-day irrigation intervals and pit depth of 20 cm ($M_2I_2D_1$) (30.9 t/ha), gave the highest yam tuber yield (31.53 t/ha) which significantly (P < 0.01) out yielded those from plots that received sprinkler irrigation at 3 – day irrigation intervals and 60 cm pit depth ($M_1I_1D_3$) and some others including those that received furrow irrigation at a less frequent irrigation intervals of 7 days and pit depth of 20 cm ($M_2I_2D_1$) by about 12 – 27 %. The increase in yield might be due to the higher availability of moisture under sprinkler irrigation at a more frequent irrigation interval than furrow irrigation. Pawal et al. (2002) and Sharma et al (2012) also reported similarly for potato and are consistent with the findings by Vanangamudi, et al. (1990) who showed grain yield of finger millet to have been increased by more frequent irrigation intervals.

CONCLUSION

The study found out that the yield range of yam obtained under this production system (24.73 – 31.54 t/ha, mean 28.5 t/ha) was 457 – 230 % higher than that obtained in an earlier study at the same location under hydromorphic ecology without irrigation (4.44 – 15.77 t/ha) as well as increased the average yield of yam in Nigeria (13.9 t/ha) by 105 %. Furthermore, tuber length and diameter were 2 and 6 % higher under sprinkler than furrow irrigation just as these parameters were higher at pit depths of 20 and 60 cm than at 40 cm. Also, irrigating the yams at a more frequent 3 – 4 day intervals under sprinkler irrigation and 40 cm pit depth ($M_1I_1D_2$) maximised tuber yield responses (31.54 t/ha) with similar tuber yields to those produced under same irrigation method and depth but at a less frequent 7-day intervals ($M_1I_2D_2$) which gave the highest tuber morphological characteristics. These results suggest that a farmer could enhance his yam yield and achieve the target set for meeting both domestic and export needs of yam in Nigeria by applying either $M_1I_1D_2$ or $M_1I_2D_2$ depending on his economic condition.

Table 1: Some morphological and yield characteristics of dry season yam (*Dioscorea rotundata*, cv. Nwagba) tuber as influenced by irrigation methods, irrigation intervals and planting pit depths at Umudike, Southeastern Nigeria (SEN)

Treatments	Tuber length (cm)	Tuber diameter (cm)	Tuber yield (t/ha)
Irrigation Methods (M)			
Sprinkler (M_1)	29.70	8.967	28.69
Furrow (M_2)	29.03	8.498	28.28
LSD (0.05)	Ns	0.1514**	ns
IrrigationIntervals (I)			
3 – 4 day (I_1)	28.72	8.376	28.07
7-day (I_2)	30.02	9.089	28.90
LSD (0.05)	1.009*	0.1550***	ns
Planting pit depths (D)			
20 cm (D_1)	29.69	8.873	28.29
40 cm (D_2)	28.8	8.529	28.89
60 cm (D_3)	29.61	8.796	28.28
LSD (0.05)	0.65**	0.2235**	ns
M x I x D Interactions			
$M_1I_1D_1$	29.26	8.781	25.83
$M_1I_1D_2$	26.96	7.689	28.23
$M_1I_1D_3$	30.38	9.204	30.93
$M_1I_1D_1$	28.39	8.700	29.67
$M_1I_1D_2$	28.94	7.504	25.33
$M_1I_2D_3$	30.26	9.112	29.67
$M_2I_2D_1$	31.57	9.632	30.18
$M_2I_2D_2$	31.81	10.703	30.47
$M_2I_2D_3$	30.13	8.524	27.78
$M_2I_2D_1$	29.54	8.378	27.47
$M_2I_2D_2$	27.50	8.220	31.53
$M_2I_2D_3$	27.68	8.324	24.73
LSD (0.05)	1.411**	0.3847***	3.159**

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FUNGITOXIC POTENTIALS OF CRUDE EXTRACTS AND PHYTOCHEMICALS DERIVED FROM LEAVES OF *Alchornea cordifolia* (Christmas bush) and *Curcuma longa* (Turmeric) AGAINST SEED ROT DISEASE OF COWPEA

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ABSTRACT
The causal agent of the seed rot disease of cowpea was investigated. The isolates were tested for its ability to initiate disease symptom on a relatively healthy uninfected cowpea seed. The inoculated cowpea seed were incubated at room temperature (27 – 30^{0}C) over a period of 7 – 8 days and examined daily for rot symptoms. The fungus (Sclerotium rofsii) was able to reproduce. The result shows that Sclerotium rofsii is the causal organisms of the seed rot of cowpea. The use of some plant extracts of Alchornea cordifolia and Curcuma longa to control the growth and development of the disease incitants was conducted in vitro. One disc (3mm) of the 10-day old culture of the test pathogens was transferred aseptically to the centre of the solidified PDA-Extract medium in the Petri dishes which had previously been marked underneath with 2 perpendicular lines through the centre. The Petri dishes were then incubated at 27ºC for 7 days. The radial growth of the host pathogen was measured with a meter rule along the perpendicular lines after 7 days of incubation. This experiment was laid out in a complete randomized design (CRD) made up of 4 treatments and 3 replicates. The result revealed that the crude extracts of the test plants significantly inhibited the initiation, development and spread of the fungus in cowpea. The 100% concentration of the Curcuma longa reduced the incidence of Sclerotium rofsii induced seed rot disease in the test cowpea with 83% and Alchornea cordifolia recorded 53%. Comparative to the fungicide, *there was no significant difference between benomyl (benzamidazole) 90% and 83% concentration of the extracts of Curcuma longa. The toxicity profile like in the previous in vitro assay was Curcuma longa >A. cordifolia.*
Key words: Seed rot, Cowpea and Phytochemicals

INTRODUCTION
Cowpea (*Vigna unguiculata* (L.) Walp.) commonly known as southern pea, black-eye pea, crowder pea, blackgram etc. belongs to the family Fabaceae. It is an annual legume, originated in Africa with South Africa or West Africa as its centers of speciation (SADAFF, 2009; Davis *et al.*, 2012). Its cultivation dates back to about 6 thousand years; in close association with sorghum and millet cereal farming of the West African sub-region. As a crop cowpea is widely grown in the savannas of Africa, Asia, USA and the Americas (Davis *et al.* 2012).
As a food crop, cowpea is reported as the second most important grain legume in Africa after common bean (*Phaseolus vulgaris*); and ranked among the top 5 pulse crops in the world. The crop's seeds, pods and leaves can be consumed as processed grains and vegetables (Awurum, 2000; SADAFF, 2009). One hundred grams (100 g) of cowpea seeds is reported to contain 343 KJ of metabolizable energy, carbohydrate, 59.6 g, fat, 2.1 g, protein, 23.9 g, calcium, 85.0 g, phosphorus, 438 mg, iron 9.9 mg, potassium, 1375 mg, vitamins A, 33.0 IU, C, 1.5IU, B_2, 0.2 mg, B_6, 0.4 mg, and ash 3.4 g (Infonet-biovision, 2014). Cowpea is a rich source of food for livestock and also plays important roles in erosion control and soil fertility restoration in farming systems of tropical regions through symbiotic fixation of 240kgN/ha per year (SADAFF, 2009). However, the production of this crop has been induced by heavy biotic pressures of pathogenic organisms and other health challenges (Enyiukwu *et al.*, 2014). Therefore, the objectives of the study is to isolate and identify the rot causing organisms of cowpea and to evaluate the fungitoxic effects of phytochemicals of *A. cordifolia* and *Curcuma longa* on the control of seed rot diseases of cowpea.

MATERIALS AND METHODS
The experiment was conducted at the National root crops research Institute, Umudike and College of Crop and Soil Science, Michael Okpara University of Agriculture, Umudike, Abia State Nigeria. Relatively disease – free cowpea were collected from the Michael Okpara University of Agriculture Umudike. The leave of *Alchornea cordifolia* were sourced locally and the *Curcuma longa* rhizome were collected from Minor Root Crop Programme in National Root Crop Research Institute Umudike. The organism isolate used was obtained from infected cowpea plants in the research farm of Michael Okpara University of Agriculture, Umudike. The infected cowpea seed were cut into 5mm segments, and were surface disinfected in 0.5% sodium hypochloride solution for 5 minutes and rinsed in three changes of sterile distilled water. The placed segment in PDA medium was incubated at 28^{0}C at 12 hours darkness and light for 7 days. Thirty grams (30g) of each of the ground plant extracts were dissolved in 100ml of sterile distilled water in a beaker and allowed to stand for 24hrs after which was then strained through the 4 folds of sterile cheese cloth into a beaker to obtain filtrate of 30% concentration of aqueous extract

suspension. The cultures were sub-cultured to obtain pure culture of the isolates and were tested for its ability to initiate disease symptom on a relatively healthy uninfected cowpea and the isolate were considered as pathogen.

RESULT AND DISCUSSION

Results shows that *Sclerotium rolfsii* were isolated from the seed rots of cowpea. The inoculation of the pathogen organism affected tissues leading to appearance of rot symptoms on seed of the cowpea. Two plant materials, a synthetic (chemical) and sterile water were evaluated for the inhibition of mycelial growth and spore germination of the rot pathogen (*Sclerotium rolfsii*) . The results indicated that the organisms were most sensitive to *C. longa,* while *A. cordifolia* was least fungitoxic. The extracts of the test plants showed significant difference (P<0.05) in the inhibition of the spore germination of the pathogens when compared with the control experiment. Extracts of *C. longa* recorded the best mean percentage inhibition of spore germination of the pathogen (83%) which was significantly different (P < 0.05) from extracts *A. cordifolia* (53%). The fungicide gave appreciable reduction in spore germination of the test pathogens with mean percentage of 90%. The benomyl was significantly different (p ≤ 0.05) from the plant extracts, but compared well with extracts of *C. longa.* The control (sterile water) had no effect on the spore germination of the test fungi.

Table 1: Effect of the plant extracts on the spore germination of the cowpea seed rot pathogens

Pathogen	**Plant Extract**			
Sclerotium rolfsii	Curcuma. Longa	*Alchornea. Cordifolia*	Benomyl	S/ water
	85	55	91	08
	80	51	89	7
	84	53	90	8
Mean	83	53	90	7.7
LSD	1.22	0.97	1.54	0.07

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PERFORMANCE OF SELECTED WATER YAM (*D. ALATA*) CULTIVARS AS PARENTS FOR GENETIC RECOMBINATION IN THE RAINFED AGROECOLOGY OF UMUDIKE, SOUTHEASTERN NIGERIA

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ABSTRACT
The experiment was conducted at the Western experimental field of National Root Crops Research Institute, Umudike Umuahia Abia State in 2014 and 2015 respectively the objectives to was to select high tuber yielding cultivars as parents, to define the accessions into sexes, to select parents that flowers profusely, to determine the intensity of flowering among the cultivars, and to select cultivars with high flowering intensity for inclusion into the germplasm for breeding purposes. Twelve water yam cultivars were used. Each cultivar was planted in a 4 by 5m plot at a planting distant of 100cm between ridges and 100cm between plants and the plots were replicated four times. Data collected were on: tuber yield, flowering intensity, number of male and female plants that flowers, Number of leaf axils/nodes per plant, Number of male (staminate spike) flowers on the leaf-axils/nodes per plant, Number of female (pistillate spike) flowers per plant and Sex of the yam plant. The result indicated that Cultivars with total number of tubers less than the grand mean and total fresh tuber weight lower than the grand mean of 26.25 and 22.82t/ha respectively were not selected as parents. and that cultivars with profuse flowering having the score 4 were selected as male parents while Sakata with 38 number of tuber per plot and 19.5t/ha fresh weight of tubers were selected as the only female water yam plant. These cultivars would be included in the germplasm for D. alata improvement programme.
Keywords: Parents, tuber yield, flowering intensity, germplasm and hybridization

INTRODUCTION
Yam in general is one of the major carbohydrate staple foods for the people of Nigeria and to a large extent for people in West Africa. There are six major yam species cultivated in West Africa namely: *D. rotundata, D. alata, D. dumetorum, D. cayenensis, D.esculenta* and *D. bulbifera* (Onwueme and Sinha, 1999). *Dioscorea alata* is one of the major yam species in the family *Dioscoreaceae* (Okoli,1986). *D. alata* is very important in terms of food quality and when compared with other yam species is fraught with many problems which range from low genetic improvement, poor food quality in terms of dry matter content, biotic and abiotic factors which make it prone to pests and diseases (Onwueme and Sinha, 1999). One of the major problems is low dry matter content, and attack by diseases such as anthracnose, Yam mosaic diseases and pests such as yam beetles. Some of these problems could be solved by breeding, however, Egesi (1998) noted that poor flowering and seed setting limits the introduction of valuable genes from some germplasm with desirable attributes. The introduction of desirable genes will be possible with a good choice of parents. Parents with desirable attributes could be selected through screening of parental stock (Okoli, 1986). Therefore the objectives of this work was to: to select high tuber yielding cultivars as parents, to define the accessions into sexes, to select parents that flowers profusely, to determine the intensity of flowering among the cultivars, and to select cultivars with high flowering intensity for inclusion into the germplasm for breeding purposes.

MATERIALS AND METHODS
The experiment was conducted at the Western experimental field of National Root Crops Research Institute, Umudike Umuahia Abia State in 2014 and 2015 respectively.. The average weight of each sett was 300g. The land was prepared with tractor. The soil at the site of evaluation was well drained deep clay sandy loam and a mean annual rainfall of 1500mm and mean sunshine hours of 5.5 per day. Twelve water yam cultivars were used Each cultivar was planted in a 4 by 5m plot at a planting distant of 100cm between ridges and 100cm between plants and the plots were replicated four times. Farming operations such as weeding and staking were carried out. However, no fertilizer was applied to avoid the crop growing very vegetative which will delay flowering and fruit set.

Data collection: Data collected were on: tuber yield, flowering intensity, number of male and female plants that flowers, Number of leaf axils/nodes per plant, Number of male (staminate spike) flowers on the leaf-axils/nodes per plant, Number of female (pistillate spike) flowers per plant and Sex of the yam plant, .

Data analysis: The number of tubers per plant were counted and recorded at harvest, All tubers per plant were weighed after harvest and Analysis of variance was used to determine the variability in fresh tuber yield and mean tuber yield were separated using standard error of means. Fresh weight was measured in tonnes per hectare. Number of flowered male and female yam plants was calculated in percentages, Sex score, using scoring procedure outlined by Orkwor et al (2000) were as follow:1 = absence of flower, 2 = presence of either male or female flower, 3 = male yam plant, 4 = female yam plant, 5 = monoecious, male flower > female flower , 6 = monoecious, female flower > male flower.

Flowering intensity were determined using the formula derived by (Orkwor, et al 2000). Flowering intensity for Male Flowers

$$\frac{\text{Total number of staminate spike flowers}}{\text{Total number of nodes}} \times \frac{100}{1}$$

(ii) Female flowering intensity;

$$\frac{\text{Total number of pistillate spike flowers}}{\text{Total number of nodes}} \times \frac{100}{1}$$

Scoring for flowering intensity was carried out after calculation using the percentage for the scoring as follows: 0 =(0.0%) = No Flower, 1 = (1 – 25%) = low flowering intensity (sparse), 2 = (26 – 50%) = Medium flowering intensity (moderate), 3 = (51 – 75%) = High flowering intensity, 4 = (76 – 100%) = Profuse flowering

RESULTS AND DISCUSSION

The result on number of tubers and fresh tuber weight is presented on Table 1. There was high significant (P<0.01) variation in the total number of tubers produced by the water yam plants. Number of tubers varied from 20.0 (TDa02/00019) to as high as 55.0 (TDa/00194) per plot. Also this variety had the highest number of ware tubers per plot (Table 1). Four of the varieties evaluated produced less number of tubers per plot even lower than the general mean of 26.25 numbers of tubers per plot. According to Nwankwo (2012), number of tubers per plant per plot is a function of yield and the first thing a farmer considers while assessing for a high yielding varieties. Varieties with high number of tubers per plant per plot should be considered for selection while selecting for parents for inclusion in the hybridization programme of *D. alata*. Also considered is the tuber weight. Significant (P<0.05) variability existed in the total fresh tuber weight produced by the water yam varieties. The total weight of tubers varied from 17.0t/ha (TDa02/00019) to as high as 42.3t/ha (TDa00/194) with a general mean of 22.82t/ha (Table 1). However, 7 out of 12 of the water yam cultivars evaluated produced total fresh weight of tubers lower than the general mean of 22.82t/ha and may not be considered as good candidate for selection as parents for inclusion in the hybridization programme.

Flowering intensity, Flowering pattern and Sex of the water yam plant: The result of the Flowering intensity, Flowering pattern and Sex of the water yam plant (*D. alata*) are presented in Table 2. The result indicated that all the water yam plants with the score 2 under the sex of yam plant flowered as either male or female yam plant. One variety (Sakata) with the score 4 flowered as female water yam plant which represent 8.3% while 91.7% with the score 3 were male water yam plants (Table 2). The following water yam plants flowered profusely with the score 4 under flowering intensity: TDa/96/01168, TDa00060, TDa1166, TDa02/00019 and TDa/00194, and were selected for inclusion as parents in the hybridization programme for *D. alata*. The female water yam plant (Sakata) had high flowering intensity with the score 3 and should be selected as female flowering water yam plant for inclusion in the hybridization programme.

The number of nodes and the number of male and female flowers arising from the axil are used to calculate the flowering intensity of the male and female yam plants (Orkwor et al., 2000). Yam plants that flowered profusely were given the score 4 which indicated that the flower production was much between 76 -100%, while those that were scored zero. produced no flowers. Low or sparse flowering were given the score 1 (that is between 1 - 25%). Five of the male yam plants flowered profusely with the score of 4 while the only female yam plant (Sakata) scored 3 which indicated flower production of between 51 - 75% and was regarded as high flowering intensity. Therefore male and female water yam plants that flowered highly intensive (score 3) and profusely (score 4) were selected as parents for hybridization programme (Table 2).

CONCLUSION

Cultivars with total number of tubers less than the grand mean and total fresh tuber weight lower than the grand mean of 26.25 and 22.82t/ha respectively were not selected as parents. Based on the result obtained, the following male water yam cultivars TDa02/000194 with 55 number of tubers per plot and 42.3t/ha fresh weight of tubers, TDa96/01168 with 41 number of tubers per plot and 28.2t/ha fresh weight of tubers, and Abanaoyibo with 31 number of tubers per plot and 23.1t/ha of fresh weight and profuse in flowering having the score 4 were selected as male parents while Sakata with 38 number of tuber per plot and 19.5t/ha fresh weight of tubers were selected as the only female water yam plant. These cultivars would be included in the germplasm for *D. alata* improvement programme.

Table 1: Number of tubers and fresh tuber weight of selected water yam cultivars

Name of cultivar	Total number of tubers	Number of ware yam tuber	Number of seed tuber	Total tuber weight	Ware tuber weight	Seed yam weight
TDa96/01168	41.0	33.0	8.0	28.2	24.3	3.9
TDa00060	32.0	19.0	13.0	21.3	14.1	7.2
TDa1166	27.0	21.0	6.0	18.0	13.0	5.0
Abanaoyibo	31.0	20.0	11.0	23.1	18.0	4.70
02/00151	22.0	17.0	5.0	18.1	12.5	5.6
Bufu	21.0	15.0	6.0	17.4	13.2	4.2
UM/680	27.0	12.0	15.0	24.6	20.00	4.60
Sakata	38.0	25.0	13.0	25.5	21.30	4.20
Gborogboro	28.0	19.0	9.0	19.5	13.70	5.60
TDa02/00019	20.0	18.0	2.0	17.0	16.50	0.50
98/1164	23.0	17.0	6.0	18.8	16.00	2.80
TDa/00194	55.0	34.0	21.0	42.3	34.00	8.30
Mean	26.25	20.8	9.6	22.82	18.05	4.72
Std error	11.64	9.83	5.55	12.65	13.74	9.93
Sig. level	P<0.01	P<0.05	P<0.01	P<0.05	P<0.05	P<0.05

Table 2: Flowering intensity, Flowering pattern and Sex of the yam plant (D. alata)

Genotypes	No of nodes	No of male flowers	No of female flowers	Percentage flowering intensity (male)	Percentage flowering intensity (female)	Presence of flower	Score for Flowering intensity (male)	Score for flowering intensity (female)	Sex of yam plant
TDa/96/01168	195.0	164.0	0.0	84.1	0.0	2	4	0	3
TDa00060	207.0	173.5	0.0	83.8	0.0	2	4	0	3
TDa1166	205.0	72.0	0.0	83.9	0.0	2	4	0	3
Abanaoyibo	211.0	122.2	0.0	57.9	0.0	2	3	0	3
02/00151	200.0	138.1	0.0	69.4	0.0	2	3	0	3
Bufu	217.0	97.6	0.0	45.0	0.0	2	2	0	3
UM/680	195.0	141.8	0.0	72.7	0.0	2	2	0	3
Sakata	216.0	0.0	202.6	0.0	93.7	2	3	2	
Gborogboro	386.0	99.2	252.9	25.6	65.5	2	1	3	3
TDa02/00019	218.0	185.9	0.0	85.3	0.0	2	4	0	3
98/1164	216.0	0.0	24.1	0.0	11.2	2	0	1	3
TDa/00194	230.0	0.0	191.9	0.0	83.4	2	4	0	3

Note: Flowering intensity score
1 = (1-25%) low/sparse flowering
2= (26-50%) medium (moderate) flowerin
3 = (51-75%) high intensity flowering
4 = (76-100%) profuse flower

Sex of yam plant
1 = absence of flower
2 = presence of either male or female flower
3 = male yam plant
4 = female yam plant
5 = monoecions male flower > female flower

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EFFECT OF NPK FERTILIZER-ENRICHED BIO-CHAR ON THE FIELD PERFORMANCE OF GINGER IN SOUTHERN GUINEA SAVANNA OF NIGERIA

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ABSTRACT
The capacity of biochar, applied alone and in combinations with varying levels of NPK fertilizer, to improve the productivity of low fertility soils of Southern Guinea Savanna using ginger as a test crop, was evaluated in a field study conducted in 2015 at the research farm of the National Root Crops Research Institute, Nyanya Sub-Station, Abuja. Treatments comprised five biochar rates (0, 1, 2, 3, and 4 t/ha) factorially combined with four rates of NPK fertilizer (0, 75, 150, 300 and 450 kg/ha). Soil amendments with both bio-char and NPK fertilizer significantly improved ginger plant height and rhizome yield responses relative to absolute control. Both ginger plant height and fresh rhizome yield increased significantly with increasing rate of biochar application and NPK fertilizer rate. Optimum ginger plant height was recorded on plots treated with 3 t/ha biochar beyond which there was a gradual decline in height. Highest yield response was achieved using 300 kg/ha NPK fertilizer rate.
Keywords:Fertilizer, Bio-char, Performance and Ginger

INTRODUCTION
Maintaining an appropriate level of soil organic matter and biological cycling of nutrients is crucial to the success of any soil management program in the humid tropics. Cover crops, mulches, compost, or manure additions have been used successfully, supplying nutrients to crops, supporting rapid nutrient cycling through microbial biomass, and helping to retain applied mineral fertilizers better. The benefits of such amendments are, however, often short-lived, especially in the tropics, since decomposition rates are high (Lehmann and Rondon 2006) and the added organic matter is usually mineralized to CO2 within only a few cropping seasons. Organic amendments therefore have to be applied each year to sustain soil productivity. Management of black carbon (C), also referred to as bio-char, may overcome some of the limitations in organic manure use in crop production and provide an additional soil management option. Bio-char is a solid material obtained from the thermochemical conversion of biomass in an oxygen-limited environment. The objectives of this study are (i) to assess the effects of bio-char and NPK fertilizer amendments on the growth and yield responses of ginger in the Southern Guinea Savanna ecology of Nigeria; (ii) to determine the optimum rate of bio-char applied alone or in combinations with inorganic NPK fertilizer for sustainable ginger yield in the Savanna.

MATERIALS AND METHODS
The study was conducted in 2015 at the research farm of the National Root Crops Research Institute, Nyanya Sub-Station, Abuja, Nigeria (Latitude 09º 04' N; Longitude 07º 37' E) with an altitude of 426 m above sea level. The soil of the experimental site was a kaolinitic hyperthermic oxic paleudult (USDA) with loamy sand topsoil texture. Selected physico-chemical properties of the soil used for the study before imposition of treatments are shown in Table 1. The site used for the experiment had earlier been put to continuous cultivation for eight years and recently cropped for three years with maize and maize/cassava crop mixture before the trial was initiated. Pre-cropping analysis of some physical and chemical properties of the soil was done using standard methods as reported by International Soil Reference and Information Centre (2002). Treatments comprised five levels of Bio-char (0, 1, 2, 3, 4 t/ha) in factorial combinations with four inorganic NPK fertilizer rates (0, 150, 300, 450 kg/ha). The Bio-char used for the study was made from thermo-conversion of Avocado tree under oxygen-limited condition. Both the bio-char and the NPK fertilizer treatments were applied into the soil by manual incorporation during land preparation using a spade. Land preparation (slashing, ploughing and harrowing) was done by use of a tractor. The land was demarcated into plots measuring 2 m x 2 m. Inter plot distance was kept at 0.5 m. The treatments were laid out on the demarcated plots in a randomized complete block design with 3 replications. The plots were planted with 20 g Yellow ginger (UG 1) rhizome setts at a population of 250,000 plants/ha. The plots were kept weed-free throughout the duration of the study. Weeding was done by rouging. Data on ginger plant height and fresh rhizome yield were collected and analyzed statistically using analysis of Variance (ANOVA) according to the procedures for Randomized Complete Block Design as reported by Gomez and Gomez (1984).

RESULTS AND DISCUSSION
Table 1 shows some selected properties of both the bio-char and the soils of the site used for the study. The soil of the experimental site was of low fertility classification as illustrated by its low values of Total N, changeable K, Ca, Mg and medium level of organic Carbon. Soil amendments with both bio-char and NPK fertilizer significantly influenced ginger plant height (Table 2). Ginger plant height increased increasingly with increasing

rate of biochar application up to 3 t/ha beyond which there was a gradual decline in height. A similar trend was observed with respect to rhizome yield (Table 3). With increasing rates of biochar application, rhizome yield response of ginger was positively and progressively linear until some maximum was reached at 3 t/ha biochar rate, above which yield response tended to be negative. Averaged over the four NPK fertilizer rates evaluated, the highest mean plant height response of 82.3 cm and highest mean rhizome yield of 18.8 t/ha were recorded with the application of 300 kg/ha NPK fertilizer rate. The results of this study in Table 3 are implicating the fact that addition of nutrients using inorganic fertilizers is essential for high ginger productivity and that it also increases the positive response of the bio-char amendment in the low fertility soils of Southern Guinea Savanna ecology. This assertion is corroborated by the observed significant interaction effect between biochar and NPK fertilizer with respect to ginger plant height and rhizome yield responses (Tables 2 and 3). Conventionally in ginger production, inorganic NPK fertilizer is usually applied during ginger planting. Between the time fertilizer is applied and the time it is taken up by ginger, fertilizer nutrients can be leached out of the soil by excess rainfall, consumed by weeds, or metabolized by microbial activity in the soil. But when biochar and NPK fertilizer are complementarily applied, biochar helps conserve fertilizer nutrients by storing them within its matrix and making the nutrients available when they are needed by the ginger crop plant. This happens because of a property in biochar, known as enhanced cation exchange capacity (CEC) as a consequence of the large surface area of biochar particles. CEC is a measure of a biochar's capacity to retain positive ions, such as ammonium and potassium cations, in an exchangeable form that is available to plants. The lower ginger plant height response recorded at biochar rate > 3 t/ha may be ascribed to nitrogen limitation. Nitrogen availability decreases through immobilization by microbial biomass at high C:N ratios occasioned by higher biochar application rates (Lehmann et al., 2003b). This observation is in agreement with the report of Glaser et al, (2002) who found higher crop yield responses at lower biochar application rates. However, other growth-limiting factors may be responsible as well.

CONCLUSION

Combined application of biochar and NPK fertilizer improves the relative efficiencies of the two amendment materials to improve ginger growth and yield relative to when they are sole-applied. Optimum growth and yield responses of ginger are achieved using 3 t/ha biochar rate on a soil amended with 300 kg/ha of NPK fertilizer.

Table 1: Selected Properties of Bio-char and Soil used for the Study

Bio-char Parameter	**Value**	**Soil Parameter**	**Value**
Total N (%)	0.14	Total N (%)	0.14
Total P (%)	3.4	Available P (mg/kg)	10.2
Total K (%)	2.2	Exch. K (cmol/kg)	0.12
Total Ca (%)	3.1	Exch. Ca (cmol/kg)	2.16
Total Mg (%)	2.2	Exch. Mg (cmol/kg)	2.60
Organic C (%)	56.4	Soil Org. C (%)	2.50
pH	5.3	pH	5.8
		Texture	Sandy Loam

Table 2: Effect of Bio-char and NPK Fertilizer Amendment on the Plant Height (cm) of Ginger in the Guinea Savanna of Nigeria (4 MAP)

NPK Fertilizer Rate (kg/ha)	**Bio-char Rate (t/ha)**					
	0	**1**	**2**	**3**	**4**	**Mean**
0	56.2	48.4	63.4	66.8	56.5	58.3
150	67.2	69.3	72.2	58.8	65.2	66.5
300	68.6	74.4	82.4	96.4	89.5	82.3
450	64.9	68.8	77.5	88.4	75.8	75.1
Mean	64.2	65.2	73.9	77.6	71.8	-
	LSD (0.05):					
	Bio-char Rate = 2.542					
	NPK Fertilizer Rate = 4.123					
	Bio-char Rate x NPK Fertilizer Rate = 1.206					

Table 3: Effect of Bio-char and NPK Fertilizer Amendment on Fresh Rhizome Yield (t/ha) of Ginger in the Guinea Savanna of Nigeria

NPK Fertilizer Rate (kg/ha)	**Bio-char Rate (t/ha)**					
	0	**1**	**2**	**3**	**4**	**Mean**
0	10.2	13.3	12.6	15.3	11.6	12.6
150	11.4	14.4	17.1	18.7	15.5	15.4
300	14.3	15.4	20.2	24.4	19.7	18.8
450	15.2	18.8	21.0	25.0	22.2	20.4
Mean	12.8	15.5	17.7	20.9	17.3	-
	LSD (0.05):					
	Bio-char Rate = 2.22					
	NPK Fertilizer Rate = 1.76					
	Bio-char Rate x NPK Fertilizer Rate = 1.02					

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EFFECT OF NITROGEN FERTILIZATION ON THE VARIETAL YIELD RESPONSE OF YAM UNDER MINISETT TECHNOLOGY IN THE GUINEA SAVANNA ECOLOGY OF NIGERIA

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ABSTRACT
Relative effects of nitrogen fertilization on the yield response of three yam varieties mostly preferred by farmers in the Southern Guinea Savanna ecology of Nigeria were assessed under yam minisett technology. Treatments comprised three yam varieties (Meccakusa, Pepa and Yangode) in factorial combinations with five rates of Nitrogen fertilizer in form of Urea (0, 15, 30, 45 and 60 kg N/ha) laid on a Randomized Complete Block Design with three replications. Results showed that contrary to farmers' belief, N fertilization had significant influence on the tuber yield of yam as it resulted to a progressive increase in both tuber number and tuber yields relative to when no N fertilizer was applied. Application of 45 kg N/ha maximized the number and yield of seed yam tuber production. Across all N fertilizer rates studied, Meccakusa variety proved most superior in terms of yield increase due to N fertilization with 31 and 106 % higher yields over Yangode and Pepa respectively.
Keywords: Fertilization, Yield, minisett and Yam

INTRODUCTION
Yams, particularly white yam (*Dioscorea rotundata spp.*) are a valued starchy staple for many communities in Nigeria. Yam plays important roles in the livelihood of people especially those from the yam producing belts of Nigeria. Apart from being the major source of carbohydrate food intake, its role in the socio-cultural life of many households in Nigeria is very remarkable. It is used in celebrating important cultural festivals, chieftaincy title taking and payment of bride price. Yam is eaten boiled, roasted, fried or pounded and eaten as food. Yam can also be processed into flour and used in making different food forms. Nigeria is the world's leading producer of yams and Ghana is Africa's leading exporter. Despite the importance of yam, research and support for yam production in Nigeria has been limited and current average yields of 13.9 t/ha represent a fraction of the yield potential of 20 t/ha (Onyenweaku, 2015). Major constraints to yam production in Nigeria are low yield due to poor soil fertility accentuated by scarcity of reliable planting material. The minisett technique introduced in the recent past by NRCRI in collaboration with IITA for rapidly multiplying seed yams has so far not been widely adopted by farmers because the technology did not provide for proper understanding of the specific effects of fertilizer elements in the yam production chain. As a result of this information gap, smallholder yam farmers hold a strong belief that inorganic fertilizer application in seed yam production, especially N-based fertilizers, decreases yam tuber size and causes easy tuber rot under storage. This belief among smallholder yam farmers has not been validated scientifically. The objective of this study therefore, is to evaluate the impact of nitrogen fertilization on the tuber yield response of different yam varieties in the Southern Guinea Savanna ecology of Nigeria.

MATERIALS AND METHODS
The study was conducted in 2015 at Adunu Village in Paiko Local Government Area of Niger State, Nigeria. The soil used for the study was of loamy sand texture with total N, available P, exchangeable K, Ca and Mg contents of 0.18 %, 10.0 mg/kg, 0.22, 2.3 and 1.6 cmol/kg respectively. The organic C content of the soil was 2.8 % with a slightly acidic pH value of 6.4. Treatments comprised three varieties of yam mostly preferred by farmers in the Southern Guinea Savanna (Meccakusa, Pepa and Yangode) in factorial combinations with five rates of Nitrogen fertilizer in form of Urea (0, 15, 30, 45 and 60 kg N/ha equivalent to 0, 33.3, 66.6, 99.9, and 133.2 kg/ha of urea). Basal applications of P (20 kg P /ha equivalent to 47 kg P_2O_5/ha) and basal K (50 kg K/ha equivalent to 60 kg K_2O) were made to all the plots excepting the absolute control treatment. The treatments were laid out on 3m x 5 m ridged plots prepared using a tractor. Both N fertilizer treatments and the basal P and K fertilizers were applied 2 months after planting (MAP) of yam. The plots were kept weed free throughout the duration of the study. Weeding was done manually using a weeding hoe. All other important agronomic practices for yam production were carried out. Data on weight, number and grade of seed yam tubers produced were collected and analyzed using analysis of Variance according to the procedures outlined for randomized complete block design by Gomez and Gomez (1984). Treatment means with significant effects were separated using the Least Significant Difference method at 5 % level of probability ($P \geq 0.05$).

RESULTS AND DISCUSSION
The results in Table 1 show that N fertilization has significant influence on the tuber yield of yam. There was an observed progressive increase in tuber yields with increase in the rate of N fertilization irrespective of yam variety.

Highest interactive tuber yield response of 12.5 t/ha given by Meccakusa was obtained with the application of 45 kg N/ha. This figure represented a 331 % yield increase over the mean tuber yield value of 2.9 t/ha obtained from the three yam varieties receiving no N fertilizer application (Table 1). Tuber yield response varied among the three yam varieties evaluated. Across all N fertilizer rates studied, Meccakusa variety proved most superior over Yangode and Pepa in terms of yield with 31 and 106 % yield increases respectively. Growing yam with nitrogen fertilizer application resulted in increased number of seed yam tuber production relative to when no N fertilizer was applied (Table 2). Mean number of seed yams produced per plot increased significantly as the quantities of N fertilizer applied increased. Application of 45 kg N/ha appeared adequate for maximizing the number of yam tuber production under the conditions of this experiment. Further increases in the Quantity of N fertilizer beyond this rate did not however translate to increased number of seed yam, suggesting possible physiological imbalance in which fertilizer N did not favour seed yam production. Application of N fertilizer had a significant influence on the weight of different categories of seed yam tubers produced (Table 3). Significantly higher numbers of ware yam (yams weighing from 1 kg and above) and seed yam A (i.e. yam tubers weighing from 500 g to 999 g) was produced with the application of 45 kg N/ha while application of 65 kg N/ha favored production of higher number of seed yam B (i.e tubers weighing from 100 g to 449 g). Averaged over all N fertilizer rates evaluated, Meccakusa variety produced significantly heavier seed yam A followed by Pepa while Yangode gave heavier ware yam tubers.

CONCLUSION

Contrary to farmers' belief, N fertilization has significant influence on the tuber yield of yam as it results to a progressive increase in both tuber number and yields relative to when no N fertilizer was applied. Such increases in number and yield of seed yam tubers were more with increasing rates of application irrespective of yam variety. Under the conditions of this experiment, application of 45 kg N/ha maximized the number and yield of seed yam tuber production. Across all N fertilizer rates studied, Meccakusa variety proved most superior in terms of yield increase due to N fertilization with 31 and 106 % higher yields over Yangode and Pepa respectively.

Table 1: Effect of Nitrogen Fertilization on the Varietal Tuber Yield (t/ha) Response of Yam in Southern Guinea Savanna Ecology of Nigeria

Variety	**Nitrogen Fertilizer Rate (kg/ha)**					
	0	**15**	**30**	**45**	**65**	**Mean**
Meccakusa	3.5	3.2	8.5	12.5	8.1	7.2
Pepa	1.6	2.4	3.9	5.3	8.1	3.5
Yangode	3.6	5.2	5.5	6.2	5.1	5.5
Mean	2.9	3.6	6.0	8.0	5.9	-
	LSD (0.05): Variety = 1.64 N Fertilizer Rate = 2. 90 Variety x N Fertilizer Rate = 1.02					

Table 2: Effect of Nitrogen Fertilization on the Total Number of Seed Yam Tubers Produced /Plot (no./plot) of Different Yam Varieties in the Southern Guinea Savanna Ecology of Nigeria

Variety	**Nitrogen Fertilizer Rate (kg/ha)**					
	0	**15**	**30**	**45**	**65**	**Mean**
Meccakusa	10.0	13.3	15.4	15.7	14.3	13.7
Pepa	5.0	5.5	6.8	6.8	5.4	5.9
Yangode	8.0	11.2	14.0	16.0	10.2	11.9
Mean	7.7	10.0	12.1	12.8	10.0	-
	LSD (0.05): Variety = 3.42 N Fertilizer Rate = 1.23 Variety x N Fertilizer Rate = NS					

Table 3: Effect of N Fertilization on the Varietal weight of Different Yam Tuber Sizes in Southern Guinea Savanna of Nigeria

Treatment	Seed Yam A (500 g – 999 g)	Seed Yam B (100 g – 499 g)	Mini Tubers (< 100 g)	Ware Yam (> 1 kg)
N Fertilizer Rate (kg/ha):				
0	1.2	0.7	0.9	1.5
15	0.8	1.6	0.9	2.0
30	2.8	1.8	1.0	3.4
45	3.6	0.8	2.2	5.4
65	2.5	2.4	1.6	2.3
Mean	2.2	1.5	1.3	3.0
LSD (0.05) N Fertilizer Rate	1.02	NS	NS	1.32
Yam Variety:				
Meccakusa	3.4	2.7	1.3	3.4
Pepa	2.4	0.6	1.1	1.2
Yangode	0.6	0.3	2.0	4.8
Mean				
LSD (0.05) Yam Variety	1.03	0.22	NS	1.24

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PHARMACEUTICAL CROPS: BANE OR BLESSINGS

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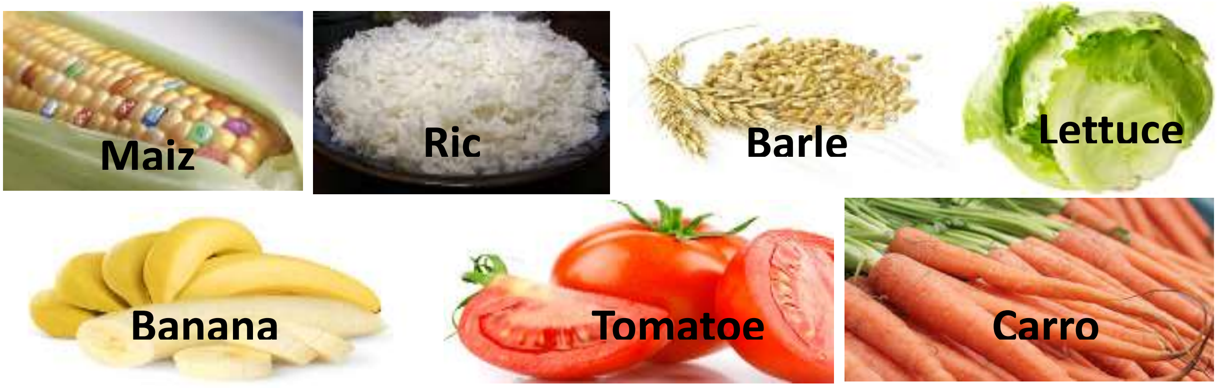
ABSTRACT
Biotechnology is offering innovative possibilities for engineering crops to produce not just food, but drugs, vaccines and enzymes. Often, crops are being engineered so that a vaccine can be delivered through the direct consumption of leaves, fruits, or other parts, without the cost and inconvenience of extracting the proteins and delivering them via pills or injections. But of concern are the possibility of accidental contamination of food or livestock feed with genetically modified crops containing edible vaccines and the potential of transgene escape and fertilization of nonpharmaceutical crops. However, a possible strategy to circumvent these problems would be to engineer proteins so that they do not become biologically active until after they are extracted and further processed in a laboratory.
Keywords: Pharmaceuticals, crops, bane.

INTRODUCTION
It is now 39 years since the concept of commercial potential of gene manipulation was conceived by Robert Swanson and Herb Boyer. Seven years later, precisely in 1983, the first transgenic plant was engineered by Rob Horsch. The two events (1976 and 1983) marked the beginning in our long scientific journey towards today's achievements in the plant and agricultural biotechnology revolution (Altman, 2003; Ubalua, 2009). One of the earliest commercial applications of gene-manipulation techniques was the production in bacteria of human proteins with therapeutic applications. Not surprisingly, the first such products were recombinant versions of proteins already used as therapeutics: human growth hormone and insulin. Prior to the advent of genetic engineering, human growth hormone was produced from pituitary glands removed from cadavers. Not only did this limit the supply of the hormone, but in some cases, it resulted in recipients contracting Creutzfeld-Jackob syndrome. By contrast, the recombinant approach resulted in unlimited supplies of safe material. Another milestone in recombinant DNA technology is in 'biopharming' which refers to the use of transgenic animals and plants to produce recombinant therapeutics. Presently, plants are being turned into factories producing not just food, but drugs, vaccines, enzymes, and antibodies. The first step in using crops to produce pharmaceutically active proteins is the synthesis or isolation of genes that code pharmaceutical proteins, followed by the transfer of those genes into the DNA of crop plants. In most cases, the crop-produced pharmaceutical protein is extracted, purified and possibly modified further before it is administered to humans or livestock. In some instances, crops are engineered so that a vaccine can be delivered through the direct consumption of leaves, fruits, or other parts, without the cost and inconvenience of extracting the proteins and delivering them via pills or injections (Sala et al., 2003). Although they may open doors to less expensive and more-ready available drugs, there is concern regarding the potential for contamination of human food and livestock feed, as well as environmental harm. The potential benefits, concerns and principles of pharmaceutical crops are hereby discussed.

Benefits of pharmaceutical crops
One of the most exciting aspects of recombinant DNA technology is that it permits the design, development, and isolation of proteins with improved operating characteristics and even completely novel proteins (Wilkinson *et al*., 1984). Plants are a useful alternative to animals for recombinant protein production because they are inexpensive to grow and scale-up from laboratory testing to commercial production is easy (Ma *et al*., 2005). Transgenic plants can potentially express any foreign gene, whether that gene is derived from bacteria, yeast, other plants or even animals. The scope for exploitation and improvement is virtually limitless and gene-manipulation techniques have therefore given the biotechnology industry a new lease of life. Some of the potential products of transgenic plants include blood thinner, hemoglobin, insulin, growth hormones, cancer treatments, and contraceptives. Products already in the pipeline include plant-produced vaccines for hepatititis-B, cholera, rabies, HIV, malaria and influenza. Lipase, a digestive enzyme used to treat patients with cystic fibrosis is currently being developed in genetically modified maize (corn) (Sala *et al*., 2003). Arthritis and other autoimmune diseases are also targets for plant-produced vaccines (Sala *et al*., 2003). Maize, bananas, tomatoes, carrots, and lettuce are major targets for edible vaccine production because these foods can be eaten raw (Fig. 1), thereby avoiding the protein denaturation that typically occurs during cooking (Sala *et al*., 2003). Moreover, plants are an attractive alternative because they could potentially produce greater yields. This is especially important for monoclonal antibodies (such as etanercept, which is used to treat rheumatoid arthritis) (Elbehri, 2005). Grain crops are usually favoured because protein yields from the large seeds of maize, rice, and barley (Fig. 1) are

typically much higher than those obtained from leaves and other vegetative parts. In addition pharmaceutical proteins can remain stable in dried grain for several years compared with the much-reduced stability of these same proteins in leaf tissue. Another major benefit of utilizing plants is the reduced risk of disease transmission. There is concern that producing drugs via mammalian cell cultures or animal milk could facilitate the movement of certain viruses to humans.



Concerns of pharmaceutical crops

The aims of biotechnology industry goes hand in hand with those of conventional breeders, but offers the possibility of importing useful genes from distant species that could not be used for breeding. The initial focus of plant biotechnology was on improving agronomic traits, i.e. the protection of crops against pests, pathogens and weeds and thus increasing yields. Herbicide generally affects processes that are unique to plants, e.g. photosynthesis or amino acid biosynthesis. Both crops and weeds share these processes and developing herbicides that are selective for weeds is very difficult. An alternative approach is to modify crop plants so that they become resistant to broad-spectrum herbicides, i.e incorporating selectivity into the plant itself rather than relying on the selectivity of the chemical. Two approaches to engineering herbicide resistance have been adopted. In the first, the target molecule in the cell either is rendered insensitive or is overproduced. In the second, a pathway that degrades or detoxifies the herbicide is introduced into the plant. For example, glyphosate is a non-selective herbicide that inhibits 5-enol-pyruvylshikimate-3-phosphate (EPSP) synthase, a key enzyme in the biosynthesis of aromatic amino acids in plants and bacteria (Table 1).

Insect pests represent one of the most serious biotic constraints to crop production. Typical insecticides are non-selective, so they kill harmless and beneficial insects as well as pests. For these reasons, transgenic plants can express toxins that are selective for particular insect species. Unlike other *Bacillus* species, *Bacillus thuringiensis* (Bt) produces crystals during sporulation, comprising one or a small number of ~130 KDA protoxins called crystal proteins. These proteins are potent and presumed to be specific. The specificity reflects interactions between the crystal proteins and receptors in the insect midgut. In susceptible species, ingested crystals dissolve in the alkaline conditions of the gut and the protoxins are activated by gut proteases. The active toxins bind to receptors on midgut epithelial cells, become inserted into the plasma membrane and form pores that lead to cell death (and eventual insect death) through osmotic lysis. Unfortunately, the toxins overtime affects both targets (corn borer) and non-target organisms like monarch butterflies, bees etc. The primary concern associated with pharmaceutical crops is the accidental contamination of food or livestock feed with edible vaccines (Elbehri, 2005, Kirk *et al*., 2005). Transgenes can escape when pollen from pharmaceutical crops drifts into and fertilizes fields of nonpharmaceutical crops. Alternatively, if seeds are left behind in the soil following harvest, "volunteer" pharmaceutical plants could establish themselves in subsequent growing seasons, possibly in mixture with nonpharmaceutical crops. Even if production is limited to non-food crops, potential risks would remain. Pollen, fine particles of leaves that are crushed during harvest, and possibly even runoff water contaminated with proteins from decomposing plants, could expose people and wildlife that live on or near pharmaceutical-producing fields to the transgenic material. Birds, insects and other wildlife can consume pharmaceutical crops, regardless of where they are grown or what species they are. One possible strategy to avoid these problems would be to engineer proteins so that they do not become biologically active until after they are extracted and further processed in a laboratory. Tissue-specific expression of pharmaceutical proteins may also reduce or eliminate certain avenues of exposure (such as the possibility of exposure via pollen inhalation), and gene deletion technologies could potentially be used to remove transgenes from certain tissues (such as pollen) to reduce the possibility of transgene spread (Keenan and Stemmer, 2002). If transgenes could be contained, regulations could be much more permissive about which traits are allowed in crop plants. On the other hand, if transgenes will inevitably escape and spread – a more cautious approach about which traits are allowed to be developed in crop plants has to be adopted.

CONCLUSION

The future of pharmaceutical crops will require thoughtful input from environmentalists/ecologists, public health experts, and medical researchers – as well as from those who genetically engineer these crops.

Table: 1: Mode of action of herbicides and method of engineering herbicide–resistant plants

Herbicide	Pathway inhibited	Target enzyme	Basis of engineering resistance to herbicide
Glyphosate	Aromatic amino acid biosynthesis	5-Enol-pyruvylshikimate-3-phosphate (EPSP) synthase	Overexpression of plant EPSP gene or introduction of bacterial glyphosate-resisitant *aro* Agene.
Sulphonylurea	Branched-chain amino acid biosynthesis	Acetolactate synthase (ALS)	Introduction of resistant *ALS* gene
Atrazine	Photosystem 11	Q_8	Introduction of mutant gene for Q_8 protein or introduction of gene for glutathione-S-transferase, which can detoxify atrazines
Bromoxynil	Photosynthesis	-	Introduction of nitrilase gene, which detoxifies bromoxynil.

Courtesy: Primerose *et al*., 2001

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SEEDLING EMERGENCE OF TURMERIC *(Curcuma longa L.)* AS AFFECTED BY PRIMING

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ABSTRACT
The field experiment was conducted in early cropping season of 2014 at the Teaching and Research Farm of Imo State University, Owerri, to evaluate the effect of priming on seedling emergence of turmeric seeds. The experiment was laid out in a randomized complete block design with seven treatments and three replicates. The treatments were seeds of turmeric soaked for 12hours in water, seeds soaked for 24hours in water, seed soaked for 48hours in water, seeds soaked for 12hours in moringa leaf extract, seeds soaked for 24hours in moringa leaf extract, seeds soaked for 48hours in moringa leaf extract and non-soaked seeds. The result revealed that priming had significant effect ($P \leq 0.05$) on number of days to 50% seedling emergence and emergence speed. Interms of seedling emergence the seeds soaked for 48hours in 100% crude MLE had the least value of 92%. The value was statistically similar to the values obtained from the seeds soaked for 24hours in 100% crude MLE (96%) and that of non-soaked seeds (93%). All other treatment gave 100% seedling emergence. The non-soaked seed gave the least emergence speed (60% /day) and the highest number to 50% seedling emergence (47 days).
Key words: Turmeric, priming, seedling emergence, water and moringa leaf extract.

INTRODUCTION

Turmeric *(Curcuma longa L.)* is a rhizomatous herbaceous perennial plant of the ginger family *Zingiberacea* (Chan *et al.*, 2009). It is a low growing tropical herbaceous plant, which forms many long thin rhizomes. It is best known as one of the ingredients used to make curry. Turmeric is rich in the yellow food pigment called *Curcuminoid* (6%) and essential oils which accounted for 5% (Nunes, 1989). In Indian systems of medicine, turmeric is used to some extent as stomach tonic and blood purifier (http//myfolia.com). It is a relief for rheumatoid arthritis (http://myfolia.com). Poor seedling emergence and establishment is one of the major abiotic constraint encountered by resource poor farmers (Muhammad *et al.*, 2013). The decline rate of seedling emergence was found to be obvious, varying with crop species and cultivars. Improvement in seedling emergence is an active area of research and efforts are being made to improve seed germination in various economically important crops (Suleman *et al.*, 2011). Seed priming is an effective tool to minimized time between germination and emergence which resulted in synchronized emergence (Harris *et al.*, 2002). Bradford (1986), stated that seed priming is a pregermination treatment in which seeds are held at low water potential to allow imbibitions by preventing radical extension. Different techniques have been carried out for seed priming, like hydropriming, matripriming, osmopriming, hardening, osmohardening and hormonal priming (Basra *et al.*, 2005). This is to improve the germination rate, field emergence, seedling vigour, stand establishment and economic yields in many crops (Farooq *et al.*, 2008). Seed priming enhances speed and uniformity of germination (Khalil *et al.*, 2010), extend many biochemical modification which are basically needed for starting germination process via dormancy breaking, hydrolysis, enzyme creation and seed imbibitions (Asgedon and Becker, 2001). The general purpose of seed priming is to hydrate partially the seed to a point where germination processes are initiated but not completed. Hydropriming is a sample low cost method of seed priming that requires no sophisticated equipment and gives results which are easy to see (Foti *et al.*, 2008). Hydropriming encounters available soil moisture dryness to endow plants with greater tolerance to subsequent stress exposure (Patanea *et al.*, 2009). In hydropriming, seeds are soaked in water for usually overnight, followed by drying. Due to imbibitions, seeds take short time to germinate (Hartman *et al.*, 2002). However, non-primed seeds take longer time with relation to soil moisture for imbibitions. Therefore, it is suggested that seed germination might be increased by hydropriming technique (Hartman *et al.*, 2002). Among the seed priming treatments, hydropriming is in the control of farmer (without chemicals) and could be employed to accelerate germination, seedling growth and yield of many yield crops under normal and water stress conditions (Muhammad *et al.*, 2013). Hydropriming practically ensures rapid and uniform germination accompanied with low abnormal seedling percentage (Shivankar *et al.*, 2003). *Moringa oleifera* leaf extract has the potential to promote plant growth hence; it is used as a natural plant growth enhancer (Basra *et al.*, 2011). The leaves of *M. oleifera* are rich source of protein, zeatin, ascorbate, phenolic compounds, calcium, vitamins and potassium (Basra *et al.*, 2011). *Moringa oleifera* extract as a plant growth promoter influences plant growth in several ways and also promotes defense mechanism against abiotic stresses by harmonizing the plant growth regulators (PGRs) endogenous concentration (Wasif *et al.*, 2012). *Moringa* is increasingly becoming popular among communities in Zambia for uses such as a food supplement, as a weaning food in children and for medicinal purposes (Phiri and Mbewe 2010). Stakeholders such as the health sector are promoting *Moringa* as a food supplement while others such as the water sector are promoting *moringa* for water treatment (Phiri and Mbewe, 2010). Nigeria has favourable climate condition for turmeric production. However, there is a dearth of available information on its agronomic and processing requirements to harness its production. The problem associated with the production of this crop is late maturity (i.e. it matures within 7-9 months) which can be attributed to late sprouting. There is need to use low cost techniques such as hydropriming and *moringa* leaf extract to enhance early sprouting which will shorten the maturity period and hence enhances seedling development. The objective of the study was therefore to ascertain the effect of priming on seedling emergence of turmeric.

MATERIALS AND METHODS

Location

The experiment was carried out in the planting season of July-October of 2015 at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. The location lies between the latitude of $5^0$10'N and $6^0$0'N and longitude $6^0$35'E or $7^0$28'E within the South-East rainforest agricultural zone of Nigeria. The environmental conditions are characterized by a temperature above 27^0C, average annual rainfall of 2500mm and relative humidity of 85% during the rainy seasons (NIMET, 2010).

Experimental Material/Land Preparation

Moringa oleifera leaves were collected from Ikwerre, Rivers State. Turmeric rhizomes were collected from Imo State University, Farm.

Land Preparation /Experimental Design

The experimental field was cleared and all debris was completely removed from the site. The experimental design used was Randomized Complete Block Design with three replications and six treatments and control. The area of the experimental field was 10m x 5m ($50m^2$) which was partitioned into plots each separated by 1m space and a total of twenty-one (21) plots were made.

Preparation of Extract /Treatment Application

The *moringa oleifera* leaves were air-dried and grounded mechanically with Electronic blending machine after which 10g of the grounded *moringa* leaves was added in 50cl of water and was allowed to stay overnight after which the mixture was sieved. The turmeric rhizomes were soaked in water at three(3) different time durations which were 12hours -24hours and 48hours. Turmeric rhizomes were also soaked in 100% crude MLE at three(3) different levels of time duration which were 12hours, 24hours and 48hours and non-soaked turmeric. The soaking of turmeric rhizomes in *moringa leaf* extract and water was serialized into different levels of time duration which formed the different treatments as follows:

T_1 = Seeds soaked for 12hours in water, T_2 = (Seeds soaked for 24hours in water)
T_3 = Seeds soaked for 48hours in water T_4 = (Seeds soaked for 12hours in 100% crude MLE)
T_5 = Seeds soaked for 24hours in 100% crude MLE
T_6 = Seeds soaked for 48hours in 100% crude MLE T_7 = (Non-soaked turmeric).

Sowing

The turmeric rhizomes were planted on beds at the rate of one seed per hole, at a plant spacing of 30cm x 50cm and at a shallow depth of 4cm for easy sprouting. All the necessary cultural practices were done in all the plots.

Data Collection: The experiment was monitored and data was collected on the following parameters;

Percentage Seedling Emergence: This was calculated using the formular below;

$$\frac{Sg}{St} \times \frac{100}{1}$$

Sg = the total emerged seeds, St = the total number of seeds planted

Number of days to 50% Emergence: This was the counting of number of days from sowing till 50% of planted seeds emerged in days.

Emergence Speed: This was calculated using the formular as applied by Delouche, J.C. and Baskin, C.C. (1980).

$$\sum \frac{Number\ of\ seedlings\ emerged}{Number\ of\ days\ taken} x \frac{100}{1}$$

RESULTS AND DISCUSSION

Percentage Seedling Emergence (%)

The effect of seed priming on percentage seedling emergence of turmeric *(Curcuma longa)* is shown in table 1.The result showed that seed priming had significant influence on emergence of turmeric. The highest percentage seedling emergence (100%) was obtained from seeds soaked for 12 hours in water; seed soaked for 24hrs in water, seeds soaked for 48hours in water seeds and soaked for 12hours in *moringa* leaf extract seeds. The value was statistically similar to seeds soaked for 24hours in *moringa* leaf extract (Table 1). But the least value (92%) was obtained from seeds soaked for 48hours in *moringa* leaf extract was significantly similar ($P \leq 0.05$) to the value (96%) obtained from the seeds soaked for 24hrs in 100% MLE and non-soaked seeds (Table 1).

Number of Days to 50% Emergence of Turmeric

Statistical analysis of data showed that seed priming significantly affected the number of days to 50% emergence. Number of days to 50% seedling emergence of seeds soaked for 12hours in water, 24hours in water, 48hours in water, 12hours in *moringa* leaf extract, 24hours in *moringa* leaf extract, 48hours in *moringa* leaf extract, and non-soaked seeds were 12days, 13days, 14days, 15days, 12days, 12hours in *moringa* leaf extract, 24hours in *moringa* leaf extract, 12days and 47days respectively. The 47days obtained from non-soaked turmeric was significantly higher than all others (Table 2). The values obtained from other treatment were statistically similar ($P \leq 0.05$) (Table 2).

Emergence Speed (% /day)

The effect of the priming treatments on emergence speed was shown in table 2. The value (86%/day) obtained from seeds soaked for 12hours in water was the highest which differed significantly ($P \leq 0.05$) from 60%/day obtained from the non-soaked seeds. But all the values obtained from other treatments were statistically similar ($P \leq 0.05$) (Table 2).

The result obtained from the research work revealed that seed priming had significant effect on percentage seedling emergence. The days to 50% emergence was significantly affected by priming. The seeds that were primed reached 50% emergence earlier than non-soaked seeds. The reason for the early emergence of the primed seeds might be attributed to the fact that primed seeds imbibed water, breaks dormancy and revive seed metabolism faster, resulting in reduction in number of days to 50% emergence. This result is in conformity with the findings of Asgedon and Becker (2001) who reported the extension of many biochemical modifications and enzymes creation by primed seeds. The seeds that were primed had higher emergence speed than non-soaked seeds. This result is a reflection of the fact that seed priming enhances speed and uniformity of germination as reported by Khalil *et al.* (2010). Priming of turmeric is highly recommended for early seedling emergence.

Table 1: Effect of Seed Priming on Percentage Seedling Emergence of Turmeric

Priming Treatments	Percentage seedling emergence (%)
Seeds soaked for 12hours in water	100^{a}
Seeds soaked for 24hours in water	100^{a}
Seeds soaked for 48hours in water	100^{a}
Seeds soaked for 12hours in 100% crude MLE	100^{a}
Seeds soaked for 24hours in 100% crude MLE	96^{ab}
Seeds soaked for 48hours in 100% crude MLE	92^{b}
Non-soaked seeds (control)	93^{b}

Mean in the column, having the same letter(s) are not significantly different at ($P \leq 0.05$), according to Duncan Multiple Range Test

Table 2: Effect of Seed Priming on Number of Days to 50% Emergence of Turmeric

Priming Treatments	N0. of days to 50% emergence (%)	Emergence speed (%/day)
Seeds soaked for 12hours in water	12^{b}	86^{a}
Seeds soaked for 24hours in water	13^{b}	82^{a}
Seeds soaked for 48hours in water	14^{b}	80^{a}
Seeds soaked for 12hours in 100% crude MLE	15^{b}	82^{a}
Seeds soaked for 24hours in 100% crude MLE	12^{b}	85^{a}
Seeds soaked for 48hours 100% crude MLE	12^{b}	80^{a}
Non-soaked seeds (control)	47^{a}	60^{b}

Mean in the column, having the same letter(s) are not significantly different at ($P \leq 0.05$), according to Duncan Multiple Range Test

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RESPONSES OF GROWTH AND YIELD OF TARO VAR. COCO-INDIA TO DIFFERENT RATES OF NPK FERTILIZER AND POULTRY MANURE AT UMUDIKE

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ABSTRACT
The study was conducted to assess the responses of growth and yield of taro var. Coco-India [Colocasia esculenta (L.)] to NPK Fertilizer and Poultry manure rates at umudike, south Eastern Nigeria in 2014 cropping season. The experiment was laid out in 4 x 4 factorial in randomized complete block design (RCBD). Factor A comprises 0, 150, 200 and 250 kg/ha levels of NPK fertilizer while Factor B consists of 0, 5, 10, and 15 t/ha levels of poultry manure. A total of 16 treatment combinations with 3 replicates were obtained. Data were collected on growth and yield parameters and analyzed using analysis of variance (ANOVA). The results showed that significant effects of treatments varied across the intervals of measurement. Though, non-significant, the highest yield was obtained with application of 250kg/ha and 15t/ha of NPK fertilizer and the poultry manure, respectively.
Keywords: Growth, yield, cocoyam, NPK fertilizer, poultry manure

INTRODUCTION

Taro var. Coco-India (NCe 001) has deep green coloration with erectophylous growth habit. Its petiole and petiole junction are brownish green and brown, respectively. Also, its corm shape is oval with smooth skin, and deep green flesh coloration. Coco-India produces suckers ranging from three to ten per plant (Orji and Ogbonna, 2015). Taro is a plant with a broad, beautiful, nutritious strong leaf shaped like a huge heart. There are more than 200 cultivars of taro, selected for their edible corms and cormels, or their tropical looking ornamental foliage. The taro plant has a triple value in that the stem may be used as salads, the tubers provide easily digested starch, with the leaves are used as a green vegetable. Taro root is often used in a similar fashion to a potato, but in fact has better nutritional qualities than a potato. It has almost three times the dietary fiber, which is important for proper digestive health and regularity. Fiber can also fill you up and make you feel less hungry with fewer calories. This study is aimed at determining the effects of NPK fertilizer and poultry manure on growth and yield of taro var. Coco-India at Umudike.

MATERIALS AND METHODS

An on-farm trial on taro var. Coco-india was carried out at Research and Training Eastern Farm, Michael Okpara University of Agriculture, Umudike. Umudke lies on a longitude 07° 32' E and latitude 05^0 29' N with altitude 122 m above sea level. This study was carried out between June and December, 2014 cropping season. A piece of land with a dimension of 11m× 38 m was cleared. The land was ploughed, harrowed and ridged with a tractor. The ridges were converted into plots of bed manually. Each plot of bed measuring 2 m × 3 m with a gap of 0.50 m and 1.0 m within and between the plots, respectively was created. Twelve cornels with an average weight of 17.5g each were planted with planting space of 0.5 m × 1.0 m. The experiment was laid out in 4 x 4 factorial arrangement in randomized complete block design (RCBD) in which NPK 15:15:15 fertilizer formed Factor A with four levels - 0, 150, 200, 250 kg/ha while poultry manure formed Factor B with four levels - 0, 5, 10, 15 t/ha. There was a total of 16 treatment combinations with three replicates. Weeding was done at 3 WAP and 12 WAP. Data were taken on the following crop attributes: Number of suckers/plant, number of leaves/plant and on yield and yield components. The field data collected were subjected to analysis of variance (ANOVA) using Genstat 12 edition. F-LSD was applied to detect significant difference between two means (p=0.05).

RESULTS AND DISCUSSION

Main effect of zero application of NPK fertilizer rate was significant ($p \leq 0.05$) on the number of suckers/plant at 12 WAP while poultry manure rate of 10 t/ha application was also significantly ($p \leq 0.05$) produced higher number of suckers/plant (Table 1). Zero application of NPK fertilizer rate gave the highest number of suckers/plant relative to other treatment levels. The interaction between fertilizer rate and poultry manure rate was significant with 10 t/ha of poultry manure application only giving the highest number of suckers per plant (15.20) compared to other interactions while zero application of the treatment factors (control) gave the least number of suckers/plant (2.70). NPK fertilizer rates differed significantly ($p \leq 0.05$) on the number of leaves/plant across the period of data collection. Greater number of leaves/plant was produced at 12 WAP when NPK fertilizer was not applied (Table 1). Also, poultry manure rate significantly ($p \leq 0.05$) produced the highest number of leaves/plant at 12 WAP when 15 t/ha was applied. More so, the interaction between NPK fertilizer and poultry manure rate was significant at all the sampled period (Tables 1). The main and interaction effects of NPK fertilizer and poultry manure rates did not significantly ($p \geq 0.05$) influence the number of cormels/plant at harvest, although 250kg/ha and 5t/ha levels of NPK fertilizer and poultry manure, respectively produced higher number of cormels/plant (Table 2). Also, 150kg/ha rate of NPK fertilizer x 10 t/ha rate of poultry manure interaction gave higher number of cormels/plant (Table 2). In the same vein, NPK fertilizer and poultry manure treatments and their treatment combinations did not differ significantly on the weight of cormels/plant, nevertheless peak rates of the two factors produced weightier cormels/plant than other levels. The main effects of NPK fertilizer and poultry manure rates were non-significant ($p \geq 0.05$) on the weight of corm/plant, although 150kg/ha rate of NPK fertilizer with zero application of poultry manure produced greater weights of corm/plant (Table 2). But, the rates of NPK fertilizer x poultry manure interaction significantly ($p \leq 0.05$) influenced the weight of corm/plant with a combination of 150kg/ha rate of NPK fertilizer and zero application of poultry manure giving weightier corm/plant than other treatment levels. On the hand, total yield (kg/ha) was not influenced by main and interaction effects of both factor, nevertheless, higher total yield of Coco-India was obtained from plots where NPK fertilizer rate of 250kg/ha and zero application of poultry manure were added (Table 2). In the same vein, a combination of 50kg/ha rate of NPK fertilizer and 15 t/ha rate of poultry manure gave higher total yield (kg/ha) which amounted to 11.40% over the control yield.

The significant effect of NPK fertilizer rates on the number of suckers and leaves/plant was in response by poor nutrient soil that required fertilization more than cation base-saturated soils as reported by Mare and Modi (2009) who asserted that application of NPK fertilizer improved growth and yield of cocoyam. In the same vein, Orji and Ogbonna (2015) observed increase in the number of suckers and leaves per plant with application of 150 kg/ha and 200 kg/ha rates of NPK fertilizer in Nsukka plants in 2008 and 2009 cropping seasons, respectively (Tables 1). Also, Hamma *et al*. (2004) reported increase in the number of suckers and leaves per plant with the application of 10 t/ha rate of poultry manure. Significant interaction effects of NPK fertilizer in combination with poultry manure could be caused by positive interaction between the two factors which resulted in the production of higher number of suckers and leaves plant. Non-significant effects of NPK fertilizer and poultry manure on the yield and yield components of taro could be attributed to weather, soil conditions, and slow mineralization of poultry manure which might have nullified treatment applications.

CONCLUSION

Despite non-significant effects of NPK 15;15:15 fertilizer rates on the yield of taro variety Coco-India, I would still recommend 250kg/ha rate to farmers at Umudike as it still gave the optimum yield. However, more years of poultry manure experiments are still required on taro production to confirm this research report.

Table1: Effects of NPK Fertilizer and Poultry Manure rates on number of suckers and leaves/plant at 12 weeks after planting (WAP)

NPK Fertilizer	**poultry manure Rate (t/ha)**				
Rates kg/ha	0	5	10	15	Mean
0	13.60	13.30	15.20	4.50	11.60
150	2.70	3.80	5.50	4.50	4.40
200	3.80	4.80	3.80	5.50	4.20
250	3.20	4.20	4.50	4.10	4.20
Mean	7.27	8.33	8.83	6.69	
		Number of leaves/plant			
0	22.58	20.75	24.50	18.00	21.46
150	12.92	14.25	18.92	16.42	15.62
200	15.67	29.25	17.00	15.67	16.90
250	14.42	15.25	13.17	18.83	15.60
Mean	14.60	17.38	18.58	17.23	

	No of suckers/plant	No of leaves/plant
F-LSD $_{(0.05)}$ for comparing two Fertilizer means (F):	5.81*	4.31*
F-LSD $_{(0.05)}$ for comparing two Poultry means (P):	5.81^{ns}	4.31*
F-LSD $_{(0.05)}$ for comparing F x P means:	11.62*	8.63*

Table 2: Effects of NPK Fertilizer and Poultry Manure rates on yield and yield components of taro at harvest

NPK Fertilizer	poultry manure Rates (t/ha)				
Rates kg/ha	0	5	10	15	Mean
0	8.50	7.58	7.33	7.25	7.67
150	5.67	7.00	7.75	8.75	7.29
200	6.42	8.08	6.83	5.75	6.77
250	8.33	7.92	7.83	8.00	8.02
Mean	7.23	7.65	7.44	7.44	
Weight of cormels/plant(g)					
0	12.39	10.42	8.70	9.53	10.26
150	7.04	8.00	10.33	13.08	9.61
200	10.38	10.60	8.33	7.33	9.01
250	11.58	10.12	12.92	12.33	11.74
Mean	10.35	9.64	10.07	10.57	
Weight of corm/plant(g)					
0	4.81	4.74	3.30	5.14	4.50
150	9.61	2.88	5.23	6.08	5.95
200	4.23	4.56	5.84	4.28	4.73
250	5.00	4.77	5.10	5.67	5.13
Mean	5.91	4.24	4.87	5.29	
Total yield/ha (kg)					
0	860.00	743.00	600.00	733.00	734.00
150	832.00	544.00	778.00	958.00	778.00
200	730.00	728.00	709.00	580.00	687.00
250	829.00	745.00	901.00	900.00	844.00
Mean	813.00	690.00	747.00	793.00	

	NC	WC(g)	WCM (g)	TY (kg/ha)
F-LSD $_{(0.05)}$ for comparing two fertilizer means:	1.79^{ns}	3.34^{ns}	2.64^{ns}	250.90^{ns}
F-LSD $_{(0.05)}$ for comparing two poultry means:	1.79^{ns}	3.34^{ns}	2.64^{ns}	250.90^{ns}
F-LSD $_{(0.05)}$ for comparing two 2 F x P means:	3.59^{ns}	6.69^{ns}	5.29*	501.90^{ns}

KEY:
NC= Number of Cormels
WC= Weight of Cormels
WCM= Weight of Corms
TY= Total Yield

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GROWTH AND YIELD RESPONSE OF SWEET SORGHUM (*SORGHUM BICOLOR* L. MOENCH) *SUB*-SPP *SACCHARATUM*) VARIETIES TO DIFFERENT LEVELS OF NPK IN THE SUDAN SAVANNAH ECOLOGICAL ZONE

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ABSTRACT

A field experiment was conducted during the 2014 wet season at the Agricultural Research Station, Institute for Agricultural Research farm, Wasai-Minjibir in Kano (12^0 8.58'N, 8^0 40.46'E), 500m above sea level in the Sudan savanna ecological zone of Nigeria to evaluate the growth and yield response of sweet sorghum to NPK levels (Sorghum bicolor (L.) Moench. sub-spp saccharatum) varieties. The treatments consisted of three varieties of sweet sorghum (SSV NTJ2, SSV Ex-Daura and SSV Ex-Garki), and four NPK levels (0, 200, 300 and 400 kg ha^{-1}) which were combined and laid in a randomized complete block design (RCBD) and replicated three times. The result showed that application of 400 kg ha^{-1} of NPK significantly increased grain weight per ear, stalk and grain yields (129.12g), (40.4 t ha^{-1}) and (2.7 t ha^{-1}) and is comparable to 300 kg NPK ha^{-1} rate. Similarly application of 400 kg ha^{-1} of NPK gave superior growth parameters such as plant height (291.6 cm) and crop dry weight (260.3g) compared to other rates of application. The SSV NTJ2 variety had higher plant height (271.3 cm), crop dry weight (205.17g) than SSV Ex-Daura or SSV Ex-Garki). While SSV NTJ2 variety had the highest grain weight per panicle (88.56g), there were not significant differences among the test crop in terms of stalk yield. From the study, it could be suggested that a farmer may use SSV NTJ2 variety with the application of 300 kg NPK ha^{-1} in the Sudan savannah ecological zone to grow sweet sorghum crop that is now nearing extinction.

Keywords: Sweet sorghum, NPK, Minjibir, Sudan savannah, growth and yield

INTRODUCTION

Sweet sorghum [*Sorghum bicolor* (L) Moench. *sub-spp saccharatum*] belongs to same species as grain sorghum, grass sorghum and broom sorghum. It is similar to grain sorghum but has sugar-rich stalks (Doggett, 1970). It is a crop that is well adapted to sub-tropical and temperate regions of the world and it is both water and nutrient efficient. Sweet sorghum has good tolerance to drought, water lodging and salinity (Almondares *et al.*, 2008). It can be grown in areas of low fertility and unpredictable rainfall (Van-Oosteroma *et al.,* 2001). It is a C4 plant with a high biomass yield and good nitrogen used efficiency (Gardener *et al.*, 1994). Sweet sorghum has the potential to be a good alternative feedstock for ethanol production. It is a multi-purpose crop which can be cultivated for simultaneous production of grain from its ear-head as food and feed ingredients, sugary juice from its stalk for making syrup, jaggery or ethanol, the bagasse and green foliage as an excellent fodder for animals, as organic fertilizer or for paper manufacturing. It is special purpose sorghum with rapid growth and has wider adaptability (Reddy and Sanjana, 2003). The grain contains 11.3% protein, 3.3% fat and 56–73% starch, relatively rich in iron, zinc, phosphorus and B-complex vitamins and the high tannin, an anti-oxidant, makes it a beneficial source of nutrition and medicine (Gnansounoua *et al.* 2005). Nitrogen, Phosphorous and Potassium (NPK) are the most important nutrients that influence the growth and yield of crops, sweet sorghum inclusive. Most of the crop growing soils in Sudan savannah are deficient in these nutrients (Burns *et al.*, 1991). Global warming, energy crises and environmental pollution have become a source for concern, adversely affecting agricultural production with consequences on food security issues. Developing this multi-purpose crop could play important role in promoting food production, livestock husbandry, energy source, sugar and paper making, leading to jobs creation. The study was undertaken to investigate rates of NPK for optimum productivity of sweet sorghum.

MATERIALS AND METHODS

The study was conducted during the 2014 wet season at the Agricultural Research Station, Institute for Agricultural Research farm, Minjibir-Kano (12^0 8.58'N, 80 40.46'E), 500m above sea level in the Sudan savanna ecological zone of Nigeria during the 2014 rainy season in Sudan savanna ecological zone, where annual rainfall averaged 600 mm is received between May and September. Soil type is a semi drain ferruginous tropical sandy loam. The results are presented in Tables 1 and 2. The treatment consisted of three sweet sorghum varieties SSV NTJ2, SSV Ex-Daura and SSV Garki and four NPK levels (0, 200, 300, and 400 kg ha^{-1}). Treatment combinations were laid in RCBD and replicated three times. Gross and net plot sizes used were 18m^2 and 12m^2. The test crops were obtained from IAR sorghum breeding unit. SSV NTJ2 is an improved and early maturing, while the other two varieties SSV Ex-Daura and SSV Ex-Garki are local land races sourced from Daura in Katsina and Garki in

Jigawa States respectively. Planting was carried out in mid-May and thinning was done at three weeks after sowing (WAS), while manual hoe weeding was done at 3 and 6 WAS. The NPK treatments, using 20:10:10 compound fertilizer, was applied in two split doses as per the treatment rate to each main plot at 3 and 6 WAS. Data collected were subjected to analysis of variance (ANOVA) using SAS software package (SAS, 2002). Means were separated using Duncan Multiple Range Test (DMRT) method at 5% level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

The response of sweet sorghum to NPK was significant on both growth and yield characteristics such as plant height, number of leaves per plant, plant dry weight, grain weight per ear, stalks and grain yields during the trial period.Table1 shows the response of sweet sorghum to NPK on plant height (cm), number of leaves per plant and plant dry weight (g) of sweet sorghum. Application of 400 kg NPK gave significantly the highest plant height, which was similar to 200 and 300 kg ha^{-1} application rates. Thus by implication, for each increase in the NPK level from 0 to 400 kg ha^{-1} there was corresponding increase in the plant height with statistical similarities. The response of the sweet sorghum varieties however, showed a different trend where SSV NTJ2 produced the tallest plants while Ex-Garki produced the shortest. Application of 300 kg ha^{-1} NPK resulted in significantly higher number of leaves per plant than other rates of application. The result further revealed that the control recorded the lowest leaves number. SSV NTJ2 recorded the highest number of leaves per plant though was similar to other varieties, a situation that shows similarities in response to NPK by all varieties. Application of 400 kg ha^{-1} of the NPK significantly increased the crop dry matter and was comparable with the 300 kg ha^{-1} rate; the control and the 200 kg ha^{-1} were similar but significantly much lower. Response to NPK as portrayed in grain weight per ear, stalk and grain yields are shown in Table 2. The application of 300 and 400 kg ha^{-1} NPK were similar in all the three parameters (grain weight, stalk and grain yields) and significantly higher than other rates; consistently the control recorded the lowest responses of all. Response of SSV NTJ2 to NPK was the highest in grain weight per ear, stalk yield and grain yield, compared to other varieties during the trial period. Though NTJ2 response was higher than SSV Ex-Daura in stalk yield, the difference was not significant. Sudan savanna soils are low in organic content of C and N attributable to low vegetative cover and annual bush burning prevalent in many farming communities in the zone, thus the need to supplement crop growing with fertilizers (Buah, 2009). In the present study, the growth parameter such as plant height, number of leaves per plant and dry weight responded significantly to the different rate of NPK applied (200, 300 and 400 kg NPK ha^{-1}) which was in tandem with the report of Alagarsamy (1995). Plant height, number of leaves and other growth characters increased progressively with increase in NPK, which may be due to the effect of on cell division and tissue elongation which consequently led to increase in number of node and internode elongation as well as proper root formation that enhances soil nutrient absorption (Leible, 1991). The enhanced vegetative growth of sweet sorghum resulted in significant response of yield parameters such as grain weight ear^{-1}, stalk yield and grain yields. The increase in these parameters could be linked to higher assimilate partitioning and dry matter production for grain filling with increased NPK application as reported by Mosier (2004). SSV NTJ2 superior response with regards the yield traits may have been in its ability to efficiently use the production resources compared to other varieties.

CONCLUSION

Sweet sorghum growing has almost gone extinct in the Sudan savannah zone as a result of neglect, however, this study has shown that just like its family member, the grain sorghum, its growing can be successfully revived given it significant response to NPK. Farmer in the Sudan savannah can grow sweet sorghum successfully, especially the SSV NTJ2 variety, with application of 300 kg ha^{-1} NPK in the ecology.

Table 1: Effect of NPK Fertilizer on Growth and Yield of Sweet Sorghum Varieties ((Growth Parameters)

Treatment	Plt Ht.(cm) 12 WAS	Lvs/Plt 12 WAS	Dry Wt (g) 12 WAS
NPK			
0	140.4c	12.9d	136.7d
200	193.3b	13.0c	164.1c
300	218.4ab	18.0a	201.9b
400	291.6a	14.3b	260.3a
SE±	3.37	0.383	3.95
Variety			
Ex-Garki	162.3c	18.2a	204.4b
Ex-Daura	201.6b	13.3b	192.5b
NJT2	271.3a	17.4ab	245.7a
SE±	4.31	0.442	4.39

Means with the same letter within a treatment are not significantly different at 0.05 level of probability using DMRT

Table 2: Effect of NPK Fertilizer on Growth and Yield of Sweet Sorghum Varieties (Yield Parameters)

Treatment	Grain Wt/Panicle (g)	Stalk Yield (Ton/ha)	Grain Yield (Ton/ha)
NPK			
0	56.2c	20.4c	1.8c
200	79.6b	29.3b	1.9b
300	108.9ab	35.8ab	2.6a
SE±	1.89	1.19	1.68
Variety			
Ex-Garki	77.7b	29.8ab	1.8b
Ex-Daura	76.8b	33.3a	1.9b
NTJ2	88.6a	35.2a	2.7a
SE±	1.79	1.15	1.92

Means with the same letter within a treatment are not significantly different at 0.05% level of probability using DMRT. NS= Not Significant

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ETHANOLIC EXTRACTION OF TOXICITY OF PLANT EXTRACTS AGAINST COWPEA SEED BRUCHID *Callosobruchus maculatus*(F.) (coleoptera: chrysomelidae) ON MUNGBEAN (*Vigna radiata* (L.) Wilczek) STORAGE

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ABSTRACT
A laboratory study was conducted at Crop Science Laboratory of Michael Okpara University of Agriculture Umudike, to determine the toxicity of ethanolic extraction of Piper guineense fruits, Dennittia tripetala fruits Allium sativum bulbs, Zingiber officinale rhizomes against the cowpea seed bruchid Callosobruchus maculatus (F.) (Coleoptera:Chrysomelidae) on stored mungbean (Vigna radiata(L.)Wilczek) seeds. The experimental design was a completely randomized design with three replications. 0.5,1.0,1.5,2.0g rates of the different extraction was admixed with 20g of mungbean seeds placed in plastic containers. The effect of the treatments were assessed on insect mortality at 48, and 96hours, oviposition 7days, adult emergence on 14days after infestation, and seed viability test at the expiration in each of the experimental plots. The results showed that plant extracts were effective in controlling insect infestation by recording significantly higher performance when compared with the control. Piper guineense provided the best protection for stored mungbean at 2.0/20g compared with the other treatments, followed by Allium sativum. Dennittia tripetala and Zingiber officinale were almost the same in their performance. Plant extracts did not affect the viability of the seeds. The results obtained suggest that the plant extracts possess insecticidal properties and can be utilized in protecting stored mungbean from C. maculatus infestation since they are environmental friendly, cheaper than synthetic insecticides and safer for humans.
Keywords: Mungbean, *Callosobruchus maculatus, Piper guineense, Allium sativum, Dennittia tripetala, Zingiber officinale* and Toxicity

INTRODUCTION
Grains are however, very susceptible to infestation by insect pests belonging to two main orders, Coleoptera (beetle) and Lepidoptera (moth), micro-organisms and to rodent pests in storage. These pests are responsible for losses of grains in storage amounting to several millions of US dollars annually. They are thus, a major threat to the food security programme of any nation, particularly developing countries where the storage of agricultural produce is handled mainly by poor resource farmers. Food legumes occupy a prominent place in the nutrition level of families because their edible seeds form a cheap alternative source of protein in their diets especially in Africa (Okosun and Adedire, 2010). Mungbean (*Vigna radiata* (L) Wilczek) belong to the family Fabaceae. It is an annual erect plant reaching a height of about 0.15-1.25m. It is a good source of proteins, carbohydrates, and vitamins for mankind all over the world. Mungbean are widely grown as a tropical and subtropical crop. It is a low input crop and it is priced for its seeds which have high protein level, easily digestible and is consumed as food. Because of its non-flatulent behaviour (digestibility) and high protein level, it has an edge over other pulses(Ghafoor *et al.*, 2003). Mungbean is attacked by different species of insects, but sucking insect pests*(Ahids craccivora, Empoasa spp.,Cicadella viridis* and *Bemisia* tabaci-white fly) are the major insects (Isman,2008). A serious postharvest pest of mungbean is the bruchid, *Callosobruchus maculatus* which can infest the crop in the field before harvest then develop during storage. The protection of crop plants and seeds from pests and diseases has been achieved in industrialized countries almost through the application of chemical control means. Plant extracts or their potent derivatives such as derris, rotenone, pyrethrum, nicotine, sabadilla, physostigmine, quassin or azadirachtin, have been used as insecticides for decades (Sarfraz and Keddie, 2005). Botanical pesticides are of interest to organic farmers because the chemicals are natural products, hence easily biodegradable and are often thought of being safe to handle and use on food products. The objective of this research work was to evaluate the toxicity of ethanolic extraction of some plant extracts against the bruchid *C. maculatus.*

MATERIALS AND METHODS
The laboratory study was conducted at the Crop Science Laboratory College of Crop and Soil Sciences, Michael Okpara University of Agriculture Umudike. Bruchid beetles used for the study was obtained from naturally infested stored Cowpea collected from Umuahia main market, Abia State, and reared in the laboratory on dry susceptible brown cowpea, in plastic buckets covered with muslin cloth held with rubber bands to ensure aeration and prevent escape of the beetle. The plastic buckets was kept at an ambient temperature and relative humidity (28$\pm$30C and 75$\pm$5% r. h).The sexes of bean beetle *C. maculatus* was determined by examining the elytral pattern (Southgate et al., 1975). The different plant extracts used were obtained from Umuahia main market, Abia State. They are; Guinea pepper (*Piper guineense* Schum and Thonn), Pepper fruit (*Dennittia tripetala*), Garlic (*Allium*

sativum) and Ginger (*Zingiber officinale*). The dried plant extracts were separately ground using a HP kitchen hammer mill. The powders were sieved into particle size of 300um with a British laboratory test standard sieve and kept in air tight containers prior to use (Okonkwo and Okoye, 1996). Each of the plant extracts were weighed into four dosages of 0.5, 1.0, 1.5 and 2.0g and added to 20g wholesome mungbean seeds in plastic containers with tight fitting, but perforated lids for aeration. Different weights of plant powder extracts, were mixed with 5ml of ethanol. The suspension was vigorously stirred and left for 16hours before filtering with muslin cloth to get the filtrate. Then 20g of clean and wholesome (uninfested) mungbean seeds were steeped in the filtrate of the different concentration for 30 seconds and quickly removed to air dry for 5hours. The treated mungbean seeds and the control were placed inside plastic containers and four freshly emerged bruchids (1-2 day old) 2 females and 2 males were introduced into each container which was tightly covered with muslin cloth and firmly screwed by the lid.

RESULTS AND DISCUSSION

The mean percentage mortality of *C. maculatus* treated with ethanol extraction of the plant extracts on Mungbean is presented in Table 1. The result indicated that the plant extracts significantly ($P \leq 0.05$) caused adult mortality of the bruchids, 48 hours post treatment compared with the control (Table 1). *P. guineense* had the highest percentage adult insect mortality with 18.30%, while *Z. officinale* and *A. sativum* had the least with 11.70% and 11.70% respectively the plant extracts did not differ significantly from each other in their mortality effects on adult *C. maculatus* ($P < 0.05$). Table 1, also shows the mean percentage mortality of adult *C. maculatus* exposed to ethanol extracts 96hours after Infestation. All the plant ethanol extracts had higher mortality ($P \leq 0.05$) of adult *C. maculatus* than the control. *P. guineense* had the highest mortality with 55.00% which was significantly different ($P \leq 0.05$) from others, followed by *A. sativum, D. tripetala* and *Z. officinale* with 48.30% 43.30% and 43.30% respectively. There was highly significant dosage effects observed in the ethanol extracts when compared with the control. ($P \leq 0.05$). The effect of treating mungbean seeds with some ethanol extracts on oviposition by *C. maculatus* is shown in Table 2. There were highly significant reduction on oviposition in all the treated samples when compared with the control ($P \leq 0.05$). *P. guineense* had the best protectant action among the plant ethanol extracts with mean oviposition count of 58.73% which was significantly different from other plant extracts ($P \leq 0.05$). *A. sativum* had 62.53% which was not significantly different from *D. tripetala* and *Z. officinale* with 63.47% and 63.80% respectively ($P \geq 0.05$). The mean oviposition reduction effect of the different dosages was highly significant ($P \leq 0.05$) compared with the control The dosage of 2g/20g mungbean seeds had the least oviposition count with 46.17% which was significantly different from 1.5g, 1.0g and 0.5g/20g mungbean seeds with53.08%, 59.42% and 67.83% respectively ($P \leq 0.05$). This is also an indication that higher dosages reduced oviposition more. In Table 3, adult emergence count of *C. maculatus* on mungbean seeds treated with some plant ethanol extracts. Adult *C. maculatus* emergence was significantly suppressed by all the plant extracts ($P \leq 0.05$) when compared with the control. *P. guineense* gave the highest suppression effect with mean adult emergence count of 37.20 which was significantly different ($P \leq 0.05$) from other plant extracts. *A. sativum, D. tripetala* and *Z. officinale* were statistically the same with 40.67, 41.67 and 43.60 respectively. Table 3. also shows percentage germination of mungbean seeds treated with plant ethanol extracts. There were no significant difference among the mean of the ethanol extracts on percentage germination of mungbean seeds treated, but they differed significantly ($P \leq 0.05$) with the control. *A. sativum* had the least percentage germination count with 38.67%, while *Z. officinale* had the highest percentage germination count with 41.33%. The dosage effect on percentage germination were highly significant ($P \leq 0.05$) when compared with the control. The higher the dosage the more the percentage germination count. The result of the experiment indicates that all the ethanol extracts were insecticidal to the bruchids. *P. guineense* were significantly different from other extracts used in all the dosage due to stronger contact toxicity. Longer exposure of the insects to treated seeds with ethanol extracts 96 hours enhanced the insecticidal activity and mortality became more pronounced above 60%. Dosages per 20g seeds consistently caused higher adult mortality in *P. guineense* and *A. sativum* than in *D. tripetala* and Z. officinale. Mortality trend was in line with (Emeasor, 2005). Benner (1993) reported that extraction of insecticidal plant extracts with appropriate solvents often concentrates the active material and makes their potency readily detectable. Oviposition by the bruchids was significantly suppressed by all the ethanol extracts. Oviposition was significantly suppressed by *P. guineense* more than other extracts. The adult emergence of the bruchids were significantly suppressed by the ethanol extracts compared with control ($P<0.05$). Adult emergence suppression was highest at 2.0g dose with *P. guineense* having the best suppression. The ethanol extracts did not affect the viability of the seeds.

CONCLUSION

The ethanolic extraction of all the plant extracts proves insecticidal against *C. maculatus*. Piper guineense performed best among the plant extracts used. 2.0g/20g gave the best protection. Plant extracts are therefore recommended for grains in store as they are natural products, hence easily biodegradable, ecological friendly and being safe to handle better than synthetic.

Table 1: Mean percentage mortality of adult *C. maculatus* exposed to selected ethanol extracts 48 and 96 hours post treatment

Treatment (plant extracts)	0.0 (48h)	0.5	1.0	1.5	2.0	Mean	0.0 (96h)	0.5	1.0	1.5	2.0	Mean
	Dosages g/20g Mungbean seeds											
P. guineen..	0.00	16.70	25.00	25.00	25.00	18.30	0.00	58.30	66.70	75.00	75.00	55.00
D.tripet.	0.00	8.30	16.70	16.70	25.00	18.30	0.00	41.70	58.30	58.30	58.30	43.00
Z.officina.	0.00	8.30	8.30	16.70	25.00	11.70	0.00	41.70	58.30	58.30	58.30	43.00
A.sativum	0.00	8.30	16.70	16.70	16.70	11.70	0.00	50.00	58.30	66.70	66.70	48.30
Mean	0.00	10.40	16.70	18.80	22.90		0.00	47.90	60.40	64.60	64.60	

LSD (0.05) Plant extract=7.89(P=0.287)ns
LSD (0.05)Dosages(Conc)=8.83(P<0.001)**
LSD (0.05) Plant extr. X Dosage=17.65(P=0.981)ns

LSD (0.05) Plant extract=6.55(P=0.002)**
LSD (0.05) Dosage (Conc)=7.32(P<0.0001)*
LSD (0.05) Plant extr x Dosage=14.64(P=0.88)

Table 2: The Effect of treating mungbean seeds with selected ethanol extracts on oviposition by *C. maculatus*

Treatment (Plant extract	0.00	0.5	1.0	1.5	2.0	Mean
	Dosages g/20g Mungbean seeds					
P.guineense	86.00	65.67	54.00	45.67	42.33	58.73
D.tripetala	82.33	66.00	62.67	56.67	49.67	63.47
Z. officinale	82.00	70.33	60.33	56.67	49.67	63.47
A.sativum	86.33	69.33	60.33	53.33	43.00	62.53
Mean	84.17	67.83	59.42	53.08	46.17	

LSD(0.05)Plant extract=3.18(P=0.009)**
LSD(0.05)Dosages(Conc)=3.55(P<0.001)**
LSD(0.05)Plant extract x Dosages=7.11 (P=0.113)ns

Table 3: Adult Emergence count and Percentage Germination of *C. maculatus on* mungbean seeds treated with selected ethanol extracts

Treatment (plant extracts)	0.0 (Adult emergence)	0.5	1.0	1.5	2.0	Mean	0.0 (Percentage germination)	0.5	1.0	1.5	2.0	Mean
	Dosages g/20g Mungbean seeds											
P. guineen..	71.00	45.33	32.67	21.00	15.00	37.20	26.67	30.00	36.67	46.67	60.00	40.00
D.tripet.	71.67	49.33	39.67	26.67	21.67	41.67	0.00	30.00	43.33	43.33	53.33	40.00
Z.officina.	69.33	51.33	41.67	33.33	22.33	43.60	30.00	36.67	46.67	43.33	50.00	41.33
A.sativum	72.00	49.33	38.33	24.00	19.67	40.67	26.67	30.00	40.00	43.33	53.33	38.67
Mean	71.25	48.83	37.92	26.25	19.67		28.33	31.67	41.67	44.17	54.17	

LSD (0.05) Plant extract=2.46(P=0.001)**
LSD (0.05)Dosages(Conc)=2.75(P<0.001)**
LSD (0.05) Plant extr. X Dosage=5.51(P=0.109)ns

LSD (0.05) Plant extract=3.24(P=0.488)ns
LSD (0.05) Dosage (Conc)=3.62(P<0.0001)*
LSD (0.05) Plant extr x Dosage=7.25(P=0.07)ns

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VARIETAL RESPONSE OF SELECTED LANDRACES FOR ENHANCING THE MULTIPLICATION RATIO OF YAM TUBER THROUGH VINE CUTTINGS

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ABSTRACT
The experiment was conducted at the screen house and field of National Root Crops Research Institute (NRCRI), Umudike with the aim of determining the varietal response of selected landraces for enhancing the multiplication ratio of yam tuber through vine cuttings for seed yam production, to select the variety /varieties that responded best to vine cuttings survivability ratio for seed yam production and to determine 'over all seed yam' production. Single micro-tubers of size 100g from white yam varieties was planted in each of the 20 polybags measuring 8 x 12cm filled with sterilized top soil and arranged in the screen house. Vines were cut one node and planted in black polybags of size 5 x 6cm filled with sterilized topsoil and later transplanted to the field until harvested. The following data were collected: number of vines collected from each yam plant every 3 months after planting (MAP), for 9 months, number of plants transported to the field, percentage field establishment, number of tubers per plant and per variety, tuber length and tuber diameter, The result indicated that the variety with the highest number of vine cuttings per stand were Gbagu and TDr89/02665 with 56 vine cuttings per stand respectively and yielded 56 and 58 tubers each with average of one tuber per stand as against the natural method of one tuber at planting and one tuber of seed yam at harvest. A total of 180 yam plants from 9 varieties, cloned up to 461 yam plants gave tuber yield totaling 39,166,560 tubers for seed yam production within one year when compared with the control, only one tuber was produced within the same year. This indicated that vine cuttings could be used to enhance the rate of tuber multiplication of yam varieties for commercial seed yam production.
Keywords: vine cuttings, clonning, multiplication ratio, seed yams and commercial seed yam

INTRODUCTION

Yams have long been vegetatively propagated through seed tubers or through tuber setts. However, Sadik and Okereke (1975) reported the possibility of propagating yams through botanical seeds although this method has not increased the multiplication ratio of single yam plant. Therefore, seed tubers, tuber setts and botanical seeds are still limited in the application of tuber yam multiplication for ware tuber yam production. Many researchers such as Njoku, in 1968, and Martins and Gaskins also in the same year (1968) had demonstrated that yams can be propagated by vine cuttings. According to Vander Zang and Fox (1981), vine cuttings could be used for ware yam production in *Dioscorea alata* field. They reported that vine cuttings are able to produce roots within 3 - 4 weeks after planting. The bud in the leaf axil when cut with the vine and planted, first produce roots and then a new shoot or multiple shoots, tuber initiation followed and bulk and the whole physiological processes continued and end when the plant senescence. All researchers have been working on vine cutting for seed tuber /ware yam production however; very few number who had worked on vine cuttings for seed tuber multiplication have left their work unreported. Therefore this study aimed at determining the varietal response of selected landraces for enhancing the multiplication ratio of yam tuber through vine cuttings for seed yam production, to select the variety /varieties that responded best to vine cuttings survivability ratio for seed yam production and to determine 'over all seed tuber for ware yam production.

MATERIALS AND METHODS

Screen house activity: The experiment was conducted at the screen house and field of National Root Crops Research Institute (NRCRI), Umudike in 2014 and 2015 seasons. Single micro-tubers of size 100g from white yam varieties were planted in each of the perforated 20 plastic buckets measuring 8 x 12cm filled with sterilized top soil and arranged in the screen house. They were watered twice a week with watering can until they sprout. The vines were trained on ropes to the top of the screen house. The vine tips were cut back at two months after planting to induce lateral branching. Three competitive yam plants from each variety were tagged and vine cuttings were collected from lateral branches of the tagged yam plants 3 months after planting (MAP) and for every 3 months for a period of 9 months. The vines were cut one node and planted in black polybags of size 5 x 6cm filled with sterilized topsoil. After 4 weeks after pre-sprouting (root initiation and shoots), the potted vines were transplanted to the field. Also one perforated plastic bucket of same size filled with sterilized top soil was planted with one micro tuber of the same size using the national check (TDr89/02665) and was used as control. At time of transplanting to the field, the potted yam plant used as control was transferred to the field and planted.

Field activity: The area for the experiment was slashed, ploughed, harrowed and ridged. The ridges were spaced 1.0m apart. Planting was on the crest of the ridges at 0.3 x 0.1m apart in a plot for each of the varieties collected for a period of 9 months. Each variety constituted a plot and the 9 varieties constituted a block while the 3 months interval constituted replicates. (that is each 3 months interval is a replicate, for the 9 months were 3 replicates). The clone seedlings in the 9 varieties were laid out in a Randomized Complete Block Design (RCBD. The Sprouted vine plants were trellised with ropes to enable the yam plants to climb up. Fertilizer application was N P K 15: 15:15, applied 8 weeks after being transplanted and 9cm round the base of each clone seedling in the field. The whole plots were kept weed-free throughout the growth of the yam clone seedlings with hand-hoe. Hand rouging was done toward harvesting which took place when the yam plants senescence. All agronomic practices such as pests and disease control were carried out as at when due.
Data Collection: Data collected from the clone seedlings at harvest from each variety in the field were: number of plants transplanted to the field, percentage field establishment, number of tubers per plant and per variety, tuber length and tuber diameter.
Data analyzes: Data collected after logarithmic transformation using log base ten were statistically analyzed using Analysis of variance and means were separated.

RESULTS AND DISCUSSION

Number of vine cuttings produce per variety: The result for the mean ratio of vine cuttings per variety, Number of Sprouts, Mean number of tubers per variety and Size of tubers for the two years combined are presented in Table 1. The result on Table 1 showed significant ($P<0.05$) variation in the ratio of vine cuttings to one stand of potted variety. Therefore ratio of 9 stands of various yam varieties yielded 504 vine cuttings. That is 9 yam stands : 504 vine cuttings which was equivalent to 1 yam plant : 56 yam plants. When compared to the control, the number of yam plants yielded was 1 yam plant : 1 yam plant. The ones that sprouted and were planted in the field were 465 yam plants; however, 461 yam plants survived in the field and the tubers produced were harvested.
Number of tubers per clone per variety: The results of number of tubers per clone per variety, size of tuber and number of tubers harvested are presented in Table 1. There was significant ($P<0.05$) variation in the number of tubers yielded by the vine cuttings. The result of the number of tubers per variety, and size of tubers are presented in Table 1. Total number of tubers harvested from the cloning of the various 9 yam plants was 472 tubers, which was in the ratio of 9 stands to 472 tubers. This gave a grand mean of 1 yam plant to 52.4 tubers. When compared to the control where one tuber was planted without cutting into setts, only one tuber was harvested for planting as seed yam. However, the variety with the highest number of vine cuttings per stand were Gbagu and TDr89/02665 with 56 vine cuttings per stand respectively and yielded 56 and 58 tubers each with average of one tuber per stand (Table 1). However, the mean length of tuber was 28.7cm and diameter was 4.2cm which indicated that the size of the tubers produced by the vine cuttings was large enough to be used as seed yam (Table 1).
Multiplication ratio of the cloned vine cuttings: The multiplication ratio of the cloned vine cuttings with the twenty stands per variety of the yams planted in the Screen house are presented in Table 2.
One stand of yam plant can be cloned to obtain many yam plants to enhance the rate of seed yam multiplication for commercial purposes. The result in Table 2 indicated that with a total of 180 yam plants from 9 varieties, cloned up to 461 yam plants gave a total yield of 39,166,560 tubers for seed yam production within one year when compared with the control, which produced only one tuber within the same year. This indicated that vine cuttings could be used to enhance the rate of tuber multiplication of yam varieties for commercial seed yam production. Seed yams are used for the production of ware yams (table yam and ceremonial yam). The mean ratio of vine cuttings of 1 yam plant to 52.4 number of tubers as against the control which is 1 yam plant to 1 tuber of yam is an indication that the vine cutting had high multiplication ratio than using tubers in seed yam production..

CONCLUSION

The result indicated that the variety with the highest number of vine cuttings per stand were Gbagu and TDr89/02665 with 56 vine cuttings per stand respectively and yielded 56 and 58 tubers each with average of one tuber per stand as against the natural method of one tuber at planting and one tuber of seed yam at harvest. This showed that vine cuttings could be used for rapid multiplication of yam tubers for commercial seed yam production. A total of 180 yam plants from 9 varieties, cloned up to 461 yam plants gave tuber yield totalled 39,166,560 tubers for seed yam production within one year based on this study. However, when compared with the control, only one tuber was produced within the same year. This indicated that vine cuttings could be used to enhance the rate of tuber multiplication of yam varieties for commercial yam production.

Table 1: Mean ratio of vine cuttings per variety, Number of Sprouts, Mean number of tubers per variety and Size of tubers for the two years combined

Varieties	Ratio of vine cuttings per stand	Number of potted vines	No. of sprouted vines	Number of sprout transplanted to field (4WAP)	Number of field survival 4MAP)	Ratio of vine cuttings per stand that survived	Ratio of No. of tubers harvested/stand / Variety	No. of tubers/ stand	Tuber length (cm)	Tuber diameter (cm)
Obiaoturugo	57	57	51	51	51	51	54	1.1	7.3	3.0
Amola	59	59	49	49	49	49	51	1.0	6.5	3.2
Gbagu	63	63	58	58	56	56	56	1.0	5.5	2.5
Aloshi	53	53	50	50	50	50	51	1.0	7.1	5.2
Hembakwasi	53	53	53	53	51	51	53	1.0	6.8	5.0
Ogini	57	57	51	51	51	51	51	1.0	4.4	6.2
Ekpe	51	51	45	45	45	45	46	1.0	6.2	4.6
Ame	57	57	52	52	52	52	52	1.0	7.2	4.3
TDr89/02665	56	56	56	56	56	56	58	1.0	6.4	3.6
Total	504	504	465	465	461	461	472	9.1	57.4	37.6
Control(02665)	1	1	1	1	1	51.2	52.4	1.0	28.7	4.2
Control(02665)	-	-	-	-	-	1 tuber	1	1	9.0	6.0
Prob.level	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05	P<0.05

Table 2: The multiplication ratio of the cloned vine cuttings with the twenty stands per variety of the yams planted in the Screen house

Variety	Ratio of vine cuttings to one stand	Total No. of tubers harvested/ Variety	Number of potted yam plants	Estimated total number of tubers from various varieties
Obiaoturugo	51	54	20	55080
Amola	49	51	20	49980
Gbagu	56	56	20	62720
Aloshi	50	51	20	51000
Hembakwasi	51	53	20	54060
Ogini	51	51	20	52020
Ekpe	45	46	20	41400
Ame	52	52	20	54080
TDr89/02665	56	58	20	64960
Total	461	472	180	39,166,560
Control	1 tuber	1	1	1

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ENHANCEMENT OF SEED GERMINATION IN THREE *CAPSICUM SPECIES* USING HYDRO PRIMING METHOD

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ABSTRACT

In order to determine the effect of hydro-priming as seed enhancement method in three pepper species, a laboratory experiment was conducted. Seeds of Capsicum annum, Capsicum frutescences and Capsicum chinense were hydro-primed and drawn at 0,2,4,6 and 8 hrs and were further dehydrated under natural air drying conditions at 0, 6, 12, 18, and 24 hrs. The experiment was a factorial laid out in Completely Randomized Design with three replicates. Data collected on seed germination test were subjected to analysis of variance and means were separated using Tukey's HSD test at 5% probability level. Species, hydro priming time and drying hour had considerable effect on seed germination. Seeds of C. annum as well as seeds of C. frutescences gave higher seed germination. Seed lot, irrespective of species, hydro primed for 0 and 2 hours showed higher seed germination Also, seeds of C. annum hydro primed for 8 hrs and air dried for 6 and 12 hrs had highest germination of 92 - 97 % while C. annum seed soaked for 6 hrs and air dried for 24 hrs showed higher germination. Capsicum frutescences seeds hydro primed for 8 hrs and air dried for 6 hrs had enhanced germination data and therefore recommended. C. chinense seeds found with lower germination suggests the presence of dormancy in the seeds and may require further studies on how to break the seed dormancy.

Key words: Seed quality, seed improvement, seed priming and seed dormancy

INTRODUCTION

Pepper, *Capsicum spp,* is one of the most cultivated vegetable and spices crop worldwide and plays important role as a constituent in many food industries. Pepper was the first plant to be domesticated and cultivated in the western hemisphere (Bosland, 1996). *Capsicum spp* is a native of tropical and subtropical America and may comprise up to 30 species among them are five major cultivated species which are *Capsicum annum*, *Capsicum frutescence*, *Capsicum pubescence*, *Capsicum pendulum* and *Capsicum chinese* (Moscone *et. al.*, 2007). In order to improve field emergence and uniformity, priming treatment may be applied. During priming, treated seeds are allowed to take up water and start (part of) their germination related processes, but emergence of the radical is prevented to avoid the loss of desiccation tolerance that is needed for subsequent drying, storage, and marketing of the treated seeds. Priming treatments are used to synchronize the germination of seeds (Heydekker *et. al.*, 1973). Seed priming is pre-sowing treatment that involves the controlled hydration of seeds, sufficient to allow pre-germination metabolic events to take place but insufficient to allow radical protrusion through the seed coat (Heydekker *et. al.*, 1973). This technique has been used is some vegetable seeds to increase the germination rate, total germination and seedling uniformity, mainly under favourable environmental conditions (Misra and Dwibedi, 1980; Basra *et. al.*, 2005). Hydro-priming is a pre-sowing priming technique in which seeds are soaked in aerated distilled water as a priming medium, and does not require any special technique or equipment, thus, it is probably the simple and inexpensive technique of seed priming (Adebisi *et al.*, 2014). Although priming is one of the physiological methods, which improves seed performance and gives faster and synchronized germination (Sivritepe and Dourado, 1995), but there is little information on the benefit of hydro priming on seed quality of three pepper species grown in Nigeria. Therefore, a study was initiated to determine the effect of hydro priming in enhancement of seed quality in three *Capsicum* species.

MATERIALS AND METHODS

Seed material and source: Three *Capsicum species*(*Capsicum annum*, *Capsicum frutescence*, and *Capsicum chinense)* commonly grown in Nigeria were selected for the study and sourced from the National Horticultural Research (NIHORT) ,Ibadan, Oyo State, Ibadan, Oyo State, Nigeria.

Experimental design and treatments: The experiment was a factorial arrangement made up of seventy-five treatments and three replicates each making a total of 225 experimental units laid out in a Completely Randomized Design (CRD). The factors investigated were five hydro-priming durations, five drying period and three *Capsicum species*.

Hydro-priming treatment: Seed samples of three *Capsicum species* were sterilized using sodium hypochlorite (NaOCl) before priming. After sterilizing, the seeds of each species were divided into three replications with each replicate containing twenty-five seeds for each hydro-priming duration. Seventy-five seeds in three replicates for each hydro-priming duration were placed in net bags and then suspended in an aquarium tank containing distilled water and then drawn at 0, 2, 4, 6 and 8 hrs.

***Artificial drying of primed seeds**:* After priming seed lots were air dried for 0, 6, 12, 18 and 24 hrs before germination test under ambient conditions.

Seed quality assessment:

Standard Germination**-** Twenty-five seeds replicated three times from each species were placed in Petri-dishes lined with moistened paper towels at 25ºC in an incubator. Germination counts of normal seedlings were recorded from 4th day and subsequently at two days interval till the 14th day after sowing (DAS). The number of normal seedlings (visibly emerged radicle) was expressed in percentage following the procedure of ISTA (1985) thus:

$$SG = \frac{\textit{Number of seeds germinated after 8 days}}{\textit{Number of seed sown}} \quad X \quad 100$$

Data analysis

Data collected were transformed using arcsine transformation prior analysis. Data were analyzed using SPSS statistical software package for analysis of variance and treatment means were separated using Tukey's HSD test at 5% probability level.

RESULTS AND DISCUSSION

Table 1 presents the effect of hydro priming duration on seed germination of three Capsicum spp. The result reveals that seed of *C. annuum and C. frutescences* hydro primed for 0 hour (without priming) recorded highest value of 82% while *C. chinense* had the lease value (57%.) Similarly, *C. annuum* and *C. frutescences* seeds hydro primed for 2 hrs showed higher germination values of 76 and 74%, respectively. On seeds hydro primed for 4 hrs, the highest value was recorded in *C. annuum* (85%)< followed by *C. frutescences* (67%) while *C. chinense* had the lowest value, Also, seed primed for 6 hrs recorded highest germination of 83% in *C. annuum*, followed by 65% in *C. frutescences* while *C. chinense* gave lease value However, after 8hrs hydro priming time, *seed* of *C. annuum* showed highest germination (87%), followed by *C. frutescences* with 69% while *C. chinense* had the lease value.

The effect of drying time after hydro priming on seed germination of three *Capsicum* spp. is shown in Table 2. The result reveals that at 0 hrs of drying time, *C. annuum* and *C. frutescences* had higher values of 66 and 67%, respectively while *C. chinense* recorded lower value. After 6 hrs of drying time, seeds form *C. annuum* recorded highest germination value of 73% followed by *C. frutescences* (64%) while *C. chinense* gave the least value. At 12hrs of drying time, *C. annuum* seed air dried for12hrs was significantly highest in germination value (76%) closely followed by *C. frutescences* with 63%. Similarly, after 18 hrs drying time, *C. annuum* and *C. frutescences* showed highest germination of 66% while *C. chinense* gave lease value. For 24 hrs of dehydration time, *C. frutescences* had the highest value of 62%, followed by *C. annuum* whereas *C. chinense* gave the lease value of 16%.The effect of hydro priming time and drying duration on seed germination of three *Capsicum* spp. is shown in Table 3. The data show that seeds of *C. annuum* hydro primed for 0to 8 hrs as well as C. *frutescences* and thereafter dehydrated for 0 hour had statistically higher values of germination. Seed of *C. frutescences* primed for 2 and 4 hrs in water and dried for 0 hrs had intermediate germination performance of 73 and 65%, respectively. Likewise, seed of *C. chinense* hydro primed for 0 and 2 hrs with 0 hr dehydration also had intermediate germination performance of 62 and 67 %, respectively. Similarly, seeds of *C. annuum* hydro primed for 8 and 12 hrs and dehydrated for 6 hrs recorded the highest seed germination of 97 and 88%, respectively whereas seeds of *C. frutescences* had intermediate values in most cases except at 8 hrs of hydro priming with a lower value of 69%. In the same Table 3, unexpectedly, seed from *C. chinense* soaked in water for 0 to 8 hrs and air dried for 6 hrs had lease germination of between 38 and 57%. Also, seed of *C. annuum* hydro primed for 8 hrs and dehydrated for 12 hrs showed the highest value of 92%, though was not significantly different from values obtained under 0 to 6 hrs of priming as well as 2 hrs of priming with *C. frutescences*. Seed of *C. annuum* soaked in water for 6 and 0 hrs and dehydrated for 18 hrs recorded highest germination of 93 and 90%, respectively. Similarly. seeds of *C. annuum* and *C. frutescences* hydro primed for 8 hrs as well as seed of *C. frutescences* hydro primed for 2 hrs had intermediate germination performance of between 73 and 81 % while *C. chinense* in most cases had lowest values. Similarly, *C. annuum* seeds hydro primed for 6 and 8 hrs and dehydrated for 24 hrs had highest values of 92 and 86%, respectively which was not significantly different from 84% recorded at 4 hrs of hydro priming. However, seeds from *C. frutescences* hydro primed from 0 to 8 hrs had intermediate germination performance of between 66 and 74 % while seeds from *C. chinense* hydro primed from 0 to 8 hrs and dehydrated for 24 hrs in most cases had lease values of between 33 and 56%.

The result of the study indicated that hydro priming and drying periods significantly influenced seed germination of the three *Capsicum species.* The differential responses among the species for the seed germination could be due to differences in genetic make-up of the species. Significant differences in seed quality characters due to variation in genetic constitution have been reported by Adebisi *et, al.(* 2013) in *Capsicum spp*. Earlier observation by Adebisi *et al*. (2014) showed that differences in the periods of soaking and drying were responsible for variation observed in seed germination of eggplant genotypes. On the main effect of species across hydro priming and drying time, seed obtained from *Capsicum spp*. had highest seed germination, closely followed by seeds from *C. frutescences* while seeds from *C. chinenese* showed least value. On the hydro priming effect, seeds soaked for 0 to 2 hrs had highest seed germination while seed germination did not respond to differences in drying hours. On the effect of hydro priming time and *Capsicum spp, C. annuum* had the highest seed germination of between 76 and 86% under each of the soaking times. Seeds of *C. frutescences* hydro primed for 0 and 6 hrs recorded highest germination of between 72 and 82% while *C. chinense* had a consistent low values at each of the hydro priming hours. For the effect of hydro priming and drying duration, seeds that were hydro primed for 0 and 2 hrs were observed with highest germination of 71% while subsequent higher hydro priming time of between 4 and 8 hrs resulted in lower germination values under each of the drying periods. Seeds of *C. annum* dried for 6 and 12 hrs after hydro priming retained highest germination of between 73 and 76 % while other species had lower values at various drying times.

However, seeds of *C. annum* hydro primed for 8 hrs and dried for 6 and 12 hrs had the highest seed viability of between 92 and 97% while the same seed-lot hydro primed for 6 hrs and dried for 18 and 24 hrs were found with higher values of 93%. Also, seed of *C. frutescences* hydro primed for 0 to 2 hrs and dried for 0, 6, 12 and 18 hrs had high germination of between 73 and 89% why *C. chinense* seed hydro primed for 0 to 8 hrs and dried for 0 to 24 hrs had lower germination of between 33 and 73 % compared to other two species.

CONCLUSION

This study has shown that seeds of *Capsicum species* could be hydro primed for 0 hour and 2 hrs and dried for 0hr (no drying) for improved seed germination. However, *Capsicum species* seeds hydro primed for 8 hrs and dried for 6 hrs had improved germination data and therefore could be adopted. *C. annum* seed hydro primed for 8 hrs and dried for 6 and 12 hrs had improved germination compared to other species but *C. chinense* seed found with lease germination values suggests the presence of dormancy in the seeds. Therefore, it requires further studies on how to break the seed dormancy.

Table 1: Effect of hydro priming duration on seed germination of three *Capsicum spp*

Species	Hydro priming durations				
	0hr	2hrs	4hrs	6hrs	8hrs
Capsicum annuum	82^{a}	76^{a}	85^{a}	83^{a}	87^{a}
Capsicum frutescences	82^{a}	74^{a}	67^{b}	65^{b}	69^{b}
Capsicum chinense	57^{b}	47^{b}	41^{c}	45^{c}	47^{c}
Mean	73.67	65.67	64.33	64.33	67.67
S.E	3.32	3.32	3.32	3.32	3.32

S.E - Standard error. Means followed by the same alphabet along the column are not significantly different from one another according to Tukey's HSD test at 5% probability.

Table 2: Effect of drying time after hydro priming on seed germination of three *Capsicum spp*

Species	Drying time (hrs)				
	0hr	6hrs	12hrs	18hrs	24hrs
Capsicum annum	66^{a}	73^{a}	76^{a}	66^{a}	56^{b}
Capsicum frutescences	67^{a}	64^{b}	63^{b}	66^{a}	62^{a}
Capsicum chinense	41^{b}	33^{c}	24^{c}	20^{b}	16^{c}
Mean	58	56.67	54.33	50.67	44.67
S.E	3.39	3.39	3.39	3.39	3.39

S.E – standard error. Means followed by the same alphabet along the column are not significantly different from one another according to Tukey's HSD at 5% probability.

Table 3: Effect of hydro-priming duration and drying time on seed germination of three *Capsicum spp*

Species	Hydro priming	Drying time				
		0hr	6hrs	12hrs	18hrs	24hrs
Capsicum annum	0hr	82^{a}	84^{b}	88^{ab}	90^{a}	69^{bc}
	2hrs	81^{a}	88^{a}	84^{ab}	68^{bc}	60^{c}
	4hrs	88^{a}	85^{b}	86^{ab}	84^{ab}	84^{ab}
	6hrs	88^{a}	84^{b}	86^{ab}	93^{a}	92^{a}
	8hrs	78^{a}	97^{a}	92^{a}	81^{b}	86^{a}
Capsicum frutescences	0hr	89^{a}	85^{b}	80^{b}	82^{ab}	73^{b}
	2hrs	73^{b}	76^{b}	81^{ab}	74^{b}	66^{bc}
	4hrs	65^{b}	74^{bc}	69^{b}	60^{c}	74^{b}
	6hrs	57^{c}	74^{bc}	61^{b}	61^{c}	74^{b}
	8hrs	57^{c}	69^{c}	64^{b}	73^{b}	70^{b}
Capsicum chinense	0hr	62^{b}	57^{d}	54^{bc}	58^{c}	56^{cd}
	2hrs	73^{b}	42^{d}	30^{d}	40^{d}	50^{cd}
	4hrs	46^{c}	48^{d}	37^{d}	33^{d}	41de
	6hrs	53^{c}	38^{e}	49^{c}	50^{c}	33^{e}
	8hrs	44^{c}	56^{d}	53^{bc}	48^{c}	36^{e}
S.E		7.43	7.43	7.43	7.43	7.43

S.E – Standard error . Means followed by the same alphabet along the column are not significantly different from one another according to Tukey HSD test at 5% probability.

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EFFECT OF RELATIVE TIME OF INTRODUCTION OF GARDEN EGG ON SWEETPOTATO/GARDEN EGG INTERCROPPING SYSTEM

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ABSTRACT

Research trial was conducted during the 2014 cropping season at National Root Crops Research Institute, Umudike in the rain forest zone of south eastern Nigeria to determine the effect of relative time of introduction of garden egg on sweetpotato/garden egg system (Ipomoea batatas)/garden egg (Solanum gilo) intercropping system. Two varieties of sweetpotato NR 05/022and (TIS 87/0087) planted at spacing of m1 x 0.30 m each were intercrop with garden egg at 1 spacing of 1m x 1 m different times. The experiment was laid out in a randomized complete block design (RCBD) replicated three times with 13 treatments which comprised Sole NR 05/ 022 sole TIS 87/ 0087 sole garden egg , simultaneous garden egg + NR 05/ 022, simu.GE + TIS 87/ 0087, GE4 WAP + NR 05/ 022 (4 weeks after planting) GE 2 WAP + NR 05/022, GE 4 WAP + TIS 87/ 0087, GE 2 WAP + TIS 87/ 0087, GE 4 WBP + NR 05/022 (weeks before planting), GE 4 WBP + TIS 87/ 0087, GE 2 WBP + NR 05/ 022 and GE 2 WBP + TIS 87/ 0087. Data of sweetpotato were collected on vine length/plant, number of leaves/plant 10 WAP, and yield (t/ha) at 16 WAP. Data on garden egg were collected on plant height, number of leaves/plant, number of branches/plant at 10WAP and fruit yield (t/ha). Piecemeal harvest of garden egg fruits was done between 10 to 16 WAP. The land equivalent ratio (LER) was also computed for sweetpotato and garden egg to measure land productivity. Data collected were subjected to analysis of variance. Results indicated that vine length, number of leaves and root yield (t/ha) were significantly ($p<0.05$) higher in sole cropping and simultaneous planting of each of the two varieties of sweetpotato with GE than other times introduced. There were no statistical differences among the other times of introduction. GE growth and yield followed the same trend. Simultaneous GE + UMU/SP1, GE +UMU/SP1 4WAP and GE +TIS 2 WBP gave the highest land equivalent ratio (LER) values of 1.29, 1.14 and 1.16, respectively indicating yield advantages of growing the two crops together at those times.

Keywords: Time of introduction, sweetpotato, garden egg, intercropping, yield

INTRODUCTION

Intercropping is an agricultural practice of growing two or more crops simultaneously on the same field during a growing season, in definite pattern or arrangements. Intercropping can be defined as a multiple cropping system where two or more crops are planted in a field during a growing season. It is a type of sustainable agriculture that is more efficient in the use of resource, for the benefit of human and is in balance with the environment (Eskandari, 2012). It is one of the most widespread traditional agricultural practices by West Africa farmers which provide food and income at different periods of the year for the family (Emede and Adegoke, 2011). Time of introduction of crops in the field is an important factor in crop production, because it affects growth, development and yield. Any crop that do not complete its vegetative phase or planted earlier than required will not yield well because growth and yield is a function of time. Intercropping of crops can be planted simultaneously, before and after each of the component crops. Muoneke *et al*, (1997) and Ofori and Stern, (1987) reported that in intercropping there is simultaneous planting, early planting and late planting of one of the component crops. Sweetpotato *(Ipomoea batatas* (L.) Lam) family of *Convolvulaceae* is one of the world's widely grown crops. In sub-Saharan Africa, the high productivity of sweetpotato per unit area and time is the basis for its choice as a principal crop in agriculture campaigns towards food security and poverty alleviation (NRCRI, 2005). When the vines spread out, conserve soil moisture, improves soil fertility, control weed and erosion (Anuebunwa, 2000). Nigeria is the third largest producer of sweetpotato after China and Uganda (Kathryn *et al*, 2012). With production over 3.5 million t annually from 1.03 million ha (FAO, 2008), sweetpotato is now prominent in our farming systems and rapidly becoming staple food in Nigeria. Garden egg *Solanum gilo* (L.) belongs to the family of *Solanaceae* is a fruit vegetable crop. It is a traditional vegetable crop in Africa and has potential to improve nutrition, boost food security, and generate income, foster rural development and support sustainable land use (NRC, 2006). It is also used in many traditional ceremonies like village meetings, wedding, child naming, burials and other festivities. Garden egg is usually grown in mixed cropping systems. In south east agro ecological region of Nigeria, it is seen in homestead farms staggered arrangement with food crops like yam, cocoyam maize, fluted pumpkins. Intercropping garden egg/maize or with other food crops in some parts of Nigeria. Sweetpotato/ garden egg are compatible crops in intercropping systems (Ebeniro et al, 2015), and time of introduction is an important factor in farming operations therefore the objective of this study is to determine the best time of introducing garden egg in sweetpotato/garden egg intercrop in rainforest of Nigeria.

MATERIALS AND METHODS

This work was conducted at National Root Crop Research Institute (NRCRI), Umudike experimental farm in 2014 cropping season. The soil is acidic and well drained sandy loam. The study was conducted on land that been fallow for 2 years (2011/2013) after yam crop. Land was cleared, disc ploughed, harrowed and ridged. The experiment was laid out in a randomized complete block design. The plot size was 6 m x 4 m (24 m^2) and replicated 3 times. Treatments consisted of two varieties of sweetpotato NR 05/022 light orange flesh, TIS 87/0087 white flesh and garden egg (GE) Ngwa large planted at different times. The 13 treatments were sole NR 05/ 022, sole TIS 87/ 0087, sole garden egg, simultaneous garden egg + NR 05/ 022, simultaneous garden egg + TIS 87/ 0087, weeks after planting (WAP) GE 4 WAP + NR 05/ 022, GE 4 WAP + TIS 87/0087, GE 2 WAP + NR 05/022), GE 2 WAP + TIS 87/0087, weeks before planting (WBP), GE 4 WBP + NR 05/ 022, GE 4 WBP + TIS 87/0087, GE 2 WBP + NR 05/ 022 and garden egg 2 (GE 2 WBP + TIS 87/0087). Sole crops of sweetpotato and garden egg were planted for the computation of the productivity parameters of intercropping systems. Sweetpotato were planted on the crest of the ridge at 1 m x 0.3 m to give a population of 33,333 plants/ha. Garden egg seeds were raised in nursery beds and transplanted into at 4 to 6 WAP. Garden egg seedlings were planted midway between the crest and base of ridges at 1m x 1m to give a population of 10,000 plants/ha. Weeding was carried at 4 WAP, 300kg/ha of NPK 15: 15: 15 and 5 t/ha of poultry manure were applied in all the plots at 4 WAP. Insecticide (Karate) was applied at 6 WAP before flowering of garden egg. Data on sweetpotato were collected on vine length/plant, number of leaves/plant, number of branches at 10 WAP, root yield/plant in (g) and yield t/ha at 16 WAP. The land equivalent ratio (LER) was also computed for sweetpotato and garden egg. Data on garden egg were collected on plant height, number of leaves/plant, number of branches/plant at 10WAP, no of fruit/plant and fruit yield t/ha. Piecemeal harvest of garden egg fruits was done between 10-14 WAP. The data were subjected to analysis of variance using GENSTAT DISCOVERY EDITION 1(Lawes Agricultural Trust. 2003) and means were compared using Fisher's least significance difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

The results indicated that vine length, number of leaves and root yield (t/ha) of sweetpotato, sole NR 05/ 022 and SIM GE + NR 05/ 022 had the highest value which were significantly different from other times. Intercropping GE 4 WAP + NR 05/ 022 had root yield of 19.30(t/ha) which differed significantly from other times of planting while GE 4WBP + TIS 87/0087 gave a yield of 6.88(t/ha) which is the lowest. For garden egg plant, plant height, number of leaves and fruit yield (t/ha) were influenced by planting of time. Sole garden egg and simultaneous planting of garden egg + 2 varieties of sweetpotato were positively influenced than other periods of planting. GE 4 WBP + NR 05/ 022 gave fruit yield of 2.80 (t/ha) while the lowest fruit yield of 1.84 (t/ha) was from GE 4 WAP TIS 87/ 0087. The low yields obtained in garden fruits were due to pests' infestation at the point of flowering and fruiting. Land equivalent ratio showed that planting garden egg + sweetpotato showed that the GE4 WAP + NR 05/ 022 and GE 2 WBP + TIS 87/0087 1.14 and 1. 16 respectively while the lowest was from GE 4 WBP + NR 05/ 022 that was 0.92 which could be as a result of pest problem. The high yield obtained in sweetpotato root could be attributed to that both the space and growth resources were utilized by sweetpotato. Time of planting component crops in intercropping systems affects growth and yield of crops. The results obtained in the study agreed with the work of Njoku *et al*, 2010 that sole crop and simultaneous planting of crops in intercropping gave higher yield than other time of planning. In intercropping earlier sowing of component crops usually established, grown better and yield well.GE 4 WAP + NR 05/ 022 and GE 2 WAP + NR 05/ 022 yield well. Muoneke *et al*, 1997 in their studies reported that yield of component crops increased when sown earlier and late sowing date decreased yield of one of the component crops. Umana, 2007 also said that yield and yield components of intercrop is reduced with delayed time of introduction in the system. Planting earlier in the season increased yield as in GE 4 WAP + NR 05/ 022 that is sweetpotato planted 4 weeks before planted garden egg gave the highest root yield and GE 4 WAP + NR 05/022 garden egg planted 4 weeks before planted NR 05/ 022. Land equivalent ratio obtained in the study is the same with the work of Ebeniro *et al*, 2015 showing that the system was productive than sole cropping.

CONCLUSION

In intercropping garden egg + sweetpotato, early introduction of both crops were better than late planting. Also simultaneous planting did well than late planting.

Table 1: Effect of time of introduction of garden egg on sweetpotato/ garden intercrop

Time	VL(cm) 10WAP	No Leaves 10WAP	Yield wt (t/ha)	LER	Yield wt (t/ha)	LER
Sole NR 05/022	121.47	111.60	25.33	1.00	25.33	1.00
Sole TIS 87/0087	339.77	56.67	12.51	1.00	12.51	1.00
SIM.GE + NR05	91.07	84.10	18.06	1.29	18.06	1.29
SIM.GE + TIS 87	269.47	42.93	8.32	1.02	8.32	1.02
GE4WBP + NR05	70.90	60.63	7.31	.92	7.31	.92
GE4WBP + TIS 87	183.37	37.17	6.88	1.00	6.88	1.00
GE4WAP + NR05	99.13	80.70	19.30	1.14	12.54	.98
GE4WAP + TIS 87	295.73	43.47	9.59	1.08	9.21	1.16
GE2WBP + NR05	82.20	58.83	12.54	.98	19.30	1.14
GE2WBP + TIS 87	184.07	37.23	9.54	1.16	9.59	1.08
GE2WAP + NR05	85.63	69.03	15.04	.96	15.04	.96
GE2WAP + TIS 87	202.90	42.10	10.27	1.00	10.27	1.00
l.s.d(0.05)	7.20	8.19	2.461		2.461	

Table 2: Effect of time of introduction of garden egg on sweetpotato/ garden intercrop

Time	Plant height (cm) 10 WAP	Number of leaves 10 WAP	Fruit (t/ha)	LER
Sole GE	134.1	70	5.85	1.00
SIM. GE+NR05	101.0	54.53	3.40	1.29
SIM. GE+TIS 87	78.1	40.00	2.07	1.02
GE4WBP+NR05	106.9	57.33	3.70	.92
GE4WBP+TIS87	94.2	44.97	2.63	1.00
GE4WAP+NR05	79.2	43.10	2.20	1.14
GE4WAP+TIS87	76.2	32.40	1.84	1.08
GE2WBP+NR05	107.30	43.10	2.80	.98
GE2WBP+TIS87	81.9	40.00	2.45	1.16
GE2WAP+NR05	93.3	41.40	2.16	.96
GE2WAP+TIS87	76.7	37.20	2.06	1.17
l.s.d(0.05)	11.38	6.39	0.74	

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ANTIMICROBIAL EFFECTS OF BICARBONATE SALTS AND NEEM EXTRACT ON INHIBITION OF POSTHARVEST ROT PATHOGENS OF CROPS: A REVIEW

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ABSTRACT
Postharvest decay is the major factor limiting the extension of storage life of most vegetables .Biological control of postharvest diseases of fruits and vegetables is a new area of research. Biological control using microbial antagonist is a promising alternative to fungicides to control postharvest disease. Intensive research efforts have been made to isolate, screen and test the efficacy of biocontrol agents under laboratory and semi-commercial conditions that could serve as alternative strategies which are safe, effective, economical and needed for control of postharvest diseases. The alternative methods are needed because of concern about environmental contamination and human health risks associated with fungicide residues and because the widespread use of the chemicals in commercial packing houses which has led to the proliferation of resistant strains of pathogens.
Keywords: Antimicrobial, Bicarbornate salts, Neem extracts and Rot Pathogens

INTRODUCTION
Selected organic and inorganic salts are active anti-microbial agents and have been used widely in the food industry. Among these, Sodium bicarbonate and Potassium sorbate are used for controlling pH, taste and texture and they also exhibit broad-spectrum anti-fungal activity and have efficacy against oral pathogens (Miyasaki *et al*., 1986; Karabulut *et al*., 2001) and against aerobic and anaerobic bacteria and yeasts that are food borne (Corral *et al*., 1998). Neem (*Azadiratcha indica*) extract contains the concentrated form of active or principle compounds found in neem. Neem extracts can be used in different industries like agricultural, herbal and pharmaceutical industries to manufacture quality natural products. Neem extracts are also used as an effective and safe method to control pests and plant pathogens and also lack any residual problem (Quarles, 1994; Thacker, 2002). Diseases that infect crop after harvest and on storage are postharvest diseases. These postharvest diseases increase loss in yield, reduce quality and quantity of crops, depreciate nutritive value, cause low market demand, introduce poisons to crops and increase food insecurity. These do not encourage farmers who have worked all hard from planting to harvesting and meet doom at storage. There should be solution to these postharvest storage diseases, and the difficulties in obtaining fungicides and application machinery, and their high cost for small-scale farmers which make it almost impossible for farmers to effectively control these diseases. Ethanobotanical studies have shown that most of the plants we see as wild herbs or weeds are of medicinal value to humans. Moreso, the synthesized chemicals used as fungicides are discouraging for use and they may have side effects on both the crops and animals that consume the crops (Torigan *et al*., 2001). Thus, more emphasis should be laid on the use of biological disease control and natural herbs in disease management because they are cheap, available and with no residual effect on the environment. This study examined the possibility of using bicarbonate salts and neem (*Azadiratcha indica*) leaf extract to inhibit postharvest rot pathogens of crops.

Components and action of Neem
Neem (*Azadriatcha indica*) leaves, locally called dogoyaro or ochonyeogwo is a medicinal plant. Its liquid can be extracted and then used to prevent or reduce diseases, or used in the storage of crops after harvest. Extraction of these herbs can be done by cooking in water, squeezing or grinding, after which it is dissolved in water. Neem oil or extract is effective against rots, mildews, rusts, scab, leaf spot and blight. Scientific review papers also show that neem possess insect growth regulatory effect. Neem is also known to contain over 100 biologically active constituents that can be used in various agricultural formulations, and antiviral compounds (Quarles, 1994; Thacker, 2002). According to Anon (1990), there is considerable emphasis placed on the development of neem pesticides based on azadiratcha, which is the most widely evaluated neem compound. The seeds are known to have the highest concentration of azadiratcha and are most effective. Neem also contains several active ingredients and they act in different ways under different circumstances. Neem products are unique, in that they are not outright killers, instead they alter an insect behavior or life processes in ways that can be extremely subtle (NRC, 1992). Azadiratcha is thought to be the most bioactive ingredient found in the neem tree; however, such speculations may be due to it having been investigated more thoroughly than other compounds (Quarles, 1994; Thacker, 2002). Neem products are generally sold as emulsifiable concentrates (EC) but Copping (2001), reported that there is no known incompatibilities with other crop protection agents. Neem seeds control several types of soil pests and pathogens. It is for instance, notably effective against nematodes. Other neem compounds, nimbin

and nimbidin have been found to have antiviral activity. They control viral diseases of crops and livestock (NRC, 1992). Nimbidin is the primary component of the bitter principles obtained when neem seeds are extracted with alcohol. It occurs in sizeable quantities about 2% of the kernel (Anon, 1990). Neem extracts can be applied in many ways; they may be employed as sprays, powders, drenches or diluents in irrigation water or sub-surface irrigation system. It can be applied either as dusts or sprays (NRC, 1992).

Botanicals in Disease and Pest Control

There was a considerable interest in the use of sodium bicarbonate (NaHCO3) and potassium bicarbonate (kHCO3) for controlling various fungal diseases in plants (Karabulut et al., 2003; Smilanick et al., 2006). Bicarbonates were found to suppress several fungal diseases of potato (Nehal et al., 2009), cucumber (Ziv and Zitter 1992). Spraying plants with NaHCO3 solution provided good control of several plant diseases (Horst et al., 1992; Arimoto et al., 1997; Palmer et al., 1997; Janisiewicz and Peterson 2005). Also, spraying with KHCO3 solution provided the most effective protection against plant diseases (Fallik et al., 1996; Smilanick et al., 1999, 2006). Sodium and Potassium bicarbonate combined with oil were effective in controlling plant diseases (Horst et al., 1992; Ziv and Zitter 1992). The potential of bicarbonate salts for the control of postharvest pathogens has been demonstrated in citrus (Arimoto *et al*., 1977), carrots (Punja *et al*., 1993), bell pepper (Fallik *et al*., 1997) and melon (Aharoni *et al*., 1997). Smilanick *et al*., (1999), found that the effectiveness of sodium bicarbonate (SBC) and carbonate improved significantly when the treatment was followed by the application of the fungicide imazalil or the biocontrol agent *P. syringae* Ese – 10. The combination of bicarbonate or carbonate with *P. syringae* was synergistic. Hot water (HW) treatments have been well studied for the control of postharvest decay of citrus fruits (Schirra *et al*., 2000). Treatments with sodium carbonate (SBC, NaHCO3, baking Soda) provided satisfactory control of green mold on lemons (Smilanick *et al*., 1995, 1999) and oranges (Smilanick *et al*., 1997, 1999; Palou *et al*., 1999) and blue on oranges (Palou *et al*., 2001). On the evaluation of the use of sodium bicarbonate (SBC), potassium sorbate (K-sorb) and yeast antagonists for decreasing postharvest decay of sweet cherries by Karabulut *et al*., (2001), it was reported that SBC was more effective than K-sorb and yeast antagonists in controlling the decay of sweet cherries. SBC at a concentration of 2% showed potential for controlling postharvest disease of sweet cherry during air, MA and shelf life.

Gamage *et al*., (2003), researched on the use of sodium bicarbonate and *Candida oleophila* to control anthracnose in papaya during storage and reported that both (*C. oleophila* and 2% NaHCO3) can be used together for treatment of papaya fruit. However, the reduction of anthracnose severity was significantly ($P<0.05$) higher in fruits subjected to a combination of sodium bicarbonate and *C. oleophila*, suspension than in fruits dipped in either sodium bicarbonate or *C. oleophila* suspension. In Hot water (HW), sodium carbonate (SC) and sodium bicarbonate (SBC) treatment for the control of postharvest green and blue molds of *Clementine mandarins*, it was reported that HW dips at 45 or 50^0C for 60 0r 150s, did not effectively control either green or blue mold, a 150s dip in 3% SC at 50^0C, controlled totally both green and blue molds of mandarins without noticeably injuring the fruit (Palou *et al*., 2002). In the shelf-life estimation of Fuji apples II, the behaviours of recently harvested fruits during storage at ambient condition by Varela *et al*., (2008), he reported that Fuji apples kept at normal atmosphere for 91 days until consumption; from day 70 of the storage, the apples showed external skin damage as a result of the non-controlled atmosphere storage. Excess or too low relative humidity can have detrimental effect on fruits during storage; if the humidity is too low, it causes dehydration of the tissues leading to shriveling. Also, sensory rejection of the edible part of the apple because of the eating quality loss, would not be the reason for the end of shelf-life in this case, instead, physiological deterioration leading to the rejection of the entire fruit before consumption would be the determinant of shelf-life.

Effects of Bicarbonate salts on postharvest rot pathogens of Potato

The suppressive effect of sodium and calcium salts applied individually or combined with the yeast *Saccharomyces cerevisiae* (CBY) against *Alternaria solani* the causal agent of early blight disease of potato was evaluated under laboratory, green house and field conditions (Nehal *et. al*., 2009). In vitro test a complete inhibition in fungal growth was observed at concentration of 30mg/ml both sodium bicarbonate and calcium chloride. In pot experiment under artificial infestation with pathogenic fungus, application of sodium bicarbonate or calcium chloride significantly reduced the early blight incidence and severity by increasing their concentrations. Their most effective concentration were 30mg/ml that reduced the disease incidence by 50 and 62.4% respectively. Superior effect of sodium bicarbonate or calcium chloride in disease reduction was observed when they combined with CBY. Study on antifungal activity of some salts on growth and dry rot development of fusarium solani (Mart.) Sacc.(Mohammed et al., 2013). In the study, antifungal activity of some salts ammonium phosphate, potassium carbonate, potassium bicarbonate, sodium carbonate and sodium bicarbonate was investigated against Fusarium solani. In vitro, inhibition of the growth rate was evaluated after 7 days in PDA media. The result exhibited the salts had inhibitory activities on the growth rate of this fungus. Ammonium phosphate indicated the largest inhibition (92.2%) followed by potassium carbonate (54.92%), potassium bicarbonate (46.14%), sodium carbonate (42.60%) and sodium bicarbonate (42.3%).

Effects of Neem extract on postharvest rot pathogens of sweetpotato

Suleiman and falaye (2013) reported that neem leaf extract was effective in suppressing mycelial growth of Aspergillus niger in sweetpotato at higher concentrations (30% and 40%) and the percentage inhibition at ther various concentrations was determined. In the study, isolation and identification of of the fungi associated with rotten sweet potato root was carried out and the diseased portion of the rotted tubers were scrapped and inoculated on PDA at 27+ 2^0C, subcultured to obtain pure culture. A. niger was isolated from the rotten portion and identified based on morphological characters and pathogenicity tests.

In the in vitro and in vivo experiment to control postharvest rot pathogen of sweetpotato (Opara and Agugo 2014), neem oil inhibited growth of sweetpotato soft rot both in the in vitro and in vivo trials but performed much better in the in vivo experiment than oil extracts of the other leaves used and sterile water (p> 0.05). The antifungal effect of different concentrations of neem and moringa seed extracts on wet rot disease of sweetpotato was conducted (Tijani et al., 2013). Moringa and neem seed extracts each with four varying concentrations (30, 60, 90 and 120g/L) were evaluated along with carbendazim and untreated sweetpotato served as the control. The result showed that neem seed extract was significantly (P<0.01) better than the moringa seed extract in controlling the disease. It inhibited radial mycelial growth of *Rhizopus stolonifer* and also reduced the weight loss of sweetpotato caused by *R. stolonife*r. The effectiveness of the two plant seed extracts compared favourably with carbendazim.

CONCLUSION

The study revealed that there exist a potential in natural plant products for the control of crop diseases and if fully exploited they can replace chemical pesticide in the control of crop diseases. Hence, the use of natural plant products or botanicals is a strategy particularly well suited to assist small-scale farmers farmers of the tropics who generally lack financial resources and technical expertise required to use chemical control methods effectively, hence the purpose of the research being investigated.

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GROWTH AND YIELD OF GRAIN AMARANTH (*Amaranthus cruentus* l.) AS CONTROLLED BY SOWING METHOD AND SEED RATE UNDER IRRIGATION AT KADAWA, SUDAN SAVANNAH

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ABSTRACT
Field experiment was conducted during 2013/2014 dry season at the Research farm of Institute for Agricultural *Research (I.A.R) Ahmadu Bello University Zaria located at Kadawa Sudan savannah to study the growth and yield of grains amaranth (Amaranthus cruentus L..) as controlled by sowing method and seed rate under irrigation at Kadawa. The treatments consisted of three sowing methods (drilling, broadcasting and dibbling) and five seed rates (1 kg, 2 kg, 3 kg, 4 kg and 5 kg/ha) combined factorially in a randomized complete block design and replicated three times. Sowing method had no significant effect on plant height and leaf area index of the crop, however, drilling method had the higher values for stem diameter, panicle length, grain weight per panicle and grain yields. Drilled and dibbled plants had larger diameter compared to broadcast amaranth while at later stage of growth larger diameter was obtained in dibbled stands. No significant differences were noted due to varied sowing methods on plant height and LAI. A significantly taller plants were noted when 3 kg/ha seed was used resulting in taller plants that were at par with other rates except 5 kg/ha that gave shorter plants. In addition 3 kg/ha resulted in plant with longer panicle which was at par with 2 kg/ha seed rate. Heavier panicle weight per plant was recorded when 2 kg/ha seed was used, whereas 1 and 5 kg seed / ha resulted to reduction in panicle weight. Higher grains weight per plant and yields per hectare were recorded when 2 kg/ha seed was used which was at par with other rates except 1 kg/ha that recorded least grains output. Based on the result of this finding it was observed that drilling method using 2 kg/ha seed rate could be used for the cultivation of grains amaranth under irrigation at Kadawa , Sudan savannah agro ecological zone of Nigeria.*
Key words: Sowing method, seed rate and grain amaranth

INTRODUCTION
Amaranth is a vegetable crop belonging to the family Amaranthaceae. It is a native to South America and Mexico the crop is now widely distributed and cultivated in tropical and subtropical countries under irrigation and rainfed conditions (Husssaini, Y.(2002) Raemaekers, 2001). There are over 60 known species of Amranths of which only few are cultivated for their grains or vegetative part. Prominent among which are *Amaranthus hypochondriacus*, *Amaranthus cruentus* and *Amaranthus caudatus* (Anon, 1984). Amaranth requires good land preparation both dry and rainy season cropping.. A bed of 90 cm wide and 20 cm height is required during the dry season and under rainfed condition the bed can be raised to 30 cm or above to faciliatate drainage. Amaranth can cultivated by direct seeding or by transplanting. Seeds are either broadcast or sown in rows 10-20 cm apart. Amaranth is an important nutritious crop grown for home consumption and local sales The crop is traditionally planted using broadcasting or drilling method; with little or no attention to appropriate seed rate resulting to wastage of scarce seeds scanty. The crop has high economic values and literature on planting method and seed rate is. The present study was conducted to determine the appropriate seed rate and sowing method for efficient growth and higher yield of grain amaranth under irrigation.

MATERIALS AND METHODS
The study was conducted during 2013/2014 dry season at the research farm of the Irrigation Research Station Kadawa of the Institute for Agricultural Research, Ahmadu Bello University located in the Sudan Savannah ecological zone of Nigeria (11º 39'N, 80º 27'E and 500 m above sea level). The treatments consisted of five seed rates (1kg, 2.kg, 3 kg, 4 kg and 5kg/ha) and three sowing methods (drilling, broadcasting and dibbling) and were factorially combined in randomized complete block design (RCBD) and replicated three times. The gross plot size was 4m x 3m ($12m^2$).and the two central ridges ($6\ m^2$) served as net plot. The experimental site was harrowed and ridged to fine tilth. After plot demarcation the ridges were later flattened into raised beds. The seeds of grain amaranths mixed with clean sand were drilled, broadcast or dibbled on their respective beds as per treatments. After sowing the beds were mulched and irrigated regularly. Weeds were controlled manually by hoeing and regular hand pulling. The data collected were subjected to statistical analysis of variance (ANOVA) to test significance of treatment effects as described by Snecdector and Cochran (1967). The means obtained were compared using Duncan's multiple range test DMRT (Duncan, 1955).

RESULTS AND DISCUSSION

Table 1 shows the effect of sowing method, seed rate and their interaction on plant height,stem diameter and leaf area index (LAI) of grain amaranth at Kadawa during 2013/2014 dry season. The result showed no significant differences in plant height and LAI due to varied sowing methods during the sampling periods. The effect of seed rate on plant height of the crop was significant at 10 WAS, in which 3 kg seed/ha resulted in the production of taller plant that were statistically at par with those from 1, 2 and 4 kg seed/ha but taller than n those obtained from 5 kg seed/ha. The shortest plants produced by 5 kg seed/ha were in turn statistically similar to those from 1, 2 and 4 kg seed/ha. There was no significant interaction between the sowing method and seed rate on plant height throughout the sampling periods.The effect of sowing method on stem diameter was significant in which drilling resulted in larger stem diameter throughout a sampling periods which was at par with dibbling method. The least stem diameter was observed in broadcast stands which in turn were at par with drilled amaranth at 10 WAS. No significant interaction was recorded between sowing method and seed rate on stem diameter during the experimental period. No significant differences were noted on LAI due to different sowing methods throughout the sampling period and similar observation was made when different seed rates were used. No significant interaction was recorded between sowing method and seed rate on LAI. Table 2 shows the effect of sowing method, seed rate and their interaction on panicle length, panicle weight per plant and grains yield. of amaranth at Kadawa during 2013/2014 dry season. A significant effect of sowing method on panicle length was observed, where drilling and dibbling method resulted in longer panicle compared broadcasting method. The effect of seed rate was significant on panicle length where 3 kg seed/ha produce longer panicles that were at par with other seed rates except 1kg seed/ha which gives shorter panicle. There was no significant interaction between sowing method ad seed rate on panicle length. A significant effect on grain weight per plant when different sowing methods were used was observed. Drilled and dibbled amaranth had higher grains weight per plant and lower weigh per plant was recorded in broadcast amaranth.. Seed rate of 2, 3 and 4 kg/ha produced similar and higher grains weight per plant and the was least produced by 1 and 5 kg/ha seed rate. No significant interaction was recorded between sowing method and seed rate on grains weight per plant. A significant effect of sowing method on grain yield per hectare was observed where amaranth sown by drilling method had higher grain yield per hectare when compared to broadcast and dibbling methods which were at par with lower grains output. Seed rate had significant influence on grains yield /ha, where 2 kg seed//ha produce higher yield which was at par with other rates except 1kg seed/ha which gives least yield. The least grain yield observed 1kg seed/ha was in turn statistically similar with that at 3, 4, and 5 kg seed/ha. No significant interaction was recorded between sowing method and seed rate on grains yields.

The taller plant with longer and heavier panicle in drilled amaranth stands could be attributed to uniform seed distribution that ensure good and timely germination that reduced competition with weed at early stage of growth compared to broadcast method, that had over crowded stands resulting in serious competition for nutrient and space. This agreed with the findings of Putman (1990) who stated that broadcasting method increase the risk of poor plant stands, increase in uneven germination and competition with weeds at early stages of growth. Similarly, Olofintoye *et al* (2011) observed that grain amaranth plants compete excessively with each other when sown at closer spacing leading to smaller grain per panicle. The variation on grains yield due to sowing method might be attributed to a number of plants per plot that determine their rate of growth potential. Due to more plants /stands germination was delayed in dibbled and broadcast plots. Similarly, overcrowded stands in weaker plants that matured and produced seeds earlier at the expense of vegetative growth, hence reduction in yield potential of the plant as observed in least yield in dibbled plots. This is in conformity with findings of Gimplinger *et al* (2006) that stated higher plant population pressure drastically reduced the growth and yield characters of grain amaranth. The high yield obtained from 2 kg seed/ha and beyond could be attributed to high plant population, however, the yield attributing characters like panicle length were comparatively more in other rates hence the reason for similarity in yield. This was further indicated by lower yield obtained when 1 kg/ha seed rate was used resulting in the production of shorter panicle.. Also O'Brien and Price (2008), have pointed that low planting density in grain amaranth resulted in large heads and vice versa. Svirtkis (2003) reported that, in grain amaranth seed rate of 2-4 kg/ha with row spacing of 5 cm gave the highest yield in Lithuania. Seed rate had no significant effect on leaf area index at both locations during the experimental period. This could be due to wider leaves coverage of the soil nutrient and light interception. In the cultivation of grain amaranth, the recommended sowing density varies considerably worldwide, depending on number of factors such as the environment, production system and variety involved. (Weber, 1990,and Olofintoye *et al (*2015).

CONCLUSION

In conclusion, based on the result of this investigation it was observed that drilling method and 2 kg/ha seed rate could be used for the cultivation of grains amaranth under irrigation at Kadawa, Sudan savannah agro ecological zone of Nigeria.

Table 1: Effects of sowing method and seed rate on plant height (cm),stem diameter (cm^2) and leaf area index (cm^2) of grain amaranth during 2013/2010 dry season at Kadawa

Treatment	Plant height (cm)		Stem diameter (m^2)		Leaf area index (cm^2)	
	8 WAS	10 WAS	8 WAS	10 WAS	8 WAS	10 WAS
Sowing method ()						
Drilling	64.09	102.87	12.13a	12.02b	0.72	1.03
Broadcasting	69.41	99.70	10..88b	12.10b	0.72	0.98
Dibbling	73.83	105.47	12.50a	13.43a	0.71	0.99
SE+	5.907	3.440	0.344	0.452	0.037	0.045
Seed rate (kg/ha)(R)						
1	69.67	99.82ab	12.41	12.68	0.72	0.90
2	73.93	105.32ab	11.02	12.41	0.71	0.98
3	77.47	111.03a	11.66	12,25	0.77	1.04
4	62.44	102.70ab	12.29	12.65	0.68	1.02
5	62.05	94.51b	11.82	12.61	0.69	0.96
SE+	7.626	4.441	0.444	0.584	0.047	0.058
Interaction (I)						
S x R	NS	NS	NS	NS	NS	NS

Means followed by the same latter (s) in the same column within the same treatment group are statistically similar at 0.05 level of probability using DMRT. NS= Not significant

Table 2: Effects of sowing method and seed rate on plant height (cm), stem diameter (cm^2) and leaf area index (cm^2) of grain amaranth during 2013/2010 dry season at Kadawa

Treatment	Plant height (cm)		Stem diameter (m^2)		Leaf area index (cm^2)	
	8 WAS	10 WAS	8 WAS	10 WAS	8 WAS	10 WAS
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Interaction (I)						
S x R	NS	NS	NS	NS	NS	NS

Means followed by the same latter (s) in the same column within the same treatment group are statistically similar at 0.05 level of probability using DMRT. NS= Not significant

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CHARACTERISTICS OF COCOA TREES (*Theobroma Cacao*) AMONG COCOA FARMS IN NIGERIA

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ABSTRACT
The importance of cocoa in Nigerian economy could not be over-emphasized. The crop has contributed immensely to Nigeria's gross domestic product and has provided employment to the populace especially in cocoa producing belt. In view of this, this study which determines the characteristics of Theobroma cacao is pertinent. Simple random sampling technique was used to select 104 cocoa farmers from four cocoa producing States in Nigeria, the States include Osun, Ekiti, Abia and Cross-River. Structured questionnaire was used to collect information from the respondents. The information collected was analysed using descriptive analysis. The result shows that majority (74.04%) of the cocoa farmers in the study area were male while 85.58% of the farmers were having formal education. Most farmers (69.35%) indicated that the breed of cocoa on their farms fruits at the age of four years while 50.96% of the farmers signified that the cocoa trees on their farms do not resist to blackpod disease. In most cocoa farms, variations such as number of pods per tree, pod size, tree size, pod colour and bean size were observed among the cocoa trees in the same farm. The study recommended that a breed of cocoa needs to be developed that will be resistant to blackpod disease and that the period of first fruiting will be reduced.
Keywords: *Theobroma cacao,* characteristics and blackpod disease

INTRODUCTION

Cocoa (*Theobroma cacao*) came into the West African sub-region from Brazil, and was specifically introduced into Nigeria from Fernando Po (present day Equatorial Guinea) by Chief Squiss Ibannigo in 1874 (Ayorinde, 1966). Other sources of introduction include trade agents, Ministries of Agriculture and Research Institutes (Opeke, 1987). Government of Nigeria developed an interest in the cultivation of cocoa since 1887 when cocoa seedlings from the old Botanic Garden at Ebute-Metta (Lagos) were sent to Ibadan for trial. This explains how cocoa cultivation gained its first and earliest impetus around Ibadan, Oyo State of Nigeria which produced the bulk of Nigerian cocoa up to the early twentieth century. Cocoa cultivation later spread to various parts of Western Nigeria. At present, cocoa is grown in most parts of Southern Nigeria extending from areas having 1,100mm annual rainfall towards the North to areas having 2,500mm annual rainfall towards the coast (Sanusi, 2006). Estimation put Nigerian cocoa acreage at 10,000 acres (4,000 hectares) in 1912 and this increased to over 300,000 acres (120,000 hectares) by 1930 (Olayemi, 1974). Planting continued at a high rate from 1930 to 1945 by which time about 1,000,000 acres (400,000 hectares) had been planted (Adesimi and Ladipo, 1979) with the acreage of the main cocoa-producing region (that is, the former Western Region) reaching a peak of 56,000 acres (22,400 hectares) in 1936 alone (Olayemi, 1974). It remained at this level until the late fifties when further planting and black pod and pest control led to further and rapid increase in its cultivation (Olayemi, 1974). Climatic compatibility of cocoa with the Nigerian environment coupled with successful combination of cocoa with arable crops by peasant farmers equally promoted the thriving of cocoa in Nigeria (Adegeye, 1977). By the early 1970s, Nigeria became the second largest cocoa producer in the world with an annual output of about 270,000 tons (Aigbekaen 2004, Sanusi and Oluyole, 2005). However, with the advent of the oil boom of the 1970s, activities in the cocoa sub-sector experienced a decline. Particularly, cocoa acreage actually declined for most part of the 1980s when some cocoa farms were abandoned (ICCO, 1999). Investigations have attributed the travails of the Nigerian cocoa industry to the price paid to farmers, scattered small holdings in different locations and the old age of the existing cocoa trees (Olayemi, 1974 and Oduwole, 2000). Adegeye, (2000) observed that most of the cocoa farms were established over 40 years ago and as such the trees were ageing. Obviously, cocoa production is hampered by various problems that range from biological to environmental, socio-economic to institutional. This includes land tenure, ageing cocoa trees, low/poor yielding varieties, unavailability of inputs and chemical, persistent increase in the cost of production, lack of adoption of new technologies, political instability/inconsistencies in government policies (Fashina, 1999, Oduwole, 2004, Oduwole 2000, Adegeye 1974). Having realized this, Nigerian government decided to put some institutional efforts in place, such efforts include cocoa trade liberalization, cocoa rehabilitation programme and distribution of improved cocoa varieties to farmers at subsidized rate. With these efforts, some abandoned plots were rehabilitated and a few new plantings were carried out from mid-1980s to most part of the 1990s thus increases cocoa hectarage. Estimation put the current cocoa hectarage at about 600,000 to 700,000 hectares (Fashina, 1999 and Aigbekaen, 2004). In order to sustain cocoa production, there is a need for increased production which could be through programme aimed at increasing productivity. One of such programmes is rehabilitation programme to replace older tree-stocks. Higher standards of husbandry and better disease management and pest control systems, may also enable farmers to limit the damage caused by pests and diseases. Moreover, scientific research may provide effective and environmentally sound solutions to those losses and contribute to the future assurance of cocoa supplies (Sanusi and Oluyole, 2005). A cocoa tree growing on fertile soil can live for a hundred years or more and may yield well throughout its life. However, the highest cocoa yields are achieved between 15 and 25 years and that a profitable life span may be 50 years but as from the twenty-sixth (26th) year, yields decline gradually and production cost rise steadily (Montgomery, 1981). In order to further buttress these claims, this study was carried out to determine the characteristics of cocoa trees among cocoa farms in Nigeria.

METHODOLOGY

The study was carried out in Southern Nigeria. Simple random sampling technique was used to select four cocoa producing states within the study area. The randomly selected states were Osun, Ekiti, Abia and Cross-River. One hundred and four cocoa farmers were randomly selected from the four cocoa producing States. Structured questionnaire was used to collect information from the respondent farmers. Some of the information collected from the farmers include the socio-economic characteristics of the farmers and the characteristics of cocoa trees on their farms. The cocoa trees' characteristics investigated include (i) Length of first fruiting of cocoa trees after transplanting (ii) Undesirable qualities of cocoa trees on their farms and (iii) Variations among cocoa trees on their farms. The information collected was analyzed using descriptive analysis such as frequencies and percentages.

RESULTS AND DISCUSSION

Socio-economic characteristics of cocoa farmers

Table 1 shows the age distribution of the farmers. The table shows that only 10.5% of the total farmers were below 30 years of age. Hence, not many youths were engaged in cocoa farming. The implication of the finding is that the present old farmers may be difficult to get replacement at the time when they are incapable to continue with the work. Regarding the gender distribution of the farmers as shown on table 2, findings from the table showed that there were more male headed households than female headed households. The dominance of the male over the females may be attributed to the fact that male children are considered in the inheritance of farm land in the study area. Also, females are involved in off-farm activities such as buying and selling of farm produce, storage of crops and packing of farm produce. While their males counterparts were highly involved in tree crop production most especially cocoa in the study area. This is in consonance with Adamu *et al* (2006), who stated that majority of rural women engaged in off-farm activities such as packing of farm produce, buying and selling farm produce, storage of crops among others. Also cocoa production requires routine management practices that are considered too strenuous for the female to cope with. Results from table 3 showed that respondents with formal education were more (85.58%) in the study area. This shows that most of the farmers had formal education .This is in consonance with Orisasona *et al* (2016) ,who stated that majority of the farmers are literate and hence the ability to adopt new innovation that can bring about increase in input use efficiency. Education is a form of human capital; hence it could impact positively on household ability to take good and well informed production. Regarding the marital status, the findings revealed that 1.92 percent of the respondents were single while 88.46 percent were married. The large percentage of those who were married connotes that marriage is highly cherished by the people of the study area and could lead to increase in household size which implies that there is the likelihood that there could be more family labour available to farming households. As regards the farm size as shown on table 5, a high proportion of the respondents (75.96%) had not more than ten hectares of farm while only 24.04% of the total respondents had more than ten hectares of farm. This however shows that most of the respondents were small scale cocoa farmers.

Characteristics of *Theobroma cacao*

Table 6 shows the farmers' response to the length of first fruiting. It could be observed on the table that 69.35% of the farmers indicated that the breed of cocoa on their farms fruits at the age of four years while only 0.96% indicated that their cocoa fruits at the age of seven. The finding shows that the old variety (Amelonado) which takes longer years to fruit is gradually becoming extinct among cocoa farmers, hence they are responding well to the new technologies in cocoa production by replacing the old varieties with the new varieties which fruits earlier. However, only two farmers indicated that they had a breed on their farms which fruits at the age of two. This should be among the varieties that were recently released to cocoa farmers by Cocoa Research Institute of Nigeria. Table 7 shows the farmers' response on what is not preferable on the breeds of cocoa that are available on their farms. The finding shows that 50.96% of the total farmers indicated that the breeds of cocoa on their farms are not resistant to blackpod disease. This is quite obvious as blackpod disease is one of the most prevalent disease affecting cocoa farms in Nigeria (Oluyole, 2010). However, 24.04% of the farmers indicated that they are not satisfied with the number of seeds per pod while 9.62% of the farmers indicated that the breeds of cocoa on their farms are too tall. A tall cocoa tree is a disadvantage as it may be difficult to harvest pods on them. Meanwhile, 15.38% of the farmers listed late yielding as what they dislike in the breed of cocoa on their farms. Table 8 shows the variations among the cocoa trees on their farms. It could be observed on the table that 14.83% of the farmers observed variations among the tree size of cocoa on their farms, some cocoa trees were long while some were short. Also, 19.91% of the farmers observed differences in the number of pods per tree; 19.49% observed variations in the pod size; 16.10% took note of the differences in the pod colour while 10.59% of the farmers observed differences in cocoa bean size on their farms. However, 12.29% and 4.25% of the total farmers noted variations in the resistance to diseases and pests respectively.

CONCLUSION

Based on the findings in the study, the following conclusions were drawn:
1. Most cocoa farmers in the study area are old. This however could have implication on their productivity since at old age there would be no much strength to do farm work as farm work is very tedious.
2. Majority of the farmers are small scale farmers with total farm size of not more than 10 hectares.
3. In most cocoa farms in the study area, the breed of cocoa that is present there fruits at 4-5 years of age.
4. The breed of cocoa in most cocoa farms is not resistant to blackpod disease and the number of seeds per pod is not satisfactory.
5. In most cocoa farms, variations such as number of pods per tree, pod size, tree size, pod colour and been size were observed among the cocoa trees in the same farm.
However, the study recommends the following:
Youths should be encouraged into cocoa farming, this is quite imperative in as much that they would take over from the old farmers. The encouragement package could be in form of the provision of soft loan to the youths. Incentives should be given to farmers to enable them expand their farm size. Furthermore, a breed of cocoa needs to be developed that that will be resistant to blackpod disease and that the period of first fruiting will be reduced. However, the recently lunched eight cocoa breeds by Cocoa Research Institute of Nigeria would solve the problems as the breeds are resistant to blackpod disease and they fruit at two years.

Table 1: Age distribution of the farmers

Age (years)	Frequency	Percentage
≤ 30	11	10.5
31-60	69	66.3
> 60	24	23.2
Total	104	100.0

Source: Field survey, 2011

Table 2: Gender distribution of the farmers

Gender	Frequency	Percentage
Male	77	74.04
Female	27	25.96
Total	104	100.00

Source: Field survey, 2011

Table 3: Educational status of the farmers

Educational level	Frequency	Percentage
No formal education	15	14.42
Primary education	46	44.23
Secondary education	32	30.77
Tertiary education	11	10.58
Total	104	100.00

Source: Field survey, 2011

Table 4: Marital status of the farmers

Marital status	Frequency	Percentage
Single	2	1.92
Married	92	88.46
Widow/widower	8	7.69
Divorced	2	1.92
Total	104	100.00

Source: Field survey, 2011

Table 5: Farm size of the farmers

Farm size (Ha)	Frequency	Percentage
≤ 5	46	44.23
5.1 – 10.0	34	31.73
> 10	24	24.04
Total	104	100.00

Source: Field survey, 2011

Table 6: Length of first fruiting after transplanting

Year	Frequency	Percentage
2	2	1.92
3	7	6.73
4	69	66.35
5	18	17.31
6	7	6.73
7	1	0.96
Total	104	100.00

Source: Field survey, 2011

Table 7: Undesirable qualities of cocoa trees on farmer's farm

Quality	Frequency	Percentage
It is not resistant to black pod disease	53	50.96
It is too tall	10	9.62
Number of seeds per pod is not satisfactory	25	24.04
It is late yielding	16	15.38
Total	104	100.00

Source: Field survey,2011

Table 8: Variations among cocoa trees

Quality	Frequency	Percentage
No response	6	2.54
Tree size	35	14.83
Number of pods	47	19.91
Pod size	46	19.49
Pod colour	38	16.10
Bean size	25	10.59
Resistance to diseases	29	12.29
Resistance to pests	10	4.25
Total	236	100.00

Source: Field survey, 2011.

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CONSTRAINTS OF SCIENTISTS ON BIOTECHNOLOGY RESEARCH IN RESEARCH FACILITIES, IBADAN, OYO STATE, NIGERIA

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ABSTRACT
The study was conducted to investigate the constraints of scientist engaged in agricultural biotechnology research in Ibadan metropolis. A multistage sampling technique was used for this study. Data were collected through the administration of structured questionnaire.The data were summarized using Descriptive statistics, Likert Scales and Chi-square. Majority of the respondents were 21-40years old (79.7%), had HND/B.Sc (54.21%), had worked for 1-10years (66.7%), sourced information mostly from Journals (44.1%), were mostly engaged in tissue culture research (33.9%). Serious constraints to agricultural biotechnology research include unstable electricity supply (64.41%) and poor government funding of biotechnology research (55.91%). There was a significant relationship between the personal characteristics of the respondents and constraints faced on agricultural biotechnology research except their sex ($p<0.05$). It is recommended that training up to PhD level be provided through grants for scientist involved in agricultural biotechnology research, regular seminars/conferences be organized for the scientist, more funding from the government and the private sector be made available and extension strengthened to convey research findings to farmers.

Keywords: Agricultural Biotechnology, Constraints, Scientists and Research

INTRODUCTION
Agricultural biotechnology include range of tools that scientist employs to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products(FAO, 2004).In animals, agricultural biotechnology has been used to manipulate the physiology and the genetics make up of farm animals to enhance their performance or to get novel products.The manipulation of reproductive physiology of farm animals include artificial insemination and embryo transfer and those have enabled diverse usage of superior dams and sires (Ransom et al., 1996). In plants, agricultural biotechnology applications have aided in several plant breeding and propation techniques for improvements of food production world over (Nuffield Council on Bioethics, 2003). Some of such examples include tissue culture (Ammonety and Essebey 2003), anther cultures, protoplast cultures, production of Fi hybrids and marker assisted selection.Agricultural biotechnology research has potential to contribute to food security through increase yields, producing healthier crop varieties that can withstand drought and heat, enhancing nutritional and medicinal value and improving storability (UNmillennium project,2005b) biotechnology promises to contribute to world food demands as well as deliver a range of environmental, health and economic advantages (Wheeler, 2005).This study aims to investigate the constraints of agricultural biotechnology research in Ibadan metropolis, south western Nigeria.

METHODOLOGY
The study was conducted in Ibadan metropolis, Oyo state. Ibadan lies within longitude $07^0 02^1$ and 07^0 40E and latitude 03^0 35^1 and 4^0 10^1N Ibadan is 128km North West of Lagos and 345km southwest of Abuja, the Federal capital territory (Udo,1994). Multistage sampling techniques was used for the study.In the First stage, five (5) research centres were purposively selected because they have a mandate covering agricultural biotechnology research. They were National Institute for Horticultural Research (NIHORT), Cocoa Research Institute of Nigeria (CRIN), National Centre for Genetic Resource and Biotechnology (NACGRAB), Forestry Research Institute of Nigeria (FRIN) and Institute of Agricultural Research and Training (IAR&T). International Institute for Tropical Agriculture(IITA) was not selected because it is funded internationally. In the second stage, a list of all the research personnel in each institute involved in biotechnology research was generated and all the personnel used for this study. The sample size for this study was fifty nine (59). Data were collected through administration of structured questionnaires. Data collected were summarized using descriptive statistic such as frequencies, percentages,bar and pie chart. A 4 point Likert scale was used to measure constraints and chi-square analysis (SPSS, 2008: version 17) was used to test the hypothesis.

RESULTS AND DISCUSSION
Table 1 shows the results of the personal characteristics of the respondents. About half of the respondents were males(50.8%), majority were in the age bracket of 21-40 years(79.7%),Mostly had HND/B.Sc as educational qualification(54.2%).Majority of the respondents had between 1-10years experience on the job(66.1%) and are

majorly Christians (72.9%). Having mostly HND/B.Sc, holders in various research facilities indicates a predominance of staffs in need of further training for their M.Sc and P.hd. Result from Fig 1 indicates that majority of the respondents source information on agricultural biotechnology research from journals (44.1%). Another 25.4% source their information from the internet. Just 13.5% got information regularly from seminar/workshops and conferences attended on agricultural biotechnology. Sourcing information from journals and internet shows individual attempts of scientists at accessing information. That is okay, but not good enough. Workshops, conferences and seminars provide a for a where scientist, whether from the National Agricultural Research Institutions or Universities can meet to exchange information on agricultural biotechnology. Michelson et al., (2003) suggested workshops, seminars and conferences to enhance better sharing of information on agricultural biotechnology.Table 2 shows the respondents activities in Agricultural Biotechnology Research. Most were engaged in tissue culture research (33.9%).Another 22.0% are involved in tissue culture and fermentation research. A few of the respondents were involved in tissue culture and development of biofertilizer(11.9%). Just 1.7% are involved in tissue culture and in-vitro technique for breeding.This result support findings by Al-Hassan (2003) who reported that Nigerian infrastructure in tissue culture research is strong but relatively weak in molecular biotechnology.Nwalozie *et al*., (2006, based on Byerlee and Fischer, 2002) used three tiered model to categorize the capacity of national agricultural research systems (NARS). Type 1: "having molecular biology and plant breeding capacity", type II: "with limited molecular biology but solid plant breeding capacity", and type III: "having limited capacity overall". Although African NARS vary significantly in capacity, most fall into lower level type III. Table 3 reports the constraints of the respondents on Agricultural Biotechnology Research. Serious constraints include; Lack of modern agricultural biotechnology laboratories and facilities (52.3%), poor government commitment to funding biotechnology research (55.9%), poor extension delivery mechanism to take the products of biotechnology research to farmers (59.3%) and unstable electricity supply to research stations (64.4%).Other constraints were lack of trained manpower for biotechnology research (39.0%), poor access to information and communication technology by scientist (47.5%) and investors not funding biotechnology research and development in Nigeria(42.4%). These findings agree with Maturuka (2009) who reported that in Africa, agricultural productivity suffers from under-investments in agricultural research, education, farm mechanization, and infrastructure (such as roads, electricity and irrigation).Also, Scooner (2005) in a study stated that Africa (Nigeria inclusive) is under threat from decreasing capacity as a result of inadequate government investment and a series of external imposed conditionality's. On poor extension delivery being a constraint, Davis et al.,(2004) stated that public education is a major task of extension worldwide, and is one potential strategy to inform diverse audiences about agricultural biotechnologies. If so, extension must take a pro-active leadership role and formulate innovative strategies to address the issue of transferring the research finding on agricultural biotechnology and educating the end users to adopt innovations in biotechnology. Also,agricultural extension has a great role in improving the linkage between public and private sectors involvement in agricultural biotechnology. Public-private partnership is more effective mechanism for converting the potential of biotechnology in producing products that improve productivity and economic conditioner of agricultural sector (Seyed *et al.,* 2011). Table 5 shows the result of the chi-square analysis of the personal characteristics of the respondents and the constraint faced in agricultural biotechnology research. There was a significant relationship ($P<0.05$) between Age, marital status, religion, education level and years of experience of the respondents and the constraints faced in agricultural biotechnology research. However, no significant relationship ($p>0.05$) exist between sex of the respondents and the constraints faced in agricultural biotechnology research.

CONCLUSION

Agricultural biotechnology research in the study area is constrained by poor academic qualifications of the researchers, poor infrastructure available for conducting biotechnology research generally and especially in the area of molecular biology, poor government funding and inadequate extension service support.

Table 1: Personal Characteristics of the Respondent

Variables	Frequency (F)	Percentage (%)	Mean
SEX			
Male	30	50.8	
Female	29	49.2	
AGE (years)			
1-20	2	3.4	
21-40	47	79.7	21.4
41-60	10	16.9	
MARITAL STATUS			
Single	18	30.5	
Married	41	69.5	
RELIGION			
Islam	15	25.5	
Christian	43	72.9	
Traditional	1	1.7	
EDUCATIONAL LEVEL			
ND	4	6.8	
HND/BSC	32	54.2	
M.SC	22	37.3	
Ph.d	1	1.7	
YEARS OF EXPERIENCE			
1-10	39	66.1	
11-20	15	25.4	14.6
21-30	3	5.1	
30-40	2	3.4	
Total	**59**	**100**	

Source: Field Survey, 2015

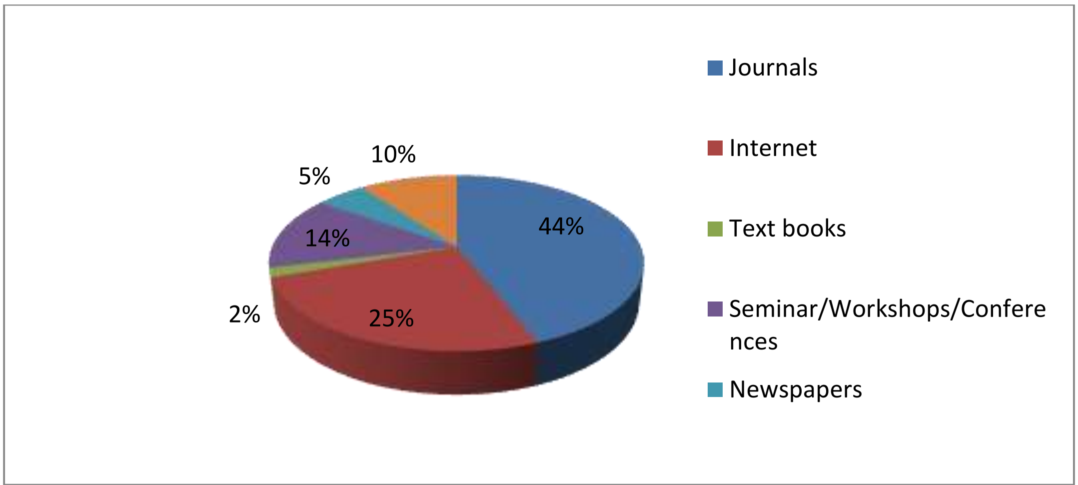

Fig 1: Respondents source of regular information on Agricultural Biotechnology Research

Table 3: Respondent activities in Agricultural Biotechnology Research

Activities	Frequency (f)	Percentage (%)
Tissue culture	20	33.9
Fermentation and tissue culture	13	22.0
Tissue culture and development of bio fertilizer	07	11.9
Tissue culture, invitro technique for breeding and development of biofertilizer	01	1.7
Fermentation, tissue culture and genetic modification	5	8.5
Tissue culture, embryo sexing, in-vitro technique for breeding	3	5.1
Tissue culture, ethno-veterinary vaccines and In-vitro techniques for breeding	2	3.4
Tissue culture, development of biofertilizer, In-vitro techniques for breeding and fermentation	2	3.4
Tissue culture, genetic modification, development of biofertilizer and in-vitro techniques for breeding	3	5.1
Total	**59**	**100**

Source: Field survey, 2015

Table 4: Constraints of Agricultural Biotechnology Research as reported by respondents

Constraint statement	SC	C	U	NC
Poor extension delivery mechanism to take the products of biotechnology research to Farmers	35(59.3)	20(33.9)	1(1.7)	2(3.4)
Poor regulatory frame work for development of Agricultural biotechnology	25(40.7)	22(37.3)	8(13.6)	3(5.1)
Lack of modern agricultural biotechnology laboratories and facilities	31(52.5)	22(37.5)	1(1.7)	3(5.1)
Lack of trained manpower for bio-technology research	16(27.1)	23(39.0)	4(6.8)	7(11.9)
Poor government commitment to funding Agricultural biotechnology research	33(55.9)	21(35.6)	2(3.4)	1(1.7)
Unstable/poor electricity supply to research stations	38(64.4)	13(22.0)	3(5.1)	2(3.4)
Poor public perception of biotechnology	23(39.0)	22(37.3)	7(11.9)	3(5.1)
Poor access to information and communi-cation technology by scientist	15(25.4)	28(47.5)	3(5.1)	11(18.6)
Few investors are funding biotechnology Research and development in Nigeria	23(39.0)	25(42.4)	5(8.5)	4(6.8)
Poor public awareness on Agricultural Biotechnology Research and Products	22(37.3)	23(39.0)	3(5.1)	6(10.2)

SC - Serious constraint, C - Constraint, U- Undecided, WC – Not a constraint; figures in parenthesis are in percentages. Figures outside parenthesis are frequencies.
Source: Field Survey, 2015

Table 5:Chi-square analysis of personal characteristics of the respondents and constraints faced in agricultural biotechnology research

Variables	DF	X^2	P-Value	Decision
Sex	1	0.017	0.896	Not significant
Age	2	68.254	0.001	Significant
Marital status	1	79.220	0.042	Significant
Religion	2	29.220	0.002	Significant
Educational level	3	17.525	0.002	Significant
Years of experience	3	37.356	0.007	Significant

S – Significant ($p<0.05$); NS – Not Significant ($p>0.05$) DF – Degree of freedom,
X^2 – Chi-square

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VARIATION IN FARMERS POTATO TUBER YIELD IN ON-FARM TRIALS IN JOS PLATEAU, NIGERIA

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ABSTRACT

Exploratory surveys have identified many constraints to potato production in Jos Plateau. These include late blight disease, bacteria wilt, low yield, low soil fertility and poor cultural practices. Local and three improved potato varieties were used in on-farm trials in the Jos Plateau Nigeria. Seven Local Government Areas were covered to remedy some of the production constraints. Six farmers were used in each location/site. A randomized complete block design (RCDB) was used in all the locations. Results indicated that variation exist among the varieties and locations. Varieties connect performed significantly better than the others in all the location. Mean tuber yield of variety connect (19.25tlha) out yielded the local variety (8.11tlha). Bassa Local Government recorded the highest tuber yield of variety connect than the rest of the LGAS. However, the ranking of varieties varied across locations. Except for variety Queen Anne all the improved varieties yielded more than the Local one. Implications of these results on future on-farm potato studies are discussed.

Keywords: Variety, locations, tuber yield, and on-farm

INTRODUCTION

In the past few years, several improved potato cultivars have been introduced into Jos Plateau Nigeria. In on-station and multi-location experiments, these introduced cultivars have produced yields more than local varieties. The superiority of these cultivars under farmer's condition has not been demonstrated. In Nigeria (Jos Plateau) on farm experiments with potato began a couple of years ago. In general. These trails are highly variable. This variability in yield is cause mainly by differences in management practices (methods of land preparation, weeding frequency, planting and harrowing time) from one farmer to the other (Ngeve, 1994), plot size, fertility levels rainfall distribution, shade, pest and disease incidence (Mutsears and Walker, 1990). This variability is control by the use of uniform blocks and applying all non- treatment operations as weeding equally each plot in a trial (Gomez and Gomez, 1983). The difference observed in each farm is done in such a way as to better understand the farmer's condition of production (Simba, 1989). The objective of this research therefore were to monitor the performance of three newly introduced potato cultivars under variable farmer conditions so as to get an appraisal of yields under sole cropping situations, to determine farmer assessments of the new varieties and to determine feed back to on-station research

MATERIALS AND METHODS

Site Selection and Characterization: Six villages were chosen in each of the seven Local Government Areas of Jos Plateau namely Jos east, Jos South, Bassa, B/Ladi, Mangu, Bokkos and Pankshin. The six villages were selected and considered a representative milieu within the Area of diagnostic survey. The site selection exercises started as early as March after Land Clearing but before the ridges were made. An Area of 5mx6m was pegged out within each farm and the farmers were asked to complete the land preparation. All farms selected consisted of Land where potato have not been planted for 5years, with no fallow period due to land scarcity. The method of land preparation was remark ably similar and consisted of slash and burn and the construction of ridges. The sites were located in the expansive Jos Plateau Area. The soils are uniform, shallow and highly- leached medium soils. Colour of the top soils ranged from dark brown to brown depending on the organic matter accumulation. The sub soils varied from high brown to near white at depth. All sites were, therefore, susceptible to severe moisture stress during the dry season. The topography of the experimental plots was fairly flat or gently sloppy. The trial sites were therefore, located on slopes of varying degrees, sites were characterized by low soil fertility. Soil fertility was rated as low, medium, or high, depending on the vigor and growth of the crops in each farm.

Planting

At planting, each farmer was supplied with tubers of improved potato varieties, connect, Caruso and Queen Anne. the farmers supplied their own local varieties, all cultural practices were those of the farmers. Intervention by researchers was committed to observations and data collection on tuber yield at harvest after 3 months. The data were subjected to analysis of variance from each individual environment were analyzed, using ANOVA for tuber yield only according to steed and Torrie (1980). Data were subjected to combined statistical analysis across environment using the procedure of little *et-al*, (1996).

RESULTS AND DISCUSSION

The combined analysis of variance is presented in Table 1. The table showed that there was a highly significant genotypic difference indicating that the evaluated cultivars differed in their genetic potential concerning tuber yield. The first order interaction (L×V) did not show any significant difference for tuber yield indicating that the cultivars did not differ in their ranking when grown at different locations, this agrees with the results of Yildrum and Caliskan (1985). There may be no need to repeat the experiment. The findings of the present study fulfill the basic requirements for stability analysis, for the tuber yield studied . The data in Table 2 indicates clearly that tuber yield showed significant differences among the evaluated varieties and reflected a large amount of variability. The variety connect produced the highest tuber yield and was followed by Caruso with a significant difference of 19.25tlh and 11.50lha respectively, while Queen Anne gave the lowest tuber yield of 5.82tlha. As for the average effect of the different environments on mean tuber yield data in Table 3, showed that tuber yield was highly affected by the environment and appeared to be sensitive for their changes. Total yield of cultivars range from 28.91t/lha for connect at Bassa, to 0.68t/lha for Queen Anne at Mangu. The studied varieties indicated their adaptation which reflected the highly magnitude of genotype x environment interaction. Data on table 4 showed the on-station versus on farm potato tuber yields. Tuber yield obtained from multi-site on-station trials were compared with farmers yields in on- farm trials, there was virtually no difference between on-station and on-farm yields of improved varieties. However, the local varieties sustained a significant yield reduction in farmer's field.

Farmer Assessment

In almost all farms, connect was unanimous first choice of farmers over Caruso and Queen Anne. The reasons for choosing connect were#;

- High plant canopy and competes well against weeds
- High resistance to late blight disease.
- It has high yield potentials.
- It has relative big tuber size

CONCLUSION

Improved cultivars out-yielded Local varieties except Queen Anne at on-farm both Local and improved cultivars produced yields at on farm comparable with on-station and mulilocational sites this suggest that the reported low yields of both improved and local at farmer level varieties may be due to inadequate farm management, that is if properly maintained most of the varieties could give better yields. Okonkwo et-at. (1970) reported that at least two properly timed weeding were necessary it potato most farmers were seen to weed only once, this might also have been responsible for the observed low yields of both improved and local varieties. On –farm potato results of different locations were higher in some locations than others. This is probably because of difference in soil fertility, because some of the sites were newly opened at Bassa, where pressure on land is acute and as a result land is really left fallow for up to 3years. From the results presented in this study, it is our suggestion that high yielding verities such as those screened and developed by the pototа programme of National Root crops research instate, athough possessing many desirable characteristics such as disease and pest resistance, have a competitive advantage over local landraces which may result in increased peasant potato production Nigeria

Table1: Combined Analysis of Variance for tuber yield of Potato

Source of Variation	DF	MS
Location	6	728.9864
Varieties	3	732.1879
L × v	18	48.4836
Pooled Error	42	25.7053

Table 2: Mean performance of tuber yield of the Four potato varieties calculated over the Environments

Varieties	Tuber Yield (tlha)
Caruso	11.50
Connect	19.25
Queen Anne	5.82
Farmer Variety	8.11
Mean	11.17
C v (%)	29.30
L.S.D (0.05)	3.17

Table 3: Mean performance of four Studied Varieties under Different Environment for Tuber Yield (t/lha)

Varieties	B/Ladi	Bassa	Bokkos	Jos East	Jos South	Mangu	Pankshin
Caruso	18.80(58.40)*	14.26(111.3) *	6.50(18.24) *	11.90(28.65) *	4.67(60.2) *	5.18(-8.5) *	9.18(6.00) *
Connect	18.52(55.60) *	28.9(257.8) *	13.87(59.2) *	26.43(18.57) *	21.31(132.64) *	10.75(89.93) *	14.93(72.4) *
Queen Anne	9.01(-39.5) *	6.75(36.2) *	3.48(-56.6) *	3.773(-59.7) *	5.52(-39.38) *	0.68(87.99) *	11.59(33.84) *
Farmers Variety	12.96	3.13	7.95	9.25	9.16	5.66	8.66
Mean	14.82	11.58	7.95	12.83	12.67	5.57	12.02
AV (%)	18.33	40.60	20.40	7.10	33.64	54.33	30.71
L.S.D (0.05)	4.58	7.95	6.81	5.81	7.19	5.10	5.76

Figures in Brackets represent Percent yield increase of improved cultivars Over Local Varieties

Table 4: Comparisons of on- Station and on -farm Potato yield (t/ha) in Several Locations of Jos Plateau, Nigeria

Varieties	Researcher-Managed On-station Yields	Farmer Managed On- farm Yield	Yield Difference
Caruso	12.23	11.50	0.73
Connect	20.85	19.25	1.60
Queen Anne	5.70	5.82	-0.12
Local(Farmers Varieties)	10.37	8.11	2.26
Mean	12.30	11.17	1.12

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ANTI-SECRETORY AND ANTI-MOTILITY EFFECT OF *Solenostemon rotundifolius* LEAVES ON EXPERIMENTAL RAT INTESTINE

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ABSTRACT
The anti-secretory and anti-motility activities of Solenostenom rotundifolius leaves were investigated in experimental animal intestine. Castor oil an enteropooling inducer was used to cause the accumulation of fluid in the small intestine of albino rats, graded doses of Solenostemon rotundifolius (300mg/kg, 500mg/kg and 1000mg/kg) were administered prior to castor oil treatment. Their effect on gastrointestinal transit of charcoal meal and enteropooling activity in the albino rat intestine were measured and compared with that of a standard drug, loperamide given at 2mg/kg body weight. All doses of S. rotundifolius significantly ($p<0.05$) reduced the intestinal fluid accumulation comparable to that of loperamide; and S. rotundifolius at 300 and 500mg/kg significantly ($p<0.05$) delayed the charcoal meal intestinal transit. These results were comparable to that of loperamide. These results suggest that S. rotundifolius leaves could be used to treat hypersecretoy and hyper motility disorders
Keywords: Anti-secretory, rat intestine, anti-motility, effect, solenostemon rotundisfolins

INTRODUCTION

Solenostemon rotundifollius (common name Hausa potato) is a small herbaceous annual crop with a succulent stem (15-30cm), thick leaves and pale violet small flowers. It has aromatic smell and small dark-brown tubers which clusters at the base of the stem. The tubers are believed to be the source of staple energy in the past but it is now being replaced by more starchy food and only been consumed as a supplementary energy food especially when income is lean. Boiled leaves of *S, rotundifolius* is eaten as a pot herb and in ethnomedicine used for the treatment of dysentery, blood in urine and eye disorders (Enyiukwu *et al.*, 2014; Sugri *et al*, 2013). Dysentery is a gastrointestinal disorder caused by micro organisms; it is characterised by hyper intestinal secretion and motility, accompanied by faecal urgency and incontinence (diarrhoea). Diarrhoea is an important health problem in children where it is the major cause of mobility and mortality accounting for more than 5-8 million deaths annually (Ladaporn *et al*, 2010); any anti-secretory and anti-motility drug will go a long way in the management of diarrhoea. In recent years there is a growing interest in the use of herbal remedies for the management of many ailments diarrhoea inclusive; in view of this the World Health Organisation (WHO) has advocated for the study of traditional medicine practice for effective diarrhoea management and prevention (Mukherjee *et al.*, 1995). Various scientific diarrhoea models have been developed to be used to ascertain the ethnomedicinal use of plant materials for the control of diarrhoea episodes. These models include the *in vivo* reduction in castor oil, induced diarrhoea; reduction in charcoal meal intestinal transit time and the enteropooling test. In this study we are investigating the reduction in charcoal meal intestinal transit time and the enteropooling activities of *S, rotundifolius* leaves.

MATERIALS AND METHODS

Drugs: Loperamide (Square pharmaceuticals Ltd., Bangladesh), Castor oil

Chemicals: All chemicals and reagents were of analytical grade and were mainly products of Sigma-Aldrich.

Plant material: Fresh leaves of *S. rotundifolius* were collected in the month of October, 2014 from the demonstration farm of National Root Crop Research Institute Umudike and identified by experts in the Institute. The leaves were dried under room temperature, milled into powder and extracted with ethanol by continuous extraction using Soxhlet apparatus. The extract was evaporated at room temperature and gave a yield of 2% of a semi solid ethanol extract.

Animal: Male albino rats (65-120g) obtained from the animal facility of the Faculty of Biological Sciences, University of Nigeria, Nsukka were acclimatized to normal laboratory conditions for two weeks, fed with standard rodent pellet and water *ad libitum*. All animal experiments were in accordance with the National Institute of Health Guide for Care and Use of Laboratory Animal (Pub No. 85-23 revised 1985)

Effect of *S. rotundifolius* on castor oil-induced fluid accumulation and electrolyte secretion

Following the method of Dicarlo *et al*. (1994), albino rats selected without discrimination were divided into four groups of six animals each and fasted for 18h before the test but had free access to water. Animals in group I received loperamide (2 mg/kg) and served as the standard while groups, II, III and IV received 300, 500 and 1000 mg/kg of *S. rotundifolius* respectively and one hour after treatment, all the animals received 1ml castor oil orally.

One hour after castor oil administration rats were sacrificed and the small intestine removed from pylorus to cecum, after ligating the ends, and weighed. Intestinal content was milked into graduated measuring cylinder, the volume was measured and the intestine was re-weighed. The difference between full and empty intestine was calculated.

Effect of *S. rotundifolius* on small intestinal transit time of charcoal meal in rats

The effect of *S. rotundifolius* on gastrointestinal motility was assessed using the charcoal meal method of Mascolo *et al*. (1994) with slight modification. Ggastrointestinal transit was calculated for each animal as the percentage distance travelled by the charcoal meal in ratio to the total length of the intestine:

$$\text{Gastrointestinal transit} = \frac{\text{Distance moved by charcoal meal}}{\text{Whole length of small intestine}} \times 100$$

The inhibitory effect of *S. rotundifolius* on gastrointestinal transit was calculated relative to the control:

$$\%\ \text{Inhibition} = \frac{\text{Distance moved by control} - \text{Distance moved by test}}{\text{Distance moved by control}} \times 100$$

RESULTS AND DISCUSSIONS

The acute toxicity of the extract of *S. rotundifolius* had earlier been established to be <5000mg/kg. The small intestine is both an excretory and absorptive organ. Castor oil produces changes in intestinal mucosal permeability to electrolyte and water leading to diarrhoea. In the intestinal mucosa recinolic acid is liberated from castor oil causing irritation and inflammation of the intestinal mucosa an the release of prostangladins which induces hypersecretion (Ammon *et a*l., 1974). Water and sodium are absorbed in the small intestine by the coupled transport of Na^+ and glucose or Na^+/amino acid across the intestinal brush boarder by the Na^+/glucose symporter and Na^+/amino acid symporter respectively with water flowing down the concentration gradient (Field, 2003). The enteropooling test showed decreased weight and volume of the intestinal content which is suggestive of inhibition of intestinal secretion and increased absorption of intestinal water and electrolyte; and by implication increased absorption of intestinal solute. The study on intestinal transit time reveals a delay in the animal treated with *S. rotundifolius* at 300mg/kg and at 500mg /kg when compared with the control but this inhibition is not comparable with that of the standard drug. Delay in intestinal motility is suggestive of diarrhoea control as delay in intestinal motility allows for further absorption of water from the faeces and reduces the watery texture of feaces.

CONCLUSION

The studies showed that *S. rotundifolius* leave extractreduced castor oil induced intestinal secretion and hypermotility, therefore the plant could contain some bioactive principles which can be explored for the management of intestinal disorders such as diarrhoea.

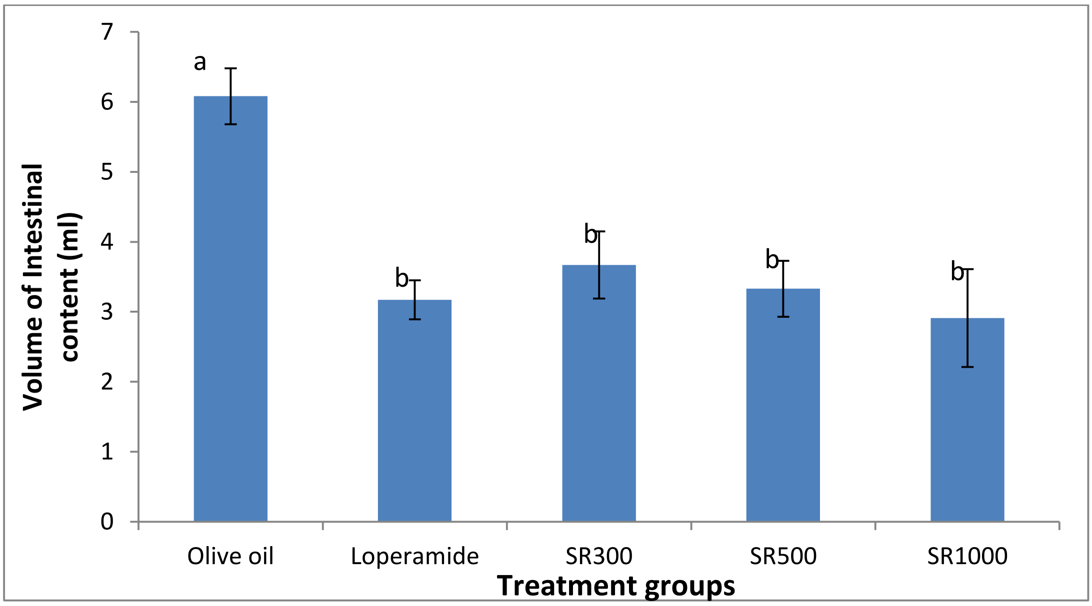

Fig. 1: Effect of ethanol extract of *Solenostemon rotundifolius* on enteropooling

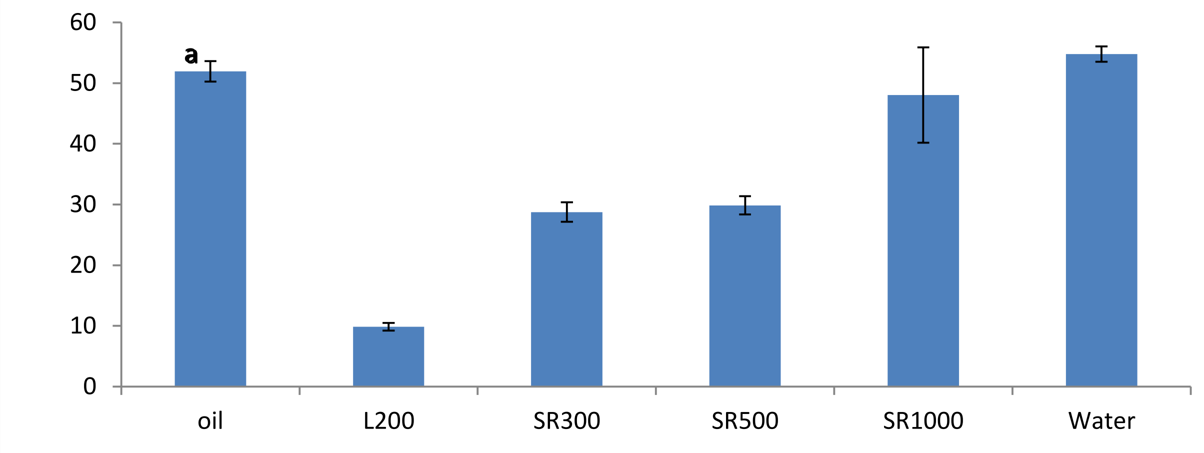

Fig. 2: Effect of *Solenostemon rotundifolius* on small intestinal transit time of charcoal meal in rats

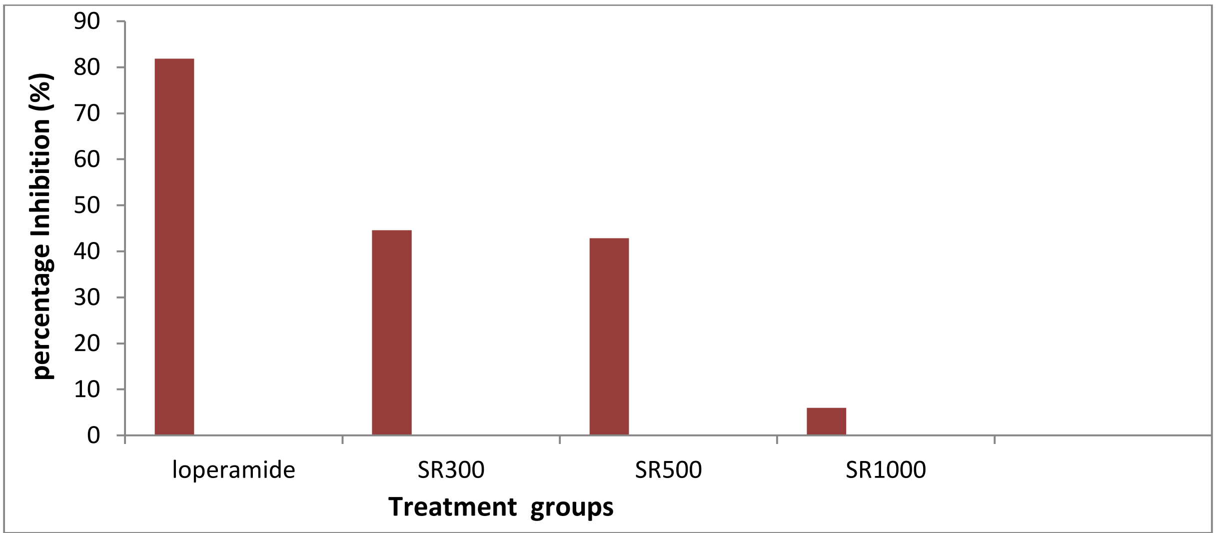

Fig. 3: Percentage inhibition of charcoal meal intestinal transit time by *Solonestemon rotundifolius* **ethanol extract**

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DNA FINGERPRINTING FOR MONITORING PURITY AND QUALITY CONTROL DURING SEEDS PRODUCTION OF DROUGHT TOLERANT MAIZE RELEASED IN NIGERIA

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ABSTRACT
The use of DNA fingerprinting as a quick technique for monitoring contamination and quality control of drought tolerant maize varieties released in Nigeria was considered to ensure quality seeds reach farmers for maximum benefits of combating losses from drought spell. Relying on DUS (distinct, unique and stable) phenotyping characteristics to monitor seed production from the breeder seeds through the foundation seeds to the certified seeds that finally get to farmers, could be time consuming and expensive. In this study, 39 drought tolerant maize varieties comprising of 14 breeder seeds, 11 foundation seeds and 14 certified seeds were examine using 40 SSR markers. Twenty eight (28) SSR markers were polymorphic across the 39 varieties and generated a total of 51 alleles. The polymorphic information content (PIC) values obtained for the polymorphic SSR markers varied from 0.11 to 0.39 with an average of 0.27. The percentage variability in seeds produced by the KNARDA (4), SeedProject (4) and Premier seeds (5) Nigeria limited was very low and non-significant. Genetic distance (GD) among all pairs of the breeder seeds ranged from 0.16 to 0.65 while it was 0.13 to 0.75 among all the varieties combined. This showed that the breeder seeds were distinctly different from each other. The foundation and certified seeds from the other sources showed minimum or no contamination and conformity to their parent breeder seeds. Thus, DNA fingerprinting was shown to be an effective and quick technique to compliment DUS phenotyping in ensuring seed purity and quality control.

Keywords: DNA fingerprinting, SSR markers, Drought tolerant maize, Seed production and quality control

INTRODUCTION

Maize is the number one cereals crop in Nigeria in terms of production and consumption. It is consumed more than other traditional cereals due to its superior grain yield and versatility of its recipes. With an annual estimated increase in population of 3%, about 4.5 million new mouths need to be provided for every year. Maize is a highly input-responsive crop with high water-use efficiency making it highly prone to yield losses from drought stress. Efforts to mitigate the danger of drought threatening the livelihoods of over 60 million people in Nigeria depending on maize as staple crop lead to the initiation of the Drought Tolerant Maize for Africa Projects (DTMA). DTMA is a project run by CIMMYT and the International Institute for Tropical Agriculture (IITA) in 13 countries of eastern, southern and West Africa: Angola, Benin, Ethiopia, Kenya, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda, Zambia, and Zimbabwe and Ghana. The goal of the DTMA projects which is to develop DT varieties in order to cushion the effect of climate change has so far been gaining grounds (La Rovere *et al.*, 2010). Several adaptable DT Maize varieties-OPV synthetics and Hybrids (farmers preferred) have been released in Nigeria by the collaborative efforts of Institute for Agricultural Research (IAR) Samaru and the International Institute of Tropical Agriculture (IITA) Ibadan (Ado *et al.*,2007). The released varieties have been deposited in the National Center for Genetic Resource and Biotechnology (NACGRAB) and various genebanks of other NARS (IAR and other collaborating institutions) that developed them. The varieties are to be disseminated and promoted for adoption by farmers to mitigate the effects of extreme weather and other climatic events in drought prone areas especially Sokoto, Katsina, Kano and Borno State. For these purposes there is the continuous and consistent need for the production of breeder seeds, foundation seeds and certified seeds of these materials. These seeds are of high purity, and quality. The conventional practice of DUS phenotyping as recommended by the International Union for the Protection of New Varieties of Plants (http://www.upov.int/en/publications/tg-rom/tg002/tg_2_6.pdf [verified Feb. 2013]) to ascertain purity and uniformity of seeds during production by breeders and before certification by the National Agricultural Seed Council (NASC) requires a lot of labour, land, time and costs and the right environments. Genotyping as an alternative offers a relatively cheaper, time saving and less labour for breeder and foundation seeds quality control (Warburton *et al.,* 2010). This will facilitate seeds certification by the NASC and purity monitoring and maintenance during breeder and foundation seeds production. The objectives of this research are therefore to fingerprint/ genotype some of the released Drought Tolerant Maize varieties in Nigerian and to use the genotyping data for monitoring the purity and quality of seeds produced by different seed producing agencies in Nigeria.

MATERIALS AND METHODS

The list of the 39 drought tolerant maize varieties used in this study, comprising of 14 breeder seeds, 11 foundation seeds and 14 certified seeds are shown in Table 1. Seeds were obtained from IAR maize breeding program, Kano State ADP (KNARDA) and SeedCo and Premier Seed companies.

DNA Extraction

Seedlings were grown in the green house for 3 weeks after which fresh leaf tissue of 15-20 seedlings of each varieties was harvested and stored in eppendorf tubes at -80°C for total genomic DNA extraction. The modified Dellaporta *et al*. (1983) cTAB method was used with some modifications to extract DNA. The quality and quantity of DNA was determined by NanoDrop spectrophotometer machine (ND-100 Technologies, Wilmington, Delaware, USA).

SSR PCR and electrophoresis

A total of 38 SSR maize primers selected from the 52 core SSR primers described by Warburton *et al*. (2002), were used for PCR amplification of the released DT Maize varieties in sets of 14 breeder seeds, 11 foundation seeds, and 14 certified seeds (Table1). The primers were chosen from the MaizeGDB database (http://nucleus.agron.missouri.edu/cgi-bin/ssr_bin.pl) based on the bin locations, which provides a uniform coverage of all the ten chromosomes in the maize genome. Primer names and chromosome loci (Bin number) of the SSR loci evaluated are included in Table 2. All the primers were diluted to a working concentration of 5 μM with sterile water and stored at -20°C. PCR conditions and gel visualisation were performed as described by Senior et al (1998). Variable "touch down" PCR profiles, annealing temperatures (65-55°C, 70°C-63°C and 60°C-50°C) were used for different SSR primers. The SSR loci amplified were separated on 2% (w/v) superfine agarose gels (Amresco). The gel was stained with ethidium bromide solution and photographed under UV light attached to a gel documentation system (Bio-Rad, Hercules, CA). Allele sizes of amplified fragments were scored on the basis of size in comparison with DNA molecular weight markers. Clear polymorphic SSR fragments (bands) were scored in a binary form of 1 or 0 for presence or absence of the band, respectively.

Data analysis

PowerMarker (Liu and Muse, 2005) was used to calculate standard diversity statistics of observed heterozygosity, gene diversity (D or expected heterozygosity), mean number of alleles per locus (A) and polymorphic information content (PIC). The differences between the seed sources were studied using the analysis of molecular variance (AMOVA) according to Weir (1996) with Arlequin V3.01 (Excoffier et al., 2005). Further analysis of the breeder seeds separately and together withal the other seed types were conducted using clustering method and Principal Co-ordinate Analysis (PCoA). The clustering method is implemented in the PowerMarker V3.25 software which estimated Euclidean genetic distance from allele frequencies (Kaufman and Rousseeuw, 1990). Cluster analysis was performed using the genetic matrices generated by the Euclidean distance method to reveal the patterns of genetic relationships among genotypes. Dendrograms were constructed based on neighbour joining using the software MEGA version 5 (Tamura *et al.*, 2011). The 3D (three dimension) representation of the genetic relationships among the breeder seeds of the studied varieties was done using PAST software version 1.18 (Hammer *et al.*, 2001) and STATISTICA version 6.0 software (StatSoft, Inc., 2001).

RESULTS AND DISCUSSION

The 39 drought tolerant maize varieties comprising of 14 breeder seeds, 11 foundation seeds and 14 certified seeds were investigated using 40 SSR markers. Twenty eight (28) SSR markers were polymorphic across the 39 varieties and generated a total of 51 alleles (Table 1). The polymorphic information content (PIC) values obtained for the 18 polymorphic SSR markers varied from 0.11 to 0.39 with an average of 0.27 (Table 1). This was similar to reports by Adeyemo *et al.* (2011) for yellow maize inbred lines. The number of polymorphic alleles per locus ranged from 1 to 3 with a mean of 2.06 being lower than 4.9 for 40 U.S maize inbreds reported by Lu and Bernardo (2001) suggesting that the varieties were less diverse than the panel of inbred lines studied in Lu and Bernardo (2001) and that they shared more common alleles due to selection for drought (Banziger *et al.*, 1999). Genetic distance (GD) values among all pairs of the breeder seeds ranged from 0.16 to 0.65 while it was 0.13 to 0.75 among all the varieties combined. Gene diversity estimate (D) which is a measure of inbreeding/ heterozygosity (Table 2) ranged from 0.0625 for SM13 to 0.2188 for SM27 (breeder seed), 0.0938 for SM12FS and SM15FS to 0.2188 for SM19FS, 0.1250 for SM18KN, between 0.0625 for SM28SP to 0.1563 for SM27SP and between 0.03 for OBA7 to 0.0938 for OBA5. The higher the value of D the more the heterozygosity. Consequently, hybrid seeds from premier seeds had the least D because they are hybrid varieties, followed by seeds from SeedProject then, KNARDA. Results of AMOVA showed that all the varieties obtained from IAR/ABU Zaria (14BS and 11FS) had significantly high intra and inter population variability (Table 3). The breeder seeds were less heterozygous than the foundation seeds which was probable due to some sort of selection in the course of rouging off types during breeder seed production. The percentage variability in seeds produced by the KNARDA (4), SeedProject (4) and Premier Seeds (5) Nigeria limited was very low and non-significant. The within individual variation of Premier seeds was the least validating the fact that there were hybrid seeds. The low values for the within population variation for these varieties from KNARDA (5.23%), Seed Project (3.90%) and Premier seeds (4.71%) complied with fact that there were fewer genotypes in these sets as compared to seeds from IAR/ABU

Zaria (38.8%). Heckenberger e*t al.* (2002) had also reported genetic differences between different sources of the same cultivar, including inbred lines and doubled haploids using molecular markers.

CONCLUSION

DNA fingerprinting confirmed that the released DT maize varieties were distinctly different from each other. The quality of seeds for farmers' use (i.e. certified seeds) produced by Agricultural Development Agency (KNARDA) and two seed companies (SeedProject and Premier Seeds) were in conformity to their parent seeds (foundation seeds). Seeds from Seed Projects and Premier seeds, though, they were produced under trade names of Obasuper, were derived from DT maize breeder seeds maintained by Institute for Agricultural Research (IAR) Ahmadu Bello University. The effectively of DNA fingerprinting for purity and quality assessment of seeds in the production chain is, thus ascertained and therefore recommended for routine quality assurance during seeds certification and production.

Table 1: Type, number of alleles, gene diversity and Polymorphic information content (PIC) of the SSR marker in the Drought tolerant maize varieties released in Nigeria

Marker	Marker Location	Motif	Minimum allele	Maximum allele	No. of Allele	Gene Diversity	PIC
nc133	1.09	GTGTC	110	120	2	0.3578	0.2938
phi011	3.04	GCT	204	230	2	0.4970	0.3735
phi029	9.04	AG/AGCG***	150	161	1	0.0000	0.0000
phi032	7.02	AAAG	234	298	2	0.2311	0.2044
phi034	10	CCT	122	145	2	0.3200	0.2688
phi041	3.05	AGCC	197	223	2	0.1800	0.1638
phi053	1.01	ATGT	160	194	2	0.4978	0.3739
phi056	10.02	CCG	241	259	1	0.0000	0.0000
phi059	1.01	ACC	147	165	2	0.1244	0.1167
phi064	4.01	ATCC	67	113	2	0.4978	0.3739
phi072	4.11	AAAC	142	162	2	0.4800	0.3648
phi076	10.04	AGCGGG	161	172	2	0.4644	0.3566
phi084	5.06	GAA	148	157	2	0.3911	0.3146
phi087	6.08	ACC	150	174	2	0.4978	0.3739
phi089	4.08	ATGC	85	90	2	0.2449	0.2149
phi093	9.05	AGCT	282	298	2	0.3911	0.3146
phi108411	1	AGCT	116	123	2	0.2311	0.2044
phi109275	2				2	0.4800	0.3648
phi109642	8.09	ACGG	133	145	2	0.4898	0.3698
phi233376	7.04	CCG	138	155	2	0.1244	0.1167
phi328175	3.02	AGG	101	130	2	0.4200	0.3318
phi374118	8	ACC	216	230	2	0.4644	0.3566
phi420701	6.01	CCG	279	300	2	0.3911	0.3146
phi423796	2	AGATG	126	139	2	0.4800	0.3648
phi96100	3.09	ACCT	268	297	2	0.4800	0.3648
umc1136	10.07	(GCA)5	135	170	2	0.3578	0.2938
umc1196	1.0000	CACACG	140	160	1	0.0000	0.0000
Mean					2.06	0.33	0.27

Table 2: Mean number of alleles per locus (A) and gene diversity (D) for the individual varieties based on the 18SSR polymorphic markers

Varieties	Major Allele Frequency	Allele No	Gene Diversity
SM12	0.8438	1.3125	0.1563
SM13	0.9375	1.1250	0.0625
SM14	0.8438	1.1250	NaN
SM15	0.8438	1.3125	0.1563
SM16	0.8750	1.2500	0.1250
SM17	0.8125	1.3750	0.1875
SM18	0.7813	1.2500	NaN
SM19	0.8125	1.3750	0.1875
SM20	0.9063	1.1875	0.0938
SM26	0.8125	1.3750	0.1875
SM27	0.7813	1.4375	0.2188
SM28	0.9063	1.1875	0.0938
SM29	0.8125	1.4375	0.2031
SM31	0.8750	1.2500	0.1250
SM11FS	0.8125	1.3750	0.1875
SM12FS	0.9063	1.1875	0.0938
SM14FS	0.7188	1.3750	NaN
SM15FS	0.9063	1.1875	0.0938
SM16FS	0.8750	1.2500	0.1250
SM18FS	0.8438	1.1250	NaN
SM19FS	0.7813	1.4375	0.2188
SM20FS	0.8750	1.2500	0.1250
SM26FS	0.8750	1.2500	0.1250
SM27FS	0.8125	1.1875	NaN
SM31FS	0.8125	1.3750	0.1875
SM17KN	0.7031	1.5625	NaN
SM17SP	0.8438	1.3125	0.1563
SM18KN	0.8750	1.2500	0.1250
SM27SP	0.8438	1.3125	0.1563
SM28KN	0.8750	1.0625	NaN
SM28SP	0.9375	1.1250	0.0625
SM29KN	0.8750	1.0625	NaN
SM29SP	0.9063	1.1875	0.0938
OBA2	0.9375	1.1250	0.0625
OBA5	0.9063	1.1875	0.0938
OBA6	0.8750	1.0625	NaN
OBA7	0.9688	1.0625	0.0313
OBA9	0.9375	1.1250	0.0625
Mean	0.75	2.072	0.33
SD	0.035	0.12	0.032

Table 3: Analysis of molecular variance based on the 18 polymorphic SSR primers for the different sources of seed producers

Source	Sum Of Square	Percentage of variation (%)
Among Populations	44.2954	10.46
Within Population(IARABUZx)	164.3668	38.83
Within Population(KNARDA)	22.1500	5.23
Within Population(PSZx)	19.9500	4.71
Within Population(SPKN)	16.5000	3.90
Within Individuals(IARABUZx)	118.0000	27.88
Within Individuals(KNARDA)	13.0000	3.07
Within Individuals(PSZx)	10.0000	2.36
Within Individuals(SPKN)	15.0000	3.54
Total	423.2622	100

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RELATIONSHIPS OF SOYBEAN (*Glycine Max (L) Merrill*) VARIETIES BASED ON MORPHOLOGICAL AND PHYSIOLOGICAL TRAITS

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ABSTRACT
In soybean breeding, the focus of attention has been developing cultivars with high and stable yield. Genetic diversity evaluation among varieties is importance and a prerequisite in breeding programme. The objectives of this study were to assess the diversity of soybean accessions at morpho-physiological traits and to identify the correlations among the traits. Results show significant variation amongst varieties for most traits. Positive and significant corrections were observed between yield and some morphological traits while the correlation between yield and physiological traits assessed were not significant. The positive and significant correlations obtained from this study can be helpful information for selection in soybean breeding program.
Keywords: Yield, Variation, morpho-physiological traits, soybean varieties.

INTRODUCTION
The soybean (Glycine max (L) Merrill) is the world most important protein crop. Primary centre of soybean origin is North-eastern China (Popovic, 2010). Primary constituents of soybean seed include about 40% protein, 20% oil, 30% of carbohydrates, 10.5% mineral (Osho and Dashiell, 1998). In soybean breeding, the focus of attention has been on developing cultivars with high and stable yield with increase protein, and oil content (Hollung *et al.*, 2005; Violic *et al.*, 2010). Inspite of the best efforts to improve the soybean varieties, the yield of this crop remains low. Several studies have been made to understand their performances which mainly include the contribution of various yield components towards yield (Mehta *et al.*, 2000, Chettri, 2003; Jian *et al.*, 2007). To improve the chances of selection for various characters within the different parent, genetic diversity among genotypes regarding to agro-morphological and physiological characters can be expected to provide information about genetic relationships. The assessment of genetic diversity is important not only for crop improvement but also for efficient management and conservation of germ plasm resources (Tahir *et al*, 2011). In the selection of diverse parental combinations, it is invaluable to estimate accurately the genetic diversity for generating segregated progenies with maximum genetic variability. Since yield is influenced by different characters, selection of yield per se does not give sufficient confidence for selection of genotypes. Hence, agro-morphological and physiological traits and correlation analysis would provide important information about the degree of relationship among important crop traits and can be used as an index to predict the yield response in relation to the change of particular trait. To understand the physiological bases of yield differences among the genotypes in soybean, it is essential to quantify the component of growth and the relevant variables which is useful in crop improvement. Also a number of factors, such as genotype variations have high impact on seed chemical composition (Cicek, 2001). It is important to evaluate agronomic and quality traits and study correlations among the traits. Knowledge of significant correlation either positive or negative between agronomic and quality traits could be of direct use in improving both kinds of traits in soybean. The objectives of this research include; determining variation in morphological and physiological characteristics of selected soybean varieties, the relationship between morphological characteristics, yield and yield components and the relationship between physiological characteristics and yield of selected soybean

MATERIAL AND METHODS
This study was performed on 16 varieties of soybean. The experiment was conducted in June 2012 at the research farm of Michael Okpara University of Agriculture, Umudike. The design was 2 x 6 factorial experiment arranged in a randomized complete block design (RCBD) replicated three times. Soybean varieties used include: NCRI Soy 16, TGX 1831-32F, TGX 1921-4F, TGX 1485-1D, TGX 1908-3F, TGX 1835-1E, TGX 1987-62F, NCRI Soy 8, TGX 1956-1F, TGX 1802-1F, TGX 1448-2F, TGX 1844-4E, TGX 1885-8F, CAMEROON LATE and TGX 1923-2E collected from National cereals Research Institute (NCRI) Badeggi, Niger State. The entries were shown in spacing of 60cm between rows and 20cm between plants. The collected morphological data consisted of plant height (PH), leaf length (LL), number of leaves (NL), number of branches (NB), number of pods per plant (NP), number of seed (NS) per plant, seed size (SS), dry matter weight (DMW), dry seed weight (DSW), dry pod weight (DPW).

In physiological identification, chrolophyll contents were determined using method described by Sartory et al, (1994) using modification by Francis et al, (2007). Leaf area and leaf area index were also determined by disc method (Watson, 1952). Analysis of variance was performed for all traits in order to test the significance of variation among varieties. For statistically different traits ($P \leq 0.05$) means were separated using Standard Error Difference (SED). Correlation analysis was conducted to detect the functional relationships between the yield and other traits. Computations were done using Genstat statistical software and SPSS statistical software version 17.0.

RESULTS AND DISCUSSION

Agro-morphological trait analysis; stem girth (SG) of different soybean varieties ranged from 0.217cm in TGX1831-32F to 0.388cm in CAMEROON LATE (Table 1) and did not differ significantly($p \leq 0.05$). Chiezey and Odunze (2009) reported significantly wider stem girth in fertilized soybean plant compared with the unfertilized plant. Variation in plant height due to variety was not significant). Leaf length of soybean did not vary significantly ($p \leq 0.05$) with variety. Leaf length of TGX 1923-2E was the longest but was not significantly different from those of 5 varieties (Table 1). Number of leaves per plant differed significantly with soybean varieties and ranged from 10.81 cm in TGX 1485-1D to 24.67 cm in CAMEROON LATE, followed by TGX 1923-3E which was significantly leafier compared to other varieties (Table 1). Result also showed that there were no significant differences amongst the varieties in number of branches per plant. Leaf area (LA) ranged from 329 cm in TGX 1831-32F to 536 cm in CAMEROON LATE (Table 1) and varied significantly. Leaf area index (LAI) of the varying soybean varieties ranged from 4.91 cm in TGX 1831-32F to 11.04 cm in TGX 1921-4F (Table 1). Variation in LAI in this result confirms the report of Chiezey and Odunze (2009) who reported that variation in leaf area index of the two soybean varieties indicates more light interception for photosynthetic activity; hence high assimilate accumulation (Chiezey *et al*, 2001). Dry matter of soybean varied significantly ($p \leq 0.05$) with variety (Table 1) and ranged from 6.54 in TGX1831-32F to 17.20 in TGX1844-4E (Table 1). Lui et al, (2004) and DeBruin and Pederson (2008) also reported significant variation in dry matter of soybean varieties in south east China and Lowa USA respectively.

Dry matter production depends largely on solar radiation intercepted over the growing season and interception of radiation depends on leaf area and leaf area index (Chiezey and Odunze, 2009). TGX1844-4E with high dry matter also had large leaf area indicating the influence of leaf area on leaf dry matter. Number of pods per soybean plant differed significantly ($p \leq 0.05$) and ranged from a mean of 18.3 in TGX1835-1E to 53 in CAMEROON LATE (Table 1). Liu et al (2004) also reported significant differences in number of pods of soybean and observed that number of pods were higher in high yielding varieties. The dry pod weight of soybean varieties ranged from 4.79g/plant in TGX1831-32F to 13.06g/plant in TGX1448-2F. The dry pod weight of the sixteen soybean varieties varied significantly ($p \leq 0.05$). Seed size of plant varied from 0.3850 cm in CAMEROON LATE to 0.4867 cm in TGX1956-1F (Table 1). Amadi and Ifenkwe (2001) reported significant differences between seed weight of soybean due to variety effect in a trail conducted at Saminaka Kaduna state while Mohammed et al, (2014) reported none significant variation in seed weights of soybean treated with fertilizer. Number of seeds/plant had significant differences ($p \leq 0.05$) amongst soybean varieties in number of seed per plant. This ranged from 31.8 in NCRI SOY16 to 89.3 in CAMEROON LATE (Table 1). Ikeogu and Nwofia (2013) reported highly significant ($p \leq 0.01$) variation in number of seeds/ plant of soybeans evaluated at Umudike and Amakama. Thangana *et al*, (2013) also reported significant differences in seed number due to variety. Variety effect on seed yield was highly significant ($p \leq 0.05$) with highest yield of 7.95g/plant in TGX1448-2F and lowest of 3.31g/plant in TGX1921-4F (Table 1). Variation in seed yield of soybean has been reported by various authors (Amadi and Ifenkwe, 2001; DeBruin and Pedersen, 2008; Thangana, et al., 2013; Ikeogu and Nwofia, 2013). Yield is a complex quantitative character governed by large number of genes and highly influenced by environment. Hence the selection of superior varieties based on yield is very difficult. For a rational approach towards improvement of yield, selection has to be made for the component of yield. Association of yield components and yield may be assumed as special importance for the bases of indirect selection. Positive and significant correlations were observed between yield and growth traits; LL (0.37*), NL (0.35*), PH (0.34*), SG (0.28*) (Table 2) and between yield and yield components; $DMW_{(g)}$ (0.84*), NFP (0.77*), NP (0.76*), NS (0.85*) Table 3. This suggests that these traits are good attribute for selection for crop improvement.

Physiological Traits Analysis

Three pigments (carotene, chlorophyll a and chlorophyll b) total chlorophyll and total nitrogen were assessed. Result showed that there were significant differences ($p \leq 0.05$) among soybean varieties in each of these attributes. Fritschi and Ray, (2007) separated soybean accessions into distinct groups based on their chlorophyll a/b ratio. However, chlorophyll a was positively and significantly associated ($p \leq 0.05$) with chlorophyll b, total chlorophyll and total nitrogen respectively (Table 4)

CONCLUSION

From the results, leaf length, number of leaf, dry matter weight, dry pod weight, number of filled pods, number of seeds varied significantly ($p \leq 0.05$) soybean varieties. Seed yield showed high positive, significant association with dry matter weight, dry pods, number of seeds, leaf length, number of leaf, plant height and stem girth. This result highly indicated the importance of these characters for selection in soybean improvement. None positive and significant association between seed yield and pigments assessed indicated that chlorophyll is not a direct determinant of yield in soybean.

Table 1: Mean value of some Agro-morphological traits of soybean

Variety	SG	PH	LL	NL	NB	NP	NS	SS	LA	LAI	DMW	DPW	SW
NCRI SOY 16	0.230	20.95	12.83	11.62	1.83	24.6	31.8	0.46	448.7	6.33	9.32	6.85	4.22
TGX 1831 – 32F	0.217	24.50	12.88	10.81	1.50	20.4	35.1	0.45	329.0	4.91	6.54	4.78	3.84
TGX 1921 – 4F	0.232	22.78	12.89	11.12	1.17	25.5	50.1	0.41	429.9	11.04	10.03	6.44	5.08
TGX 1485 – 1D	0.207	20.34	11.48	10.41	2.00	23.7	34.0	0.43	386.1	7.04	8.12	4.69	3.31
TGX 1908 – 3F	0.243	20.68	14.22	12.89	2.50	23.9	37.2	0.45	358.3	7.76	7.88	5.98	3.72
TGX 1835 – 1E	0.225	26.06	13.31	12.00	2.33	18.3	35.3	0.46	431.3	6.06	7.93	6.18	3.80
TGX 1987 – 62F	0.297	22.19	12.33	12.24	2.00	32.8	42.7	0.48	410.1	6.82	10.07	7.89	3.48
NCRI SOY 8	0.267	16.81	14.81	14.74	2.00	27.6	41.3	0.43	417.1	8.06	9.54	6.69	4.37
TGX 1440 – 1E	0.232	16.64	15.15	13.12	1.50	33.5	59.8	0.46	426.7	7.06	9.55	8.95	5.84
TGX 1956 – 1F	0.312	22.53	13.19	14.73	2.67	40.8	66.9	0.49	341.4	6.72	14.87	12.09	8.11
TGX 1802 – 1F	0.240	20.00	10.31	11.84	1.00	24.8	53.2	0.46	448.2	6.49	10.65	8.37	5.15
TGX 1448 – 2F	0.240	22.57	12.47	13.01	2.00	40.7	68.5	0.43	410.8	6.86	14.45	13.06	7.07
TGX 1844 – 4E	0.333	20.58	17.71	13.84	2.00	40.2	77.2	0.48	471.9	10.95	17.20	11.57	7.95
TGX 1885 – 8F	0.253	18.48	15.39	13.89	0.33	34.8	56.2	0.44	503.4	8.74	11.42	8.66	6.56
CAMEROON LATE	0.388	24.63	16.88	24.67	1.00	53.0	89.3	0.39	536.8	8.82	14.57	11.72	6.58
TGX 1923 – 2E	0.370	26.39	19.37	19.67	1.00	46.8	80.8	0.48	466.5	9.24	11.03	11.03	7.80
SED (Variety)	0.0673	1.042	2.43	2.345	0.851	7.35	13.21		33.62	0.687	2.658	1.905	
CV %	43.5	32.6	29.9	29.5	12.9	39.8	42.6		13.7	15.5	42.5	39.1	

SG- stem girth, PH- plant height, LL- leaf length, NL- number of leaf, NB- number of branch, NP- number of pod, NS- number of seed, SS- size of seed, LA- leaf area, LAI- leaf area index, DMW- dry matter weight, DPW- dry pod weight, SY- seed yield.

Table 2: Correlation coefficients between seed yield and growth traits of soybean

Growth Parameters	Correlation coefficients					
LA/P	0.02					
LAI	0.13	0.77*				
LL	0.37*	0.08	0.16			
NB	0.16	0.08	0.06	0.35*		
NL	0.35*	0.27*	0.22*	0.61*	0.52*	
PH	0.34*	0.09	0.15	0.62*	0.45*	0.70*
SG	0.28*	0.16	0.16	0.63*	0.68*	0.78*	0.62*
	SY	LA/P	LAI	LL	NB	NL	PH

* $P \leq 0.05$, Number of observations: 96, LA/P (Leaf area /plant), LAI (Leaf area index), LL (Leaf length), NB (Number of branches), NL (Number of leaves), PH (Plant height), SG (Stem girth), SY (Seed yield).

Table 3: Correlation between seed yield and yield traits of soybean

Plant Attribute	Correlation coefficients									
LA/P (cm^2)	0.02									
DM (g)	0.80*	0.01								
DPW (g)	0.84*	0.12	0.84*							
LAI	0.13	0.74*	0.10	0.13						
NFP	0.77*	0.10	0.77*	0.81*	0.13					
NP	0.76*	0.05	0.75*	0.79*	0.11	0.95*				
NS	0.85*	0.07	0.79*	0.82*	0.14	0.83*	0.82*			
NUP	0.09	-0.01	0.18	0.14	0.11	0.17	0.28*	0.11		
PL	0.17	0.07	0.15	0.16	0.01	0.12	0.11	0.15	-0.02	
SS	-0.13	-0.12	-0.12	-0.17	-0.07	-0.15	-0.16	-0.21*	-0.01	-0.01
	SY (g)	LA/P (cm^2)	DM (g)	DPW(g)	LAI	NFP	NP	NS	NUP	PL

* $P \leq 0.05$, Number of observations: 96; SY (Seed yield/plant), LA/P (Leaf area / plant), DM (Dry matter/plant), DPW (Dry pod weight/plant), LAI (Leaf area index/plant), NFP (Number of filled pods/plant), NP (Number of pods/plant), NS (Number of seeds/plant), NUP (Number of unfilled pods/plant), PL (Pod length), SS (Seed size)

Table 4: Correlation coefficient between yield and chlorophyll parameters

Pigments	Simple correlation coefficients				
Carotene (ug/g)	-0.09				
Chlorophyll a (ug/g/few)	0.11	0.10			
Chlorophyll b (ug/g/few)	-0.01	0.12	0.63*		
Total chlorophyll (ug/g/few)	0.05	0.12	0.91*	0.90*	
Total nitrogen (%)	-0.08	-0.05	0.75*	0.70*	0.80*
	Seed yield	Carotene (ug/g)	Chlorophyll a (ug/g/few)	Chlorophyll b (ug/g/few)	Total chlorophyll (ug/g/few)

* P≤0.05; Number of observations: 48

None of the coefficients for all the pigments assessed was significantly correlated with yield (Table 5) indicated that chlorophyll did not affect yield and as such not attribute for selection in crop improvement in soybean.

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IMPROVING ROOT YIELD AND TOTAL CAROTENOID CONTENT OF ORANGE FLESHED SWEETPOTATO USING INTEGRATED NUTRIENT MANAGEMENT

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ABSTRACT
This study was conducted to determine the effect of integrated nutrient management on root yield and total carotenoid content of orange fleshed sweetpotato at Umudike Southeastern Nigeria. The experiment was a 5x4 factorial laid out in randomized complete block design (RCBD). The treatment comprises of five levels of composite manure (Pig manure, cowdung and poultry manure) applied at the rate of 0, 2, 4, 6 and 8t/ha and mineral fertilizer (NPK 15:15:15) applied at the rate of 0, 200, 400 and 600kg/ha. Combined application of mineral fertilizer and composite manure significantly (p<0.05) increased the total and marketable root yield of orange fleshed sweetpotato. Application of 4t/ha composite manure + 400kg/ha NPK gave the highest root yield of 15.90t/ha relative to control. The carotenoid content increased generally with increasing rate of the treatment combinations with application of 8t/ha composite manure + 200kg/ha NPK giving the highest total carotenoid content of 733.2µg/g. From the results obtained, application of 4t/ha composite manure + 400kg/ha NPK is recommended for good root yield while application of 8t/ha composite manure + 200kg NPK is recommended for farmers who wish to improve the carotenoid content of orange fleshed sweetpotato.
Keywords: Composite manure, mineral fertilizer, root yield, orange fleshed sweetpotato and carotenoid

INTRODUCTION

The orange-fleshed sweet potato varieties are gaining great attention as a means of reducing common health related problems in low income communities associated with vitamin A deficiency. The varieties are believed to be the least expensive source of dietary vitamin A available to poor families (Laure *et al*, 2013). This is due to their high nutritive value of beta-carotene content, a precursor to vitamin A synthesis (Ukpabi *et al*, 2012). The high yielding orange-fleshed sweet potato varieties are fertilizer responsive (Nedunchezhiyan *et al*, 2010). Applications of inorganic fertilizers have been reported to increase root yield (Nedunchezhiyan and Reddy, 2002). But hampers the quality of sweet potato (Nedunchezhiyan *et al*, 2003). Better sweet potato root quality was observed at optimum amount of nitrogen supply especially through organic sources (Nedunchezhiyan *et al*, 2003). B-carotene content of the root though governed by the genetic factor, Agronomic factors like source and quantity of nutrients significantly influenced the content (Nedunchezhiyan, *et al*, 2010). According to Nedunchezhiyan and Reddy, (2002), sweet potato gets nutrients throughout the growing period when there is integrated use of inorganic (immediately available) and organic (slow mineralisation) source of nutrients which leads to higher yield attributes. However, there is limited information on the integrated use of Composite manure (poultry manure, Cowdung and swine waste) together with mineral fertilizer on improving the root yield and total carotenoid content of orange fleshed sweetpotato in southeastern Nigeria.

MATERIALS AND METHODS

The experiment was conducted at the Research farm of National Root Crops Research Institute Umudike, southeastern, Nigeria. The experiment was a 5x4 factorial laid out in Randomized Complete Block Design (RCBD). The plot size measures 3m x 3m with 0.5m separating the plots and 1m separating the replicates. Materials for the experiment comprises of Composite manure (cowdung, poultry droppings, pig manure) and mineral fertilizer (NPK 15:15:15). Equal weights (72kg each) of the three animal manures were bulked together and applied to the plots at the rate of 2, 4, 6 and 8t/ha with 0t/ha as control. They were factorially combined with 0, 200, 400 and 600kg/ha of NPK 15:15:15 giving a total of 20 treatment combinations replicated three times. The animal manures were applied to the plots one week before planting. While mineral fertilizer was applied at 4 weeks after planting. The test crop orange fleshed sweet potato variety Umuspo 1 was obtained from sweetpotato programme of NRCRI, Umudike. All agronomic practices recommended for sweetpotato production were carried out.

The storage roots were harvested at 16 weeks after planting and graded based on weights as Marketable roots (>100g), unmarketable roots(<100g)(Levett,1993).The total root yield was also computed. The carotenoid analysis was done using the method described by Rodriguez-Amaya and Kimura (2004) and calculated using the formula:

Total carotenoid µg/g = {[$A^{1\%}$ x volume (ml) x 104 x DF]/ [A12 1cm x Weight of sample]}

Where:

A: = Absorbance

Volume: Total volume of extract

$A^{1\%}$ 1cm: Absorbance coefficient of β- Carotene in petroleum ether (2592).
DF = dilution factor and multiplied by 100 to get the carotenoid content in μg/100g. Statistical analysis of data generated was performed using Genstat Discovery Edition using the procedures of factorial experiments. Significant means were separated using Fishers least significant difference (F-LSD) at 5% level probability.

RESULTS AND DISCUSSION

Effect of composite manure and mineral fertilizer on the total root yield orange fleshed sweet potato.

The result of the effect of composite manure and mineral fertilizer on the total root yield of orange fleshed sweet potato is presented in table 1. The results obtained showed that the interaction of composite manure and mineral fertilizer significantly ($p<0.05$) increased the total root yield of orange fleshed sweet potato relative to the control. The highest mean root yield of 15.90t/ha was recorded with the application of 4t/ha composite manure + 400kg NPK. The higher root yield obtained with the application of composite manure and mineral fertilizer in this study might be as a result of improvement in the physicochemical properties which leads to the release of nutrients for crop uptake. Similar results were reported by Agyarkor *et al*, (2014) with incorporation of organic manure and NPK on sweetpotato yield; Akinmutimi, (2014) with application of Cocoa pod husk ash and NPK on the yield of sweetpotato; Onunka *et al*, (2012) with application of organic and inorganic manures on root yield of sweet potato; Asawalam and Onwudiwe, (2011) with complementary use of Cow dung and mineral fertilizer on sweet potato; Yeng *et al* (2012) with integrated application of chicken manure and inorganic fertilizer on growth and yield of sweet potato.Santhi and Selvakumari (2000) have proposed that the addition of organic manure sources to chemical fertilizer could increase the yield of crops through improving soil productivity and higher fertilizer use efficiency.

Marketable Root yield

The results of the effect of composite manure and mineral fertilizer on the marketable root yield of orange fleshed sweetpotato are presented in table 2. The interaction of composite manure and mineral fertilizer significantly ($p<0.05$) improved the marketable root yield of orange fleshed sweet potato relative to the control. The highest marketable root yield of 13.97t/ha was obtained with the application of 4t/ha composite manure +400kg NPK. The improved marketable root yield obtained with the combination of composite manure and mineral fertilizer could be as a result of improved soil physicochemical properties leading to the release of nutrients for the uptake by the sweet potato. The result is in line with similar results by Yeng *et al*, (2012) who obtained higher marketable root yield of sweet potato with integrated application chicken manure and inorganic manure. Hartemink, (2003) reported poultry manure in combination with mineral fertilizer increased the marketable root yield of sweetpotato.

Effects of composite manure and mineral fertilizer on the carotenoid content of orange fleshed sweet potato

The results of the effect of organic manure and mineral fertilizer on the carotenoid content of orange fleshed sweet potato are presented in table 3. The result shows that the application of organic manure singly and its combination with NPK significantly ($p<0.05$) increased the carotenoid content of orange fleshed sweet potato. The highest carotenoid content of 733.2 ug/g was obtained with the application of 200kg/ha NPK with 8t/ha of organic manure. Applications of organic manure singly at 8t/ha gave a total carotenoid content of 726.6 ug/g. The increase in the carotenoid content might be due to increased soil fertilization. Similar results were reported by Gichuhi *et al*, (2013) with application of different rates of broiler litter on Beauregard sweet potato; Moumouni *et al*, (2013) with application of organic and mineral fertilizers on antioxidants, polyphenolic and carotenoid contents of orange fleshed sweet potato; Neduchezhiyan *et al*, (2010) with application of farmyard manure in sweet potato; In addition kipkosgei *et al*, (2003) working with black night shade observed that B-carotene content was significantly increased depending on the type and the level of fertilizer applied. Nedunchezhiyan *et al*, (2010) noted that B-carotene content though governed by the genetic factor, agronomic factors like source and quantity of nutrients significantly influenced the content. Also the increase in the carotenoid content of the orange fleshed sweetpotato might be as a result of improvements in the total nitrogen contents of the soil. Ukom *et al*, (2009) reported that N fertilizer application significantly increased the carotenoid and crude protein content of sweetpotato with increasing N application up to 120 Kg/ha.

Table 1: Effect of composite manure and mineral fertilizer on the total root yield of orange fleshed sweet potato (t/ha)

	Composite Manure (t/ha)					
NPK(kg/ha)	**0**	**2**	**4**	**6**	**8**	**Mean**
0	7.83	11.37	13.17	11.67	10.70	10.93
200	8.30	12.07	13.13	12.37	12.27	11.63
400	11.53	13.73	15.90	9.93	12.00	12.62
600	14.93	10.47	9.13	13.13	14.83	12.50
Mean	10.65	11.91	12.83	11.78	12.45	

LSD (0.05) organic manure=N.S
LSD (0.05) NPK=N.S
LSD (0.05)0rganic manure x NPK=4.387

Table 2: Effect of composite manure and mineral fertilizer on the marketable root yield of orange fleshed sweet potato (t/ha)

	Composite Manure (t/ha)					
NPK(kg/ha)	**0**	**2**	**4**	**6**	**8**	**Mean**
0	6.90	9.43	11.70	9.10	8.93	9.21
200	7.43	9.70	11.60	10.70	10.27	9.94
400	11.07	12.97	13.97	7.57	10.00	11.11
600	13.90	8.93	7.83	11.20	12.67	10.91
Mean	9.82	10.26	11.27	9.64	10.47	

LSD (0.05) Composite manure = N.S
LSD (0.05) NPK = N.S
LSD (0.05) Composite manure X NPK = 4.375

Table 3: **Effect of composite manure and mineral fertilizer on the carotenoid content of orange fleshed sweet potato (µg/100g)**

	Composite Manure(t/ha)					
NPK(kg/ha)	0	2	4	6	8	Mean
0	566.9	619.4	636.0	696.6	726.6	649.1
200	468.5	583.9	656.8	702.2	733.2	628.9
400	595.6	519.4	612.1	679.0	705.0	622.2
600	639.8	490.8	602.6	628.5	681.1	608.6
Mean	567.7	553.4	626.9	676.6	711.5	

LSD (0.05) Composite manure = 37.89
LSD (0.05) NPK = N.S
LSD (0.05) Composite manure X NPK = 75.78

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PESTICIDES AND SAFE FOOD CROPS PRODUCTION IN NIGERIA

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ABSTRACT
The use of pesticides in crop production is sine-qua-non to accelerated food production despite its danger to humans, environment etc. Pesticides can be safe if they are used carefully for prescribed purposes and by trained hands. This paper reviews the benefits of pesticide usage in crop production and measures necessary for the production of safe food crops for local consumption and export.
Keywords: Pesticides, Safe food and Crops

INTRODUCTION
In Nigeria, it is estimated that crop losses due to pests and diseases of some cultivated crops are within the range of 10-100% (Table 1). Besides, average losses due to storage pests have been estimated at 30% (Ezueh, 1983; Anyim, 2013) and in severe cases may lead to as much as 100% damage (Egwuatu, 1986; Anyim, 2013). These losses in most cases begin with the sowing of the seed and continue throughout the phases of production, storage and processing. The huge losses attributable to these pests aggravate the food deficit situation in Nigeria and elsewhere and drastically reduce the financial returns to farmers and their export earnings. Consequently, this precarious situation has often called for the use of plant protection measures, especially synthetic pesticides which have been valued for their effectiveness. Hence, the apparent stability in the world's food crop production is attributable to the use of pesticides to check the ravaging effect of the different types of pests and diseases on crops and crop products (Amadioha *et al*, 2004). Pesticides can be defined as substances or mixture of substances for preventing, destroying, attracting, repelling, or controlling any pest including vectors of human or animal disease, unwanted species or plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport or marketing of food, agricultural commodities, wood and wood products or animal feed stuffs, or substances which may be administered to animals for the control of insects, arachnids or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deteriorating during storage and transport. The term normally excludes fertilizers, plant and animal nutrients, food additions, and animal drugs (FAO, 2007). Table 2 lists the most important groups of pesticides currently used for pests control in crop production. These pesticides contain nerve poisons of the organochloride, organphosphaste, carbamate and pyrethroid groups. They affect a wide range of pests. However, in recent years, highly active pyrethroids have been developed, replacing the more toxic organochloride, organophosphate and carbamate products. However, if not properly used, pesticides can cause serious problems, foremost among these is toxicity with an estimated 3,000,000 or more cases of pesticide poisoning annually, 20,000 of which proved fatal and cause pollution of soils, water and air, with as yet unknown long term consequences for human, wild life and the environment (Emeribe, 2008). On the other hand, pesticides can be safe if they are used carefully as prescribed (Amadioha *et al,* 2004).

Table 1: Estimates of crops losses due to pests and diseases of the principal food crops in Nigeria.

CROP	% Losses caused by	
	Pests	**Diseases**
Cereals	15 – 25%	10 – 20%
Grain Legumes	10 – 95%	_
Roots & tubers	12 – 90%	20 – 100%

Source: Adapted from Anyim, 2004

Table 2: Major Chemical groups of pesticides used in crop production

S/N	Chemical Group	Action and effects	Examples (trade name)	Rate (g ai/ha)	Activity
1.	Organo-Chlorines	Nerve poison. Damages fat layer around nerve fibre. Muscle convulsions; internal organ functions disrupted	Endosulfan (Thiodan, Thionex) gBHC (Gammalin)	750 1000	Stomach, contact; broad spectrum Stomach, contact; broad spectrum, persistent.
2.	Organo-Phosphates	Nerve poison. Anticholinesterase; Muscle convulsions; Internal organ functions Disrupted	Monocrotophos (Nuvarcon, Azodrin) Pirimiphos-methyl (Actellic) Dimethoate (Rogor, Perfecktion)	500 500 Seed 10 ppm 400	Contact, systemic, broad spectrum Same same
3.	Carbamates	Nerve poison. Anticholinesteerase. Muscle convulsions; Internal organ functionsdisrupted	Carbofuran (Furadan) Pirimicarb (Pirimor)	500 200	Contact, systemic; Broad spectrum. Contact, fumigant; Specific aphicide.
4.	Pyrethroids	Nerve poison. Damages fat layer around nerve fiber. Muscle convulsions; Internal organ functions disrupted.	Cypermethrin (Cymbush, Sherpa,) fenvalerate (Sumicidin) Deltamethrin (Decis)	50 100 12.5	Stomach, contact; broad spectrum. Same Same.

Source: IITA, 1995; Anyim, 2013

Rationale for the use of pesticides in food crops production

According to the population projections of the World Bank, the world's population will increase from 6 billion in 1999 to 7 billion people in 2020 (Anyim, 2013). Absolutely, the consequences of the population's increase will not be far-fetched since all these people will also have to be housed, dressed and, above all, to be fed. Therefore, to narrow the gap between food production and human population growth in Nigeria, pesticides have remained a veritable instrument in farmers' effort to contend with pests and their consequent reduction in food production (Anyim, 2013). It is also important to note that in 2006 and 2007, the world used approximately 5.2 billion pounds of pesticides, with herbicides constituting the biggest part of the world pesticide use at
40%, followed by insecticide (17%) and fungicides (10%) (EPA, 2007). The U.S used approximately 1.1 billion pounds of pesticides, accounting for 22% of the world total (EPA, 2007).

Benefits of using pesticides

The overall benefits of using pesticides to control the various pest species and diseases of food crops in Nigeria and elsewhere cannot be over emphasized. Even though, recently, both the public and press have increasingly focused on the negative impacts of agricultural, urban, industrial and residential pesticides. However, there are substantial benefits to farmers and indeed, the society. The benefits are of two levels – primary and secondary. The primary benefits are direct gains from the use of pesticides while the secondary benefits are effects that are more long term (Cooper and Dobson, 2007).

Primary Benefits

(a) Pesticides are the most effective means of controlling pests and plant disease vectors in many circumstances. Pesticides can save farmers' money by preventing crop losses to insects and other pests. It permits more and crops varieties to be grown, reduces manpower requirements, mechanical cultivation, saves time, save cost etc (Emeribe, 2008). For example in the U.S, farmers get an estimated fourfold return on money they spend on pesticides (Helfrich *et al* 1996). Kunicki (2001) also found that not using pesticides reduced crop yields by about 10%. Similarly, in Nigeria, Anyim (2003) found that insecticides significantly increased the yield of soybean with 48% yield reduction in the control. Also. Ogunwolu (1992) found out that insecticide application significantly reduced pod and seed damage and consequently increased the seed yield of cowpea.

(b) Pesticides help to control human and livestock disease vectors and nuisance organisms. For example, they are used to kill mosquitoes that can transmit potentially deadly diseases like West Nile virus, yellow fever and malaria. Pesticides can protect animals from illness that can be caused by parasites such as fleas. Pesticides can prevent sickness in humans that could be caused by mould food or diseased produce.

(c) Pesticides protect private, public and commercial buildings from structural damage associated with termite infestations. Uncontrolled termites can damage structures such as farm houses etc.

(d) Pesticides are used in grocery stores and food storage facilities to manage rodents and insects that infest food such as grain.

Secondary effects

(a) Pesticides usage enhances farm and agribusiness revenues in our communities. Invariably, the nutrition and health of our people will be improved while food safety and security are assured.

(b) Nationally, the workforce productivity and export revenue increases. Government may be partially dependent upon the jobs and tax base that pesticide manufacturers, distributors, dealers, commercial applicators and farmers provide.

(c) In the long run, the use of pesticides stabilizes the national crop production which will in turn shape the national agricultural economy.

Risks involved in pesticide usage

Although there are human benefits to the use of pesticides, some also have drawbacks, such as potential toxicity to humans and other animals. According to the Stockholm Convention on Persistent Organic Pollutants, 9 of the 12 most dangerous and persistent organic chemicals are pesticides.

Therefore, Pesticides if incorrectly used can:

(a) **Be of potential hazard to the user, general public and animals including livestock**

Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems and also causing cancer. Moreso, since chlorinated hydrocarbon pesticides, dissolves in fats and are not excreted, organisms tend to retain them almost indefinitely (Anyim, 2013).

(b) **Cause damage to the local ecology and environment**

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil (Miller, 2004). Pesticides are carried by wind to other areas, potentially contaminating them. In addition, pesticide use reduces biodiversity and nitrogen fixation destroyed habit (especially for birds) (Palmer *et al* 2007) and threatens endangered species (Miller, 2004).

(c) **Damage beneficial organisms**

There is a wide range in the toxicity of pesticides to various natural enemies. So, if a choice is available, opt for the one that is least toxic to important natural enemies. Also, pesticide use contributes to pollinator decline (Haefeker, 2000; Hackengberg, 2007).

(d) **Encourage pest resistance**

Pests can develop resistance to the pesticide when used continually and the pest becomes immune to it, necessitating a new pesticide. Alternatively, a greater dose of the pesticide can be used to counteract the resistance, although this will cause a worsen of the ambient pollution problem. The development of resistance is due to selection of resistant individuals from populations in each succeeding generation and the gradual genetic development of resistant strains.

Measures Necessary for Safe Crop Production

There is no doubt that the use of pesticides in crop production is sine-qua-non to accelerated food production. However, it has been noted with utmost interest that outside its valued effectiveness, pesticides poses great danger to humans, environment and especially food production. Therefore, to avert the adverse side effects of pesticides on crop production, the following measures must be adopted.

(a) **Use of genuine pesticides**

I advocate that pesticides dealers or Crop Life Nigeria accredited distributors to ensure its genuineness. That is why it is conventionally recommended that pesticide users must not buy pesticide which does not have a label or National Agency for Food Administration and Control (NAFDAC) registration number printed on the label. The product label indicates direction for use, protective equipment to be used, active ingredients of the product, WHO hazard symbols, warnings, date of manufacture, date of expiration etc.

(b) **Correct use of pesticides**

It is of paramount importants to note that pesticides exclusively meant for field application must not be used on stored foods, especially grains. Although stored products pesticides may be a bit expensive, but it is advisable to use them in storing grains since they are safer to use for that purpose and will not pose problems to the user and eventual consumer of the grains if all necessary precautions are fully obeyed (Okunade, 2006).

(c) **Use of certified pesticide applicators**

It is unfortunate to note that some untrained hands have infiltrated fumigation programmes in agricultural farms and residential areas. I suggest that relevant Ministries, Institutions, Agencies such as the State Ministries of Agriculture, the Federal Ministry of Agriculture and Rural Development (FMARD), Research Institutes, Universities of Agriculture etc should mount qualitative training programmes for pesticide users and applicators. At the end, only certified applicators, who have passed an examination may purchase or supervise the application of pesticides, especially restricted ones.

(d) **Enforcement of ban on banned, restricted and adulterated pesticides**

The Consumer Protection Council (CPC) and NAFDAC should intensify efforts and expand their dragnet to ensure that all banned, restricted and adulterated pesticides are not used in crop production. Agricultural dealers, farmers or pest control agents found marketing or using these products should be prosecuted according to the existing laws, if any. Also, all registered pesticides should be renewed every 15 years to ensure they meet the proper standard.

(e) **Effective use of Agricultural Extension Agents to disseminate proven pest control technologies**

Currently, the Agricultural Development Programmes (ADPS) in the country are running a Unified Agricultural Extension System, in which case, every aspect of agriculture is covered. These trained Extension Agents should be empowered by the various state governments to extend effectively proven pest control technologies, especially on safe use of pesticides by farmers. Besides, with the training they have received, the Extension Agents are in a better position to discourage farmers or consumers and indeed, the general public from eating treated seeds, meant for planting and so on.

(f) **Observing the appropriate waiting period for pesticides to degrade**

It is not advisable to consume grains treated with pesticides immediately because of the inherent toxic effect. The truth is that consumers must wait for a particular period of time before consumption, this is called waiting period and the length of this period depends on the type of pesticide used, mode of the application etc. (Okunade, 2006). For example grains treated with pirimiphos methyl should be left for at least 6 weeks while grains treated with only fumigant (e.g Aluminium phosphide) could be consumed after exposure to air for about 4 hours and the content of the piece of paper/cloth removed.

(g) **Establishment of maximum residue levels (Tolerances) of pesticides**

The tolerance level of the different classes of pesticides must be established at registration to guide scientists, plant protectionists, farmers, pesticide applicators etc. Therefore, NAFDAC should use all the necessary tools at its disposal to ascertain the maximum amount of pesticide residue that may legally remain on or in treated crops.

(h) **Rodent poisons should not be used near stored grain**

Rodents are mobile creatures and can poison the food by walking over poison and after that spreading it over the food, if it is kept near it. Under normal conditions, acute poison must be used outside, not in stores containing foodstuffs. Besides, acute poison must be handled by an experienced person, who is aware of the precautions to be taken to avoid accidents. More so, other workers or occupants in the stores should be duly informed before placing poison baits. Dead rodents should be removed immediately with the aid of suitable materials to avoid contact with bare hand. It is also necessary to keep rodent poison away from the reach of children. However, I advocate that rodent poison can be used only when other means (hygiene, rodent-proofing, trapping etc) have failed.

(i) **Use of alternatives to synthetic pesticides**

Currently, the use of alternatives to synthetic pesticides is being advocated for safe crop production. Miller (2004) noted that alternatives to pesticides are available and include methods of cultivation, use of biological pest control (such as pheromones and microbial pesticides), genetic engineering and methods of interfering with pest breeding. The use of alternative to pesticides has been effective in some countries. For example, Sweden has halved its use of pesticides with hardly any reduction in crop yield. In Indonesia, farmers have reduced pesticides use in rice fields by 65% (Miller, 2004).

(j) **Applying Good Agricultural Practices (GAP) to integrated pest management (IPM)**

GAP from crop production perspective, incorporates the use of all proven crop husbandry techniques in such a combination as to enhance the optimum crop production. Consequently, its application in IPM will minimize the effect of pest damage by a combination of cultural, biological and chemical control, use of quality tested and NAFDAC registered pesticides, well timed, accurately applied, at Economic Threshholds (ETs) which is the population density at which control measures should be initiated to prevent pest population from reaching the economic injury level. (Fig. 1).

The economic injury level (EIL) is the population density that will cause economic damage (Fig. 1) while economic damage is the amount of injury which will justify the use of artificial control measures. Thus, below ET, the target population is economically innocuous while at ET, the population attains pest status, requiring crop or grain protection measures. Thus, IPM aims at developing non chemical methods of pest control which are environmental safe and less disruptive of the ecological system while at the same time enhancing sustained safe crop yield.

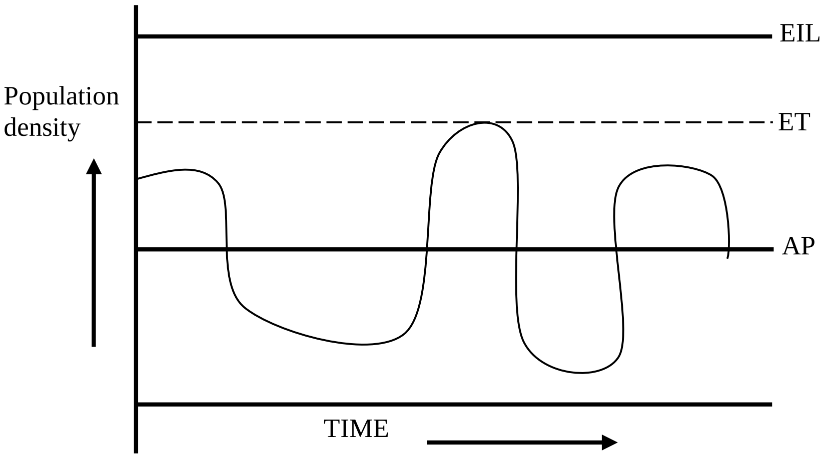

Fig.1: Pest population oscillations in a habit.
Legend
EIL-Economic injury level
ET-Economic threshold
AP-Average population

(k) **Obeying rules governing pesticide application in the field or store**

To ensure good results with minimum risk every pesticide applicator must obey and take the following rules into consideration:

i. Wearing of protective clothing (high cotton overall, gloves, boots etc)
ii. Following instructions given on the label religiously
iii. Making sure that the spray tank rests comfortably on your back for every work.
iv. Keeping weather conditions in mind to avoid spray drift.
v. Spraying should be done either in the morning or in the evening since there is less wind and spray solution less likely to evaporate.
vi. Spraying should be done at the time of the day at which organism to be destroyed is most active.
vii. Keeping other people and animals away from the area when spraying. Besides, when working with moderately toxic to extremely toxic pesticides, it is advisable to work in pairs so that help can be summoned promptly in the event of an accident.
viii. If a spray nozzle becomes blocked during use, never blow it clear by mouth. Clear it with brush or with water.
ix. Never eat, drink or smoke when applying a pesticide.
x. After application any remaining spray solution which is not needed to treat other fields should be sprayed onto a field which has already been treated.
xi. Tidy the environment. Do not leave empty containers well sealed after use and then safely stored away, especially out of reach of children.
xii. Spraying equipment (e.g. Knapsack CP15 etc) and protective clothing should be well cleaned after use and allowed to dry.
xiv. Wash yourself with soap and water.
xv. Keep record of which fields have been sprayed and when.
xvi. Also, take into consideration the safety period between spraying and harvesting etc.

CONCLUSION

The whole effort, so far, has been to highlight the rationale for using pesticides in crop production, its threat to life and measures that will ensure the production of safe food.

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EFFECT OF STAKE LENGTH AND TIME OF HARVEST ON THE PERFORMANCE OF IMPROVED CASSAVA VARIETIES IN UMUDIKE SOUTH EASTERN NIGERIA

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ABSTRACT

The experiment was conducted in 2015 cropping season at National Root Crops Research Institute Umudike to evaluate the effect of different stake lengths, varieties and time of harvest on root yield and some morphological traits of Cassava. The need for increased planting material for farmers and the continuous emergence of new improved cassava varieties call for low cost low impute technology to supply the farmers need hence this experiment. There were two stake lengths, three varieties and two time intervals of harvest. Stem girth, plant height, root yield were some of the parameters used to evaluate their performance. The results showed that stem girth of the varieties differed significantly and increased significantly with time of harvest (p< 0.05). Stake length, time and their interaction significantly affected final height at harvest. Time of harvest and variety positively influenced stem girth while stake length and time of harvest positively influenced root yield. It was concluded that time of harvest and variety are important variables for consideration for increasing planting materials for farmers and that cassava stakes should be harvested from 12 MAP. From this trial also TME 419 is recommended for increased cutting production when planted with full stake length (25 cm) or medium (12.5cm) stake length in a slanting position.

Keywords: Stake Lengths, Cassava Varieties, time of Harvest and Roots

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is the 5th most important food crop in the world and most important source of energy in the diet of Africans. Nigeria is the largest producer of the crop in the world with over 45 metric million tons (FAOSTAT). It has its origin from South America. The importance of Cassava cannot be over-emphasised; it provides food for over 800 million people (FAO, 2007). Because of its relatively high productivity under conditions of erratic rainfall and low soil fertility, about 250 million Africans depend on it as food. In 2007 more than 117 million tons was produced in Sub Saharan African and used for fresh consumption and processed foods (Phillips et al., 2006). Seeds are the foundation of Agriculture and the most important input. In Nigeria seed industry is still developing especially in crops like cassava whose botanical seeds are not consumed nor popularly used for planting. According to Ekwe (2012), most private companies seem not to be interested in the multiplication, distribution and marketing of cassava varieties. Cassava, being vegetative propagated, has a relatively low multiplication ratio and thus cannot compete vigorously with grain crops, which have very high multiplication ratios. One cassava plant can only generate about 10 stem cuttings (IITA 1998). Also, the one-year-long period of producing cassava planting materials has a comparative cost disadvantage over that of the grain seeds, which are produced in 3-5 months. Furthermore, the large hectares required to produce substantial quantities of cassava stems as well as the bulkiness of the planting materials usually require significant sums of money for transportation which often discourage private companies from investing in production, distribution and marketing of cassava stem cuttings to rural farmers. The need for more improved methods to increase cassava production to reduce the above impediments should be a continuum in research. Rapid multiplication of cassava cuttings using 2-3 nodes requires administering some preventive chemical treatments on the stems against diseases and pests, preliminary nursery care, transplanting of the sprouted stakes and efficient management. Use of half of the recommended stake length of 25cm and comparing the performance when harvested over time intervals becomes a viable option as it does not involve the above mentioned processes. Stake lengths are known to influence the yield of the crops in terms of planting materials and consumable roots (Anselem *et al*., 2000) Variations in yield of different cassava varieties have been reported (Richardson, 2011.) Investigations on the effect of stake length, orientation and variety on yield have been carried out by different researchers giving various results, without recourse to time of harvest. Time of harvest is known to play an important role in the performance of cassava. Cassava is said to be ready for harvest after six or seven months from the time of planting depending on variety and the purpose of harvest. Ebah-Djedji *et al*, (2012,) reported that harvest period has effect on starch dry matter from the tuberous roots of improved cassava varieties. The objective of this work is therefore to determine the performance of new varieties of cassava when planted with half of the recommended stake length and harvested at two different time intervals on root yield and some morphological traits.

MATERIALS AND METHODS

The study was carried out at block A3 western farm of National Root Crops Research Institute Umudike. Umudike located on latitude 4° 15' and 7° N and longitude 52° 91'and 7° 33' E of the equator with an elevation of 122m above sea level. The site of the experiment was slashed, ploughed, harrowed and ridged The blocks used for this research work was maintained in a two year rotation but in the penultimate year the block was planted with cassava and fertility enhanced by inorganic fertilizer. The dominant weed on the land before clearing was *Panicum maximum,* the pre planting soil analysis was also done but not presented .The soil is moderately acidic high in organic matter with appreciable percentage base saturation and classified sandy clay loam. The experimental design was Randomized Complete Block design in a factorial fashion. The factors were: two stake lengths of 25cm and 12.5cm, respectively, 3 varieties of cassava namely NR8082, TME419 and Umucas 37 designated v1, v_2, v_3, and two times of harvest 10 and 12 months after planting (map) also designated T_1 and T_2. The stake lengths were designated F (25cm) as the recommended and M (12.5cm) as medium, half of the recommended length. The experiment was replicated three times. The plot length was $16m^2$. Each cutting was inserted into the soil at the crest of the ridge with about one third of the cutting above the ground at an angle of about 45^0 .The planting distance was 1m within the plants and between the rides giving a population of ten thousand plants ha^1. The experiment was planted on 3rd June 2015, germination count was taken on 17th of June 2015, weeding was done on 22nd July while fertilizer (NPK 15:15:15) was applied on the 29th of July 2015 (8wap) at the rate of 600kg/ha. The second weeding was done followed by under-brushing. Data were taken on root weight (kg/plot), plant height (cm), saleable root number, total root number, stem girth and stem yield. Root and stem yields were taken from the entire plot (gross) while eight stands were randomly selected and measured for the stem girth. Data collected were subjected to analysis of variance (ANOVA) according to the procedure for RCBD experiment using Genstat discovery edition.

RESULTS AND DISCUSSION

Stem Girth

The effect of stake length and time of harvesting on stem girth of three varieties of cassava is shown on table 1. The result showed that stem girth of the varieties differed significantly and increased significantly with time of harvest ($p< 0.05$). The interaction between stake length and variety was also very highly significant. There was no significant difference in girth between the two stake lengths. The interaction between stake length time and variety were not significant ($p<0.05$). Stem girt is one of the most neglected parameters for the assessment of the performance of cassava in the field. This accounts for how resistant the stem can be to moisture loss which increases root initiation and subsequent survival of the plant. It has been reported that the root yield of the cassava stem is positively related to the stem girth (Eke Okoro et al., 2005) and less planting material will be required when stakes of greater girth is used for planting. Onunka et al (2012) in a trial to determine the nutrient requirement for optimum performance of new cassava varieties found the stem girth significant at 8 MAP instead of 4 and 6 map indicating a direct proportional relationship between time and stem girth in cassava stem production.

Plant Height at Harvest

The effect of stake length and time of harvest on plant height of cassava varieties at harvest is presented on table 2. The result showed that only stake length and time of harvest were very highly significant ($p< 0.05$) while the interaction between stake length and time was significant ($p<0.05$) amongst all the parameters evaluated. Umucas 37 (v3) recorded the highest mean height of 2.45 m closely followed by TME 419 (2.441m) .The difference in height was not significant. The least was NR8082 with a mean height of 1.86m.Harvesting at 12 MAP gave the highest mean height of 2.14m significantly different from 10 MAP of 1.950m.The significant increase in plant height at 12 MAP implies increase in quantity of planting materials available to the farmer. This result is in line with the findings of Onunka et al (2012) who observed that prolonged time of harvest in cassava resulted to increase in height. This also results to better mature planting materials as premature stakes may lead to poor establishment and subsequently low yield of both root and stakes.

Root Yield

The effect of stake length and time of harvest on root yield is shown on table 3.In this result stake length was very highly significant while variety was very significant ($p< 0.05$) on root yield .Full length stakes significantly out yielded the medium stakes 34.8 and 27.7kg per plot respectively. There was no significant difference in root yield in terms of time of harvest but NR 8082 V1 out yielded the two other varieties. Full stake length out yielded the medium stake probably because of the advantage of having more nodes exposed which produced more sprouts and subsequently more leaves and greater photosynthesis for carbohydrate formation. Furthermore the many nodes exposed by full stake lengths lead to more sprouts that increases stem production.

CONCLUSION

As result of poor seed system in Nigeria and the nature of cassava, seed supply is likely to be a hindrance to cassava production. Efforts should be geared towards developing new varieties and other improved agronomic practices than reducing the recommended stake length for planting. Cassava matures from about 6map but for increased stem and root production harvesting should be from 12 map as observed from this work.

Table1: Effect of stake length and time of harvest on stem girth of three new cassava varieties

		T1			T2		
S_L	V1	V2	V3	V1	V2	V3	Mean
F	7.167	8.067	7.967	8.453	8.697	9.233	8.264
M	7.400	8.267	6.800	9.327	9.687	8.483	8.327
Mean T		7.611			8.980		
Mean V	V = 18.087		V = 28.679		V3 = 8.121		

SED Time =0.1772
- ✓ Stake length =0.1772
- ✓ Variety=0.2170
- ✓ Stake length x variety=0.3069

Table 2: Effect of stake length and time of harvest on final plant height of three new cassava varieties

		T1			T2		
S_L	V1	V2	V3	V1	V2	V3	Mean
F	1.667	2.457	1.900	2.033	2.450	2.267	2.129
M	1.633	2.367	2.000	2.107	2.490	2.013	2.102
Mean T		2.004			2.227		
Mean V	V1 =1.860		V2 = 2.441		V3 = 2.045		

SED Time =0.0574
- ✓ Stake length =0.0574
- ✓ Variety=0.0703 ns
- ✓ Time x Stake length=0.052

Table 3: Effect of stake length and time of harvest on root yield of three new cassava varieties

		T1			T2		
S_L	V1	V2	V3	V1	V2	V3	Mean
F	35.2	31.6	36.4	47.4	23.4	35.2	34.8
M	30.3	26.9	25.5	33.3	26.4	23.7	27.7
Mean T		31.0			31.6		
Mean V	36.6		27.0		30.2		

SED Time =2.53
- ✓ Stake length =2.53
- ✓ Variety=3.10
- ✓ Time x Stake length=0.052

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EFFECT OF KI RATE ON TUBER YIELD AND EFFECTIVENESS OF IODINE BIOFORTIFICATION IN SELECTED ELITE CASSAVA (*Manihot esculenta*) VARIETIES GROWN ON COASTAL SAND IN CALABAR, NIGERIA

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ABSTRACT
A field experiment was conducted at the Crop Research Farm of the University of Calabar located in the Calabar coastal humid forest area of Southeastern Nigeria to determine the effectiveness of agronomic iodine biofortification in two popular and widely cultivated elite cassava varieties (TME 419 and TMS 30555) in Nigeria. Different rates (0, 2.5, 5.0 and 10 kg KI/ha) of Potassium Iodide (KI) were applied to cassava at 10 weeks after planting. Yield parameters measured were tuber number plant^{-1}, tuber weigh (kg plant^{1}) and tuber yield (t ha^{1}). Effectiveness of Iodine biofortification was determined by evaluating Iodine concentration (mg kg^{1}) in the freshly harvested cassava tuberous roots and processed cassava products (garri and fufu). Results obtained indicated that tuber number and weight plant^{1} and yield ha^{1} were not significantly ($p \leq 0.05$) influenced by iodine application. However, there was significant ($p \leq 0.05$) positive correlation between the rate of Iodine applied and the amount retained in fresh tuber flesh and processed products in both varieties with fresh tuber containing higher Iodine than the processed products. TMS 419 exhibited stronger iodine retention capacity (r = 0.91 – 0.92) than TMS 30555 (r = 0.82 – 0.85) in both raw and processed products, indicating effective agronomic biofortification at 10 kg KI ha^{-1}.

Keywords: Agronomic biofortification, cassava products, coastal sand, potassium iodide and iodine retention capacity

INTRODUCTION

Iodine is an essential micronutrient required in human health and like other micronutrients such as Fe, Se, and Zn, it is usually consumed below the recommended range by majority of the people in developing countries who subsist largely on carbohydrate staples which are poor in these nutrients (Zhu *et al*, 2003; McWilliams, 2011). Nutrient iodine is required in the thyroid gland for the production of the hormone thyroxin which regulates basal metabolic rate and supports normal growth and development. Iodine plays such a vital role in the body such that its deficiency has been identified as a strong causal factor in hypothyroidism (sluggishness), obesity and enlarged thyroid gland, commonly known as goiter (Abraham *et al*, 2002).The human body lacks the ability to synthesize iodine and can it can only be supplied to the body through food intake. Iodine deficiency disorders are preventable and treatable and the use of iodized salt is the most common inexpensive iodine supplementation strategy in human diet but this is still a challenge in most parts of the world (Zhu *et al*, 2003) as high salt intake is detrimental to health and is commonly associated with hypertension which is among the deadly *silent* killer diseases. Iodine requirement can be met through food diversification and consumption of different kinds of fruits, vegetables and animal products, but this approach is expensive and uneconomical to the target households which are usually chronically poor and simple and affordable alternatives such as agronomic biofortification of popular staples like cassava which provides dietary energy for over 800 million poor people world-wide (FAOSTAT, 2012; CARDI, 2013; Howeler *et al*, 2013). The objective of this experiment was to determine the optimum KI rate for effective agronomic biofortification in cassava to enhance its nutritional profile.

MATERIALS AND METHODS

Study Area

A field experiment was conducted at the Crop Research Farm of the University of Calabar located in the Calabar, Nigeria in 2012 to 2013 cropping seasons. The area is characterized by distinct dry and wet seasons which last from November/December to March/April and April/May to October/November, respectively. The minimum temperature is about 23 oC and maximum temperature is 33 oC while annual rainfall ranges between 2000 – 2500 mm and relative humidity of 75 - 90 % (Afangideh *et al*. 2010).

Plot Preparation and Experimental Design

The land was cleared and tilled manually using a machete and spade respectively. Unit plots measuring 4.0 m x 4.0 m (16.0 m²) separated by 1.0 m alley ways were marked out in blocks spaced 1.0 m apart.

The experimental design used was a 2 x 4 factorial involving two varieties of elite cassava varieties (TME 419 and TMS 30555) and four rates (0, 0.25, 0.5 and1.0 kg KI ha^{-1}) of Iodine as Potassium Iodide (KI). Experimental plots were arranged in randomized complete block design with three replications.

Planting of cassava
Mature and healthy cassava stems cut to 20 cm length were planted in the plots in the first week of August 2012 and 2013. Stands were established 1.0 m apart each way to give 10,000 plants/ha.

Application of Iodine and fertilizer
Potassium was applied as potassium Iodide (KI) by banding around individual plants ten weeks after planting (10 WAP), which coincided with period of storage root initiation when nutrient absorption is maximum (Alves, 2002; El-Sharkawy, 2004). Fertilizer N:P:K 15:15:15 was applied at 200 kg ha $^{-1}$ was applied to the field 3 MAP in both 2012 and 2013.

Soil analysis
Analysis (IITA, 1979; 1989) of the composite surface (0 – 30 cm depth) soil samples randomly taken with a soil auger at the site showed pH 4.7, total – Nitrogen 0.637%, Av Phosphorous 177 mg kg $^{-1}$, while exchangeable K, Ca, Mg and ECEC were 0.08, 0.70, 0.40 and 3.19cmol kg $^{-1}$ respectively; with organic carbon content of 4.02% and zero soil iodine content.

Data collection, analysis and evaluation of cassava iodine content
Yield parameters assessed were number of tubers (plant $^{-1}$ and plot $^{-1}$), tuber weight (plot $^{-1}$ and plot $^{-1}$) and tuber yield (t ha $^{-1}$), while the iodine content in tuber flesh and processed cassava was determined using the x-ray fluorescence method (Allen, 1989). Data was analyzed using analysis of variance (ANOVA) and significant ($p \leq 0.05$) means were compared using Duncan multiple range test (DMRT).

RESULTS AND DISCUSSION
The cassava varieties did not differ in their response to iodine fortification in terms of the yield parameters evaluated neither did iodine rates significantly ($p \leq 0.05$) influence them in 2012 and Variety and rate interaction was insignificant. However, 10 kg KI ha^{-1} produced more tubers while 5 kg KI ha^{-1} produced heavier tubers and higher tuber yield plot^{-1} than other KI rates (Table 1). The cassava varieties TME 419 and TMS 30555 did not also vary in tuber production, tuber weight and tuber yield in 2013. Tuber production was also not affected by KI rates while tuber weight and yield were all significantly ($p \leq 0.05$) influenced by application of potassium (Table 2). Potassium application resulted in reduced cassava tuber weight which reduced progressively as KI rate increased and was lowest at the highest KI rate, followed by 2.0/2.5 kg KI ha^{-1} and highest in the control with the tuber weight difference of 8.56 kg plant^{-1} between the control and highest KI rate. Plot yields followed the same trend with tuber weight giving correspondingly highest and lowest tuber yield in zero and highest KI rate, respectively with yield difference of 9.17 t ha^{-1} higher in zero KI plots. Iodine retention in cassava tuber flesh and processed cassava products presented in Table 3 showed iodine content increased in all products in both varieties as the application rates were increased. In the 2012 crop, iodine content was double in plants that received the least dose of the nutrient compared to those that did not receive iodine application. Iodine contents in tuber and processed cassava were higher in 2013 than the 2012 indicating that the nutrient was retained in the tissues of the crop. However lower concentrations were found in processed products than in the raw tuber. This result is in tandem that obtained by Smolen and Sady (2011) and Stzetelski *et al* (2009) who similarly obtained significantly higher iodine retained in carrot storage roots and radish with increasing iodine levels. Effective rate for agronomic biofortification for TME 419 was 2.5kg/ha, while that of TMS 30555 is 10kg/ha. TME 419 variety showed a stronger positive relationship between the iodine rates applied and the amount retained in processed and raw cassava than TMS 30555 (Table 4) implying that different cassava varieties probably have different capacities to retain iodine.

CONCLUSION
Though iodine application to cassava suppressed tuber yield, increased product quality obtained through agronomic iodine biofortification could compensate the yield reduction and should be promoted.

Table 1: Influence of rates of iodine application on yield in two cassava varieties (2012)

Variety	Tuber Number (Plant $^{-1}$)	Average tuber Weight (kg plant^{-1})	Tuber yield (kg plot^{-1})
TME 419	5.83	6.24	35.1
TMS 30555	5.44	6.03	34.0
SE	0.29	0.34	2.90
KI Rate			
0	5.17	5.63	32.5
2.5kg/ha	5.61	6.04	34.5
5 kg/ha	5.72	6.23	36.6
10kg/ha	6.06	5.80^{ab}	34.6
SE	0.42	0.481	4.10
Interaction			
V x R	NS	NS	NS

Means followed by same letters in each column are not significantly different at p.05 by Duncan multiple range test

NS = not significant.

Table 2: Effect of rates of iodine fertilization on yield in two cassava varieties (2013)

Variety	Tuber number (Plant $^{-1}$)	Average tuber weight (kg plant^{-1})	Tuber yield (kg plot^{-1})	Tuber Yield (t ha^{-1})
TME 419	5.17	15.82	142.40	22.00
TMS 30555	5.20	16.84	151.60	24.00
SE	0.30	2.10	18.94	11.84
Rate				
0	5.39	20.34^{a}	183.10^{a}	25.44^{a}
2.5kg/ha	5.37	17.69^{b}	159.17b	19.48b
5 kg/ha	5.25	15.52b	139.69b	17.31c
10kg/ha	4.74	11.78c	106.03c	16.27c
SE	0.43	2.98	26.79	6.74
Interaction				
V x R	Ns	Ns	NS	Ns

Means followed by same letters in each column are not significantly different at p.05 by Duncan multiple range test

* - significant NS = not significant.

Table 3: Tuber and processed cassava iodine content influenced by rate of iodine fertilization

Rate (kg/ha)	Tuber content (mg kg^{-1})				Processed cassava content (mg kg^{-1})			
	TME 419		TMS 30855		TME 419		TMS 3088	
	2012	2013	2012	2013	2012	2013	2012	2013
0	4.5^{d}	9.6^{d}	3.8^{d}	8.5^{c}	1.8^{d}	3.7^{d}	1.6^{c}	6.1^{b}
2.5	8.3^{bc}	12.0^{c}	9.9b^{c}	9.1^{a}	4.0^{abc}	6.4^{c}	4.8^{b}	7.2^{a}
5.0	7.4^{b}	13.8^{b}	10.2^{b}	13.9^{b}	3.3^{c}	10.8^{b}	5.6^{a}	7.0^{a}
10.0	11.4^{a}	14.3^{a}	11.8^{a}	15.0^{a}	5.8^{a}	14.8^{a}	5.8^{a}	7.6^{a}

Means followed by different letters in each column are significantly different at p.05 by LSD.

Table 4: Correlation coefficient of rate of iodine application on tuber and processed cassava control in two variaties of Cassava

	Tuber content		Processed cassava content	
Variety	TME 419		TME 419	
	2012	2013	2012	2013
TME 419	0.92**	0.9**	0.91**	0.92
TMS 30555	0.83**	0.44^{c}	0.82**	0.85*

* = significant at 0.05 probability level

** = significant at 0.05 and 0.01

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EVALUATION OF ORGANIC COFFEE PRODUCTION USING THREE LEVELS OF LOW INPUT ORGANIC FERTILIZER IN IBADAN, SOUTHWESTERN NIGERIA

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ABSTRACT

This study was carried out at Cocoa Research Institute of Nigeria (CRIN) Headquarters, Idi-Ayunre, Ibadan Southwestern Nigeria, Latitude 7º25'N and Longitude 3º25'E on evaluation of organic coffee production using three levels cocoa pod husk (CPH). There were four treatments comprising of 100,200 and 300 kg/ha of CPH and the control (no fertilizer) applied to coffee seedlings on the field. The cost price of CPH per kilogram at CRIN's Crop Processing Unit is #200 which translate to 20,000, 40,000 and #60,000/treatment/hectare respectively. Four coffee seedlings planted three meters apart were used per treatment. The plot was laid out using Randomized Complete Block Design (RCBD) and replicated three times given a total of 48 stands. Treatments were randomly allocated, 6 months after field establishment. Data on morphological parameters such as Plant height, stem diameter, number of leaves and leaf area were collected from 3 months after transplanting (MAT) for periods of three years (36 months), while berry yield from different treatments were collected for periods of 2 years (24 months). Data collected were subjected to statistical analysis of variance and LSD was used to separate the means that were significant. Results obtained showed that the three levels of cocoa pod husk significantly (P<0.05) enhanced morphological parameters (plant height, stem diameter and leaf area) of coffee from 6 MAT to 36 MAT relative to the control. Cocoa pod husk (CPH) applied at 200kg/ha CPH gave the highest plant height, stem diameter and leaf area from 9 MAT compared to other organic manure levels and the control. Also, 200 kg/ha produced the highest coffee berry yield relative to other levels of CPH application and the control in both 2014 and 2015. 200 kg/ha CPH also increased the plant height, stem diameter and leaf area of coffee by 28 %, 18 % and 13 % respectively compared with the control, but when compared with 300 kg/ha CPH treatment, it also increased plant height, stem diameter and leaf area of coffee by 22 %, 17 % and 10 % respectively. Again, 200 kg/ha CPH enhanced coffee berry by 10 % and 9 % compared with the control plot in 2014 and 2015 respectively, when compared with 300 kg/ha CPH, it increased coffee berry yield by 7 and 6 % in 2014 and 2015 respectively. 200 kg/ha CPH performed best while 100 kg/ha CPH performed least. Therefore, 200 kg/ha CPH is recommended for organic coffee production. Instead of other treatment as cocoa pod husk ,readily available with or no cost incurred by the farmers compare to the use of inorganic fertilizer which is scarce, costly hazardous to soil micro-ecology

Keywords: Evaluation, Organic Coffee, lnput and Production

INTRODUCTION

After oil, coffee is the most valuable traded commodity worldwide, with global retail sales estimated to be US$ 90 billion. Brazil is the largest word's coffee producer, followed by Vietnam and Colombia (Davies *et al*., 2006). Coffee is the major export product of some countries such as Uganda, Burundi, Rwanda and Ethiopia. About 70 % of the world crop is grown on smallholdings smaller than 10 ha and hence it is often a family business that provides maintenance for over 25 million people worldwide (Fassio and Silva, 2007). Among some 100 species of the *Coffea* genus, only C. *arabica* L and C. *canephora* (robusta coffee) are economically important worldwide, with these species being responsible for about 99 % of world bean production (Davies *et al*., 2006). Coffee is today grown in more than 60 tropical countries of the world and accounts for a significant part of the foreign exchange earnings of many of them (Baumann, 2006). Coffee cultivation began in the ninth century in Africa and since most varieties of coffee are naturally intolerant of direct sunlight coffee was originally grown under shade trees, most often fruit and nut trees which also helped to replenish the soil with valuable nutrients and allowed the land to remain fertile generation after generation. Shades land be-reported to be beneficial to coffee. (Famaye 2000; Famaye and Agboola 2003). Williams (1989) reported that coffee is cultivated in more than 20 states in Nigeria on over 500,000 ha with the highest concentration at Mambilla Plateau, Taraba State. It is also an important source of foreign exchange to Nigeria. In the beginning all coffee was organic and shade grown. Beginning in the 1970s full sun coffee varieties were developed to increase productivity by allowing coffee plants to be grown closer together. As a result chemical fertilizers and pesticides had to be used to compensate for the lack of nutrients being added back to the soil. These types of chemicals harm the soil, surrounding wildlife, adjacent water, the farmers themselves and the taste of coffee. (Famaye, 2005)

Increasing awareness of damage to our environment and our health through harmful production methods has led to greater demand for organic products. Although organically produced consumer goods still account for a small percentage of all grocery sales and organically-grown coffee sales currently represent about 1% of the United States of America market for coffee/beans ((Famaye, 2005). Organic coffee farming encourages sustainability, multilayer crop production and a rich array of wildlife. Organic coffee farming encourages beneficial insects and a healthier more resistant crop. The considerable potential for improving organic coffee and yield through application of organic materials is widely recognized (Adejobi *et al.*,2011; Agboola and Adeoye,1990; Rayer and Chiroma,1990; Adu-Daapah, 1994; Moyin-Jesu, 2002. Owaiye (1993) and Michori, (1981) reported that residue mulch materials including grasses and farm wastes were efficient in improving coffee yield, while Obatolu (1995) reported the use of cocoa pod husk (CPH) as fertilizer for coffee. The objective of this study therefore is to evaluate the performance of coffee on the field using three levels of Cocoa Pod Husk (CPH) as organic fertilizer in view of economic reality without the aid of artificial chemical substances .

MATERIALS AND METHODS

A field experiment was conducted at Cocoa Research Institute of Nigeria (CRIN) Ibadan. The location is on Latitude 7°25'N and Longitude 3°25'E, Alfisol in rain forest zone of Southwestern Nigeria. The annual rainfall is between 1200-1500 mm. The maximum temperature ranges between 26 to 35^{0}C with an average of about 30.1^{0}C. Relative humidity ranges from 50 to 89 % with an average of 79 %.

Soil sample and analysis

Soil samples were collected from 0-30 cm depth on the site, mixed thoroughly and the bulked samples were taken to the laboratory, air-dried and sieved to pass through a 2 mm screen for chemical analysis of particle size which was determined by the hydrometer method (Kettler *et al.*, 2001) and organic carbon content (OC) by the potassium dichromate oxidation method (Zhang *et al.*, 2001). Soil pH was read on pH meter (1:1 water). Soil potassium (K), calcium (Ca) and magnesium (Mg) were extracted with 1MNH_4 OAC, PH_7 and were determined with flame photometer; Mg was determined with an atomic absorption spectrophotometer. The total nitrogen (N) was determined by the Microkjedahl method (AOAC, 1990). Soil P was extracted by the Bray P1 extraction and measured by the Murphy blue coloration and determined on a spectronic 20 at 882um (Murphy and Riley, 1962)

Processing and analysis of cocoa pod husk used for the experiment

The cocoa pod husk (CPH) used for the experiment was obtained from the Crop Processing Unit of Cocoa Research Institute of Nigeria, Ibadan at the rate of ₦200/kg. This translated of ₦ 20,000, ₦ 40,000 and ₦60,000/treatment/hectare. The CPH was air dried for 3 weeks under the shade, later ground into powder form (< 2 mm sieve) using hammer mill and packed in 50 kg bags for application on the field. Two grammes (2 g) of the organic fertilizer (CPH) was analyzed by Moyin-Jesu (2012) for nutrients composition according to standard procedures (IITA, 1992).

Collection of coffee seeds and depulping

Diseased free coffee seeds were collected from the coffee plantation of Cocoa Research Institute of Nigeria (CRIN) in early September, 2011 and depulped. The selected berries were soaked in water over night and harsh parchment removed. The berries were washed further in water to removed mucilage and the clean coffee berries were air dried under shade.

Pre-nursery and nursery establishment

In late September 2011, air-dried seeds were sown in boxes (90 x 60 x 30 cm) after filling the seed boxes with river sand. The seed boxes were thoroughly watered and kept under shade. The watering was discontinued because rain was steady at that period of time. The seeds of coffee germinated about 6 weeks after sowing. The bulk soil taken from the site (0-30 cm depth) was sieved to remove stones and plant debris and 2.5 kg of the sieved soil was placed into a polybags (25 x 15 cm) in 2011 and 2012. The germinated coffee seeds were transplanted in to polybags filled with top soil. Watering was done immediately to prevent transplanted seedlings from wilting and this continued for one week till proper establishment. A shade was constructed over the polybags containing the germinated seeds to prevent scorching by sun. Hand weeding was done at 2, 5, 8 and 16 weeks. No chemical spray in both pre-nursery and nursery stages. The seedlings were transplanted into the field, 20 weeks after sowing.

Field experiment

Field was conducted in Cocoa Research Institute of Nigeria (CRIN), Ibadan Headquarters. The experiment was conducted between 2012 and 2015. It was laid in Randomized Complete Block Design (RCBD) with 3 replications. The site was cleared and lay-out of the experimental site (Measurement, pegging and holing) was carried out before planting. Plantain suckers were planted at 3.0 x 3.0 m apart as a shade crop for the establishment of coffee seedlings. The experiment had four treatments comprising of four coffee stand applied with 100 kg/ha CPH, 200 kg/ha CPH, 300 kg/ha CPH and the control (No CPH application). Coffee seedlings were transplanted 3.0m apart. Treatments were imposed 6 months after transplanting of coffee seedlings into the field.

Data collection

Data were collected on the growth parameters of coffee seedlings such as: Plant height measured in centimeter using a meter rule on the surface and the tip of the main stem; Stem diameter was measured in centimeter with the use of Vernier'Caliper 30 cm above the ground level and leaf area (Leaf area meter). Coffee berry yield, obtained in the first 2 years of fruit bearing were also evaluated. The results were subjected to statistical analysis of variance and LSD was used to separate the means that were significant.

RESULTS AND DISCUSSION

The chemical properties of CPH used in the experiment are represented in Table 1: CPH was indicated to be high in N, P, K, Ca, and Mg. The higher P, K, N, Ca and Mg for CPH agreed with the fact that plant derived materials including those of cocoa and kola pod husk increased P, K, Ca, Mg, and yield of vegetables, rice, millet and maize (Owolabi *et al*., 2003). The plant height, stem diameter and leaf area of coffee seedlings under different levels of CPH treatment are presented in Tables 2, 3 and 4. The application of cocoa pod husk at different levels increased significantly (P<0.05) the growth parameters of coffee seedlings compared to the control treatment with the exception of 3 MAT (Tables 2, 3 and 4). This might've been due to slow released of this organic fertilizer that are peculiar to organic matter contained in it. Cocoa pod husk (CPH) applied at 200kg/ha CPH gave the highest plant height, stem diameter and leaf area from 9 MAT compared to other organic manure levels and the control. Also,200 kg/ha CPH also increased the plant height, stem diameter and leaf area of coffee by 28 %, 18 % and 13 % respectively compared with the control, but when compared with 300 kg/ha CPH treatment, it also increased plant height, stem diameter and leaf area of coffee by 22 %, 17 % and 10 % respectively. This study showed that CPH, a seemingly waste product of cocoa could be used to produce organic coffee and increased availability of N, P, K, Ca and Mg in soil and their uptake by coffee plants thereby leading to enhanced growth performance of coffee. Poor growth of coffee as a result of low nutrient status of soil N, P, K, Ca, and Mg was generally observed in no treatment plot. This observation is in agreement with the work of (Moyin-Jesu, 2007). Which identified deficiency symptoms of yellow coloration, purple coloration and marginal burning of leaves signifying N, P, K deficiencies in tropical Africa soils. Also, 200 kg/ha produced the highest coffee berry yield relative to other levels of CPH application and the control in both 2014 and 2015. Again, 200 kg/ha CPH enhanced coffee berry by 10 % and 9 % compared with the control plot in 2014 and 2015 respectively, when compared with 300 kg/ha CPH, it increased coffee berry yield by 7 and 6 % in 2014 and 2015 respectively. These yield results authenticate the importance of organic fertilizer in crop production. These results have shown clearly that organic manures are capable of enhancing tree crops yield such as coffee (Michori, 1998; Obatolu, 1991), teak (Fagbenro, 1998), tea (Ipinmoroti and Adeoye, 2002; Ipinmoroti *et al*, 2004). Ojeniyi and Adejobi, (2002); Adejobi *et al*.,(2015 a and b), Ayeni *et al*.,(2008 and 2009) also found that wood ash, cocoa pod husk ash increased growth parameters and yield of crops such as amaranthus , tomatoes, pepper, kola and cashew seedlings and yam. It has also been observed that leaf chlorophyll, K: Na and C:Na ratio of organic manure treated crops were found to be higher than NPK treated crops. These contents might have been responsible for better growth, yield and yield quality for crops under organic treatments compared to NPK treatment (Adeniran, *et al.*, 1999; Alabi and Odebina, 2001).

CONCLUSION

The results indicated that the CPH applied at 200 kg/ha increased the plant height , stem diameter, leaf area and coffee berry yield. The organic manure applied at 300 kg/ha CPH might have been too much as the coffee may not be able to take more nutrient after 200 kg/ha CPH that seemed to be the optimum required for good growth of the coffee as recorded in all the morphological parameters at 36 MAT. The 100 kg/ha CPH treatment was however higher in growth parameters than 300kg/ha CPH but not adequate as the 200 kg/ha CPH treatment was higher than 100 kg/ha CPH. However there was no significant difference in both growth parameters and yield of coffee between 100 kg/ha CPH and the control. The better performances of 200kg/ha CPH indicate no loss of nutrient or in-adequate when applied. Since organic coffee farming encourages sustainability, healthier more resistant crop, create environment friendly. However, treatment with 200kg/ha CPH with highest growth and yield will be more profitable than other treatment. 200 kg/ha CPH that gave the highest morphological parameters and highest berry yield which increases production efficiency of farmers could be recommended for coffee farmers instead of other treatments in organic coffee production in Nigeria.

Table 1: Analysis of the organic materials used for the experiment

Treatment	C/N Ratio	N %	P Mg/kg	K -------	Ca Mg/L -	Mg -------	Fe -------	Zn Mg/kg	Cu -------
Cocoa pod husk (CPH)	11.10	1.44	100.00	20.59	9.34	7.10	50.40	1.69	0.16

Table 2: Plant height of organic coffee using 3 levels of CPH between 2011 and 2014

	Months After Transplanting (MAT)											
Treatments	3	6	9	12	15	18	21	24	27	30	33	36
100 kg/ha CPH	24.0	32.1	36.2	38.1	42.4	44.1	47.9	50.1	52.3	54.4	57.3	60.5
200 kg/ha CPH	30.8	33.0	39.2	42.4	47.4	50.5	53.7	57.5	59.1	63.0	66.1	68.9
300 kg/ha CPH	24.2	29.1	31.7	33.3	35.1	37.3	40.4	43.3	45.4	47.1	50.3	53.2
Control	26.9	27.0	28.7	20.3	31.4	33.6	36,2	39.4	41.3	43.7	46.5	49.7
Means	24.4	30.3	33.9	36.0	39.0	4.38	44.5	47.5	49.5	52.1	55.0	58.0
LSD (P=0.05)	6.8	5.9	10.0	11.4	15.4	16.0	16.7	17.1	16.8	18.5	18.5	18.3

Table 3: Stem diameter of organic coffee using 3 levels of CPH between 2011 and 2014

	Months After Transplanting (MAT)											
Treatments	3	6	9	12	15	18	21	24	27	30	33	36
100kg/ha CPH	0.36	0.45	0.42	0.49	0.52	0.56	0.50	0.66	0.70	0.83	0.92	1.08
200 kg/ha CPH	0.35	0.48	0.51	0.56	0.60	0.67	0.71	0.80	0.86	0.95	1.13	1.25
300 kg/ha CPH	0.36	0.41	0.48	0.50	0.53	0.58	0.42	0.65	0.72	0.86	0.94	1.04
Control	0.39	0.40	0.41	0.45	0.47	0.50	0.41	0.61	0.68	0.80	0.91	1.03
Means	0.35	0.44	0.47	0.50	0.53	0.58	0.62	0.68	0.74	0.87	0.98	1.08
LSD (P=0.05)	0.08	0.08	0.07	0.10	0.12	0.15	0.14	0.18	0.18	0.13	0.22	0.25

Table 4: leaf area (cm^2) of organic coffee using 3 levels of CPH in 2011 and 2014

	Months After Transplanting (MAT)											
Treatments	3	6	9	12	15	18	21	24	27	30	33	36
100 kg/ha CPH	58.8	86.3	90.7	91.8	93.0	96.1	99.7	102.1	106.4	110.2	113.1	118.2
200 kg/ha CPH	58.7	85.0	91.1	97.3	99.8	103.2	106.8	110.5	117.1	122.6	126.7	131.8
300 kg/ha CPH	53.9	79.0	89.7	94.6	97.1	99.1	102.1	105.1	109.5	112.7	115.1	119.3
Control	59.0	79.2	86.2	90.2	91.3	93.2	96.3	100.2	103.3	106.4	110.5	114.7
Means	57.6	82.6	89.4	93.5	95.3	97.9	101.2	104.5	109.1	113.0	116.3	121.0
LSD (P=0.05)	5.2	8.9	4.8	6.7	8.2	9.1	9.4	9.6	12.7	14.8	15.3	16.0

Table 5: organic coffee berry yield (t/ha) using 3 levels of CPH in 2014 and 2015

	Berry yield t/ha	
Treatments	2014	2015
100 kg/ha CPH	1,610	1,630
200 kg/ha CPH	1,750	1,800
300 kg/ha CPH	1,650	1,670
Control	1,600	1,620
Means	1,653	1,680
LSD (P=0.05)	148	179

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EFFECTS OF WOOD ASH, NITROGEN AND INRA-ROW SPACING ON NET ASSIMILATION RATE AND TOTAL TUBER YIELD OF POTATO (*Solanum tuberosum* L.) ON THE JOS PLATEAU, NIGERIA

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ABSTRACT
Field experiment were conducted during the 2008 and 2009 wet seasons at the experimental farm of the National Root Crops Research Institute, Umudike, Potato programmes farm, Kuru (Lat 09^0 44' N and Long 08^0 44'E and with an elevation of 1,239.4m above sea level) in the Northern Guinea Savanna ecological zone of Nigeria. The experiment was conducted to determine the effects of various rates of nitrogen (0, 60 and 120 kg N/ha), wood ash (0, 2.5 and 5.0 t/ha) and intra – row spacing (20, 30 and 40 cm) on the growth and yield of potato. A split plot design was used where the factorial combinations of N and intra- row spacing were assigned to the main plots, while wood ash was assigned to sub plots. The treatments were replicated three times. The result revealed that application of 60 – 120 kg N/ha and 2.5 - 5.0 t/ha wood ash enhanced net assimilation rate and total tuber yield. Application of wood ash at 5.0t/ha significantly influenced net assimilation rate and total tuber yield. The use of 30 or 40cm spacing resulted in higher net assimilation rate and total tuber yield compared to 20 cm spacing.
Keywords: Potato, wood ash, nitrogen, intra-row spacing and net assimilation

INTRODUCTION
Potato (*Solanum tuberosum* L.) is a tuber crop it belongs to the family *Solanaceae*. It ranks fourth as the world's economically valuable food crop after rice (*Oryza sativa*), wheat (*Triticum aestivum*) and maize (*Zea mays*) (USDA, 2014).Crop nutrition is a basic requirement in potato production, especially on the Jos Plateau, where continuous cropping has greatly depleted the soil of the major native nutrients such as N, P and K (Okonkwo *et al.,* 1995). The mineral fertilizers are scarce and costly, and in most cases beyond the reach of the resource – poor farmer. Wood ash has some fertilizer value, the amount varying somewhat with the species of wood ash being used (Hillary, 2009). Wood ash contains nutrients that were taken up from the soil by the tree in question. It may improve crop growth and yield through provision of phosphorus, calcium magnesium and potassium if applied as fertilizer (Jerome, 2004). N is an indispensable plant major nutrient, without it growth is retarded, leaves will turn yellow and reproductive growth is impaired while intra – row spacing in plant give room for the plant to express its potential as competition for space may lead to etiolation (Hillary,2009). It is therefore, the objective of the study, to evaluate the effects of wood ash, nitrogen and intra- row spacing on potato growth and yield.

MATERIALS AND METHODS
Field experiment were conducted in 2008 and 2009 rainy seasons on the National Root Crops Research Institute, Potato programme farm, Kuru, in the Northern Guinea savanna ecological zone. Kuru is located on latitude 09^0 44'E and longitude 08^0 44'N, 1,239.4 m above sea level, with an annual rainfall of 1,289.89 mm distributed across 150 days within the months of May to October. Potato variety; Nicola, was used as test variety. The soil is a sandy loam and of feralgilic origin, Treatments were: nitrogen (0, 60 and 120 kg ha^{-1}), wood ash (0, 2.5 and 5.0 t ha^{-1}) and intra – row spacing (20, 30 and 40 cm). Factorial combination of nitrogen and intra – row spacing was assigned to main plot while wood ash was allocated to sub – plot. The gross plot size was 4 x 6 m (measured 24 m^2) while the net plot size was 2 x 6 m (Measured 12 m^2) consisting of two inner ridges .The experiment was laid out in a split plot design replicated three times. Planting was done on the crest of the ridges spaced 100 cm apart while the intra – row spacing was 20, 30 and 40 cm. Planting was carried out on 3rd may, 2008 and 16th may, 2009. The wood ash used in this experiment was from African birch (*Anogeissus leocarpus* L.) plant, and was incorporated on the crest of the ridges at planting. Urea fertilizer was applied manually by side banding, two weeks after planting (WAP). Weeds were controlled with pre-emergence herbicide, (combination of Alachlor – EC at 1.92 kg a.i ha $^{-1}$ and Atrazine 500Sc at the rate of 4kg a.i ha^{-1}) using CP-15 knapsack sprayer at a pressure of 2.1kg cm^{-2}; and by hoe weeding at 4 and 8 WAP. Tubers were harvested manually by lifting, using garden fork. Five stands were selected and harvested; and their tubers were counted to determine the mean number of tubers per plant. The weight of the randomly selected tubers were determined using electronic balance; model TH – 5000 with capacity 5000g x1g/200 oz .Net assimilation rate was measured at 3 weeks interval beginning at 3 WAP. Tubers harvested from the net plots (12m^2) were weighed, and later the yield/net plot was expressed in tones per hectare. Harvested tubers from each net plot were weighed and yield per hectare was determined and expressed in tones per hectare. The data collected were statistically analyzed using analysis of variance (ANOVA) according

to the method described by Gomez and Gomez (1984), and the treatment means were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Net Assimilation Rate (NAR)

Nitrogen, wood ash and intra – row spacing significantly influenced NAR in both years (Table 1). At 3 – 6 WAP in 2008, 60 and 120 kg N/ha produced similar and greater NAR than the untreated control. At 3 - 6 WAP in 2009, NAR increased with increasing nitrogen rate from 0 – 120 kg N/ha. At 3 – 6 WAP in 2008 0 and 2.5 t/ha wood ash resulted in similar but lower NAR than 5.0 t/ha rate. In 2009, NAR by 2.5 and 5 t/ha wood ash rate were at par and statistically higher than by 0 t/ha at 3-6 WAP. At 6 – 9 WAP, 5.0t/ha wood ash produced higher NAR than the untreated control. At 3 – 6 and 6 – 9 WAP in both years, increasing intra – row spacing spacing of potato from 20 – 40 cm correspondingly increased NAR. The interaction of N, wood ash and intra – row spacing on NAR of potato was not significant at any of the two sampling periods in both years.

Total Tuber Yield

The effects of nitrogen, wood ash and intra – row spacing of potato on total tuber yield is presented in (Table 2). Nitrogen, wood ash and intra –row spacing significantly affected total tuber yield. In 2008, N at 60 and 120 kg N/ha increased total tuber yield over the control. In 2009, 60 kg N/ha yielded more than the control and 120 kg N/ha. Total tuber yield increased with N rate from 0 – 120 kg N/ha in 2009 and the combined data.

In 2008, 2.5 and 5.0 t/ha wood ash increased total tuber yield over the untreated control. In 2009, tuber yield increased with wood ash rate, while in the combined data, the 2.5t/ha level produced greater tuber yield than the control.

Effects of Wood Ash on Growth and Yield

The significant positive response of potato to the application of wood ash in these trials explained the importance of the material as a source of P and K as earlier reported by Beukema and Za'ag (1990) and Harris (1992). Net assimilation rate increased with progressive rise in wood ash up to the maximum applied rate of 5.0t/ha. This is in consonance with the findings of (Obi, 2000, Obi and Ekperegin 2001, Ojeniyi *et al.*, 2001, Ojeniyi and Adejobi, 2002, Reula and Janssen, 1976) who reported that wood ash is an effective source of plant nutrients such as Calcium, Phosporus, Potassium, Magnesium and other secondary elements. Wood ash is also a fast liming material that rapidly dissolves and neutralizes acid soil, apart from providing plant nutrients (Jerome, 2004). Sokoto *et al*. (2007) reported positive effect of wood ash on sweet potato. Each of K and P has a specific role in potato growth and development and absence of any in the soil may retard potato growth and decrease yield. P and K deficiency in soils of Nigerian Savanna had been occasionally reported in some areas on the Jos Plateau most especially intensely or continuously cultivated farms (Okonkwo *et al.*,1995). However reports by Ogbolu (1991), Ojeniyi *et al*. (2001) and Ojeniyi and Adejobi (2002) contradicted findings in this present study. They reported that wood ash was not as effective as fertilizer for vegetables and cassava. Also, in this study, Net assimilation rate increased with wood ash rate in 2009. This confirmed reports of Nyobe (1998) and Awodun and Ojeniyi (2005) who observed that application of wood ash increased availability of Phosporus and Potassium and their uptake in groundnut and recommended 4 t/ha of wood ash for groundnut production, while Sokoto *et al.*(2007) recommended 6 t/ha of wood ash for Sweet Potato production under irrigated conditions. Therefore, it is not surprising that the growth, and consequently yield responded positively to increasing wood ash rate. In this study, presence of N influenced leave expansion, DM accumulation and total tuber yield of potato which is in consonance with report of Okonkwo *et. al,* (1995).

Effect of Nitrogen on Growth and yield

NAR in the two years increased with increasing rate of N at 3 WAP. This could be attributed to the low N status of the soil of the experimental site, (Appendix 1). This is in consonance with reports that N in the presence of P and K stimulate canopy growth, development of leaves and branches, and need to be available from seedling emergence to flowering so as to promote rapid canopy development, haulm weight, stollon growth, as well as increase potato leaf area index, relative growth rate and final yield of Potato crop (Chapman and Carter, 1976; Okonkwo *et al*.,1988; Juzl, 1990 and 1991; Huett and Dattmann 1991; Rogozinska and Pinska, 1991; Zrust and Mica, 1992,). In this study, the significant response to applied N, by the growth parameters enumerated above and total tuber yield explained the importance of N on growth and development of Potato crop which is in agreement with (Beukema and Za'ag 1990 and Harris, 1992) who indicated that N influence positively, vegetative growth of potato and maximize total tuber yield.

Effects of Intra – row Spacing on Growth and Yield.

The growth character was significantly and positively influenced by intra – row spacing in the two years of trial. The use of 20 cm intra- row spacing gave the tallests but less robust in terms of leaf, branch and stem production, this is in consonance with the report by Ifenkwe and Allen (1978) who reported that increasing plant density reduced NAR, number of auxiliary branches, leaves per plant and dry weight of leaves, stems, underground parts and tuber/unit area, and also Sevensson and Naglicker (1995), who reported that using intra – row spacing of 10 cm and 20 cm in potato gave lower number of main stem with low number of branches than rows spaced 20 cm with resultant low NAR. This is probably because with 20 cm intra –row spacing, there was competition between plants, for solar radiation which led to low NAR due to etiolation; plants grew narrower with less branching. At the letter stage for stands spaced 40 cm plants had enough space for vegetative growth and branching and overtook the 20 cm stands. The degree of vegetativeness of the plant in terms of shoot and branch number per plant confirmed the positive correlation between leaf number and NAR. Higher NAR means higher DM production, hence more production of branches with wider intra – row spacing. This finding is in consonance with the finding of Harris (1992) who reported that larger LAI and higher NAR permitted investment of more dry matter through its effect on the amount of intercepted radiation which inturn maximized total tuber yield. This in turn might have resulted in high DM, which invariably translated itself through the shoot dry weight produced.

CONCLUSION

The result revealed that application of 60 – 120 kg N/ha and 2.5 - 5.0 t/ha wood ash enhanced net assimilation rate and total tuber yield. Application of wood ash at 5.0t/ha significantly influenced net assimilation rate and total tuber yield. The use of 30 or 40cm spacing resulted in higher net assimilation rate and total tuber yield compared to 20 cm spacing.

Table 1: Effects of nitrogen, wood ash and intra-row spacing on net assimilation rate and total tuber yield of potato during 2008 and 2009 cropping seasons.

Treatment	Net assimilation rate ($g.dm^{-2}.wk$) and Total tuber yield (t/ha)			
	2008		2009	
	NAR($g.dm^{-2}.wk$)	Yield(t/ha)	NAR($g.dm^{-2}.wk$)	Yield(t/ha)
Nitrogen kg/ha (N)				
0	0.33b	12.37b	1.48c	13.64b
60	0.41a	13.11a	1.55b	14.31a
120	0.43a	13.10a	1.70a	13.59a
SE ±	0.015	0.125	0.026	0.068
Wood ash t/ha (W)				
0	0.36b	12.15b	1.33b	13.71c
2.5	0.38b	13.12a	1.64a	14.15b
5.0	0.43a	12.89a	1.56a	14.17a
SE ±	0.009	0.098	0.022	0.076
Spacing cm (S)				
20	0.30c	12.45b	1.47c	13.77
30	0.42b	13.10a	1.55b	13.82
40	0.46a	12.71b	1.70a	13.92
SE ±	0.015	0.125	0.026	0.068
Interactions				
N x W	NS	NS	NS	NS
N x S	NS	NS	NS	NS
W x S	NS	NS	NS	NS
N x S x W	NS	NS	NS	NS

Means followed by the same letter(s) within a treatment group and column are not significantly different using DMRT (P=0.05). NS=Not significant (P=0.05).). * = Significant at ($P \leq 0.05$). WAP = Weeks after planting.

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EVALUATION OF IN-GROUND CURING AND STORAGE METHODS OF SWEETPOTATO FRESH ROOTS IN THE RAINFOREST ZONES OF NIGERIA

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ABSTRACT
Generally, farmers in Nigeria consider sweetpotato to be difficult to store. There are limited storage and curing methods especially at smallholder farm levels that could enhance the storability of sweetpotato roots at post-maturation. Therefore, it becomes expedient to devise strategies that will ensure the availability of sufficient sweetpotato roots post-harvest. A study was conducted at National Root Crops Research Institute (NRCRI), Umudike with the aim to evaluate pre-harvest curing and hilling-up on in-ground storability of fresh roots. The experiment was laid out as a split plot in a randomized complete block design, replicated 3 times. The main plot treatments comprised 7 varieties (UMUSPO1, UMUSPO3, Kwara, Ex-Igbariam, Butter milk, TIS87/0087, TIS8164), while 4 storage methods (Cured, Uncured, harvest after 1 month and 2 months) formed the subplot treatments. In most cases there were significant differences among varieties with UMUSPO3 (OFSP) and UMUSPO1 (OFSP) producing high yields (17.7 and 13.3t/ha respectively) compared to other varieties. Yields obtained at cured (9.3t/ha), uncured (9.1t/ha) and left 1 month in-ground unharvested (9.2t/ha) were not significantly different from each other but superior to those left in-ground unharvested for 2 months (7.6t/ha). Overall, there were varietal differences on level of susceptibility to weevil and rot incidences. Butter milk and UMUSPO1 in most cases recorded high rot losses compared to other varieties especially at 2 months unharvested. Also in most cases low weevil and rot losses occurred at cured, uncured and 1 month unharvest compared to when storage roots were left in-ground for 2 months unharvested. Conversely high weevil incidence occurred with UMUSPO1 and 3 compared with other varieties. UMUSPO1 and 3 are shallow rooted varieties and that may account for their susceptibility to high weevil attach. In general, there were advantages of these storage methods in prolonging the storability of roots with low pest and disease incidence. Further studies on quality assessment and acceptability of the storage roots under prolonged storage are recommended.

Keywprds: In-ground curing, Storage methods and Sweetpotato roots

INTRODUCTION
Low storability of fresh roots of sweetpotato has been a major problem in sweetpotato production. This is as a result of deterioration caused by mechanical injury during harvesting, physiological changes with the plant and infection by decay organism and pest infestation. Storage can be improved by adopting careful harvesting of the roots to avoid injury or bruises. Where damage or bruises occur, it can be cured to allow the bruise or injury to heal before storage. However, in Nigeria, farmers engage in piece meal harvesting of storage roots to avoid low prices associated with the peak of the harvesting due to glut. But when roots are left in the soil especially during the dry season, losses occur due to weevil attacks notably *Cylas punticolis*. These insects reach the roots through cracks in the dry soil (Stathers, et al, 2003) and the damage in most cases predisposes the roots to rots. Though rots and weevil incideces on sweetpotato roots have been reported sufficiently (Arinza, 1985. , Onifeda, et al., 2004), there is dearth of research work on improving in-ground storability of sweetpotato roots. The objectives of this study therefore will be to evaluate the effect of sweetpotato defoliation and earthen up on curing and in-ground storabilty of fresh roots on storability of fresh roots over time.

MATERIALS AND METHODS
The experiment was conducted at Umudike station in 2013 and 2014 cropping season. The trial was laid out as a split plots in randomized block design and replicated 3 times. The main plot treatments measuring 8 x 4.5 m comprised of 7 varieties (Butter milk, UMUSPO3, UMUSPO1, Kwara, TIS87/0087, TIS8164 and Ex-igbariam), and 4 storage methods (Cured, Uncured, harvest after 1 month and 2 months) with the dimension of 2 x 4.5m formed the subplot treatments. The cured treatment was defoliated one week prior to harvesting to allow the storage roots to harden. The uncured treatment was defoliated and harvested the same day while the treatments which were harvested 1 and 2 months after maturity were defoliated and earthen up and left for 1 month and 2 months before harvesting. Data were collected on root yield, weevil infestation, and rots. These were analyzed statistically using Genstat statistical package. Cultural management of the experiment as recommended were carried out.

RESULTS AND DISCUSSION

There were significant differences among varieties with UMUSPO3 (OFSP) and UMUSPO1 producing average high yields of 17.2 and 13.3t/ha respectively compared to other varieties in most cases in 2013 and 2014 (table1). There was however no significant difference between cured, uncured and when left in the ground for 1month before harvesting. This suggests that a farmer can delay harvesting for one month to escape the glut period and target high price. The result in 2014 followed the same trend but for the inconsistency in storage method. There was no significant effect of storage method on yield of varieties in 2014. The incidences of rots were evident when roots were left in the ground for 1 or 2 months before harvesting (Table2). More roots developed rots (6.0% and 12.3%) when left in the ground for 1 or two months before harvesting for both seasons. Butter milk in most cases recorded the highest storage losses (13.4%) compared to other varieties. There was low rot incidence when the roots were cured and uncured and harvested at maturity. Weevil infestation (2.3 and 6.7% for 1MAS and 2MAS respectively) was significantly high in most cases when harvesting was delayed (Table 3). Generally, UMUSPO1 had a high significant value (6.0%) of weevil infestation compared to other varieties with TIS8164 recording the lowest (0.7%) value. When roots were left in the soil for 1 or 2 months after maturity, 5% and 3% weevil infestation occur but this value is not too high to cost much economic damage to the yield.

CONCLUSION

Sweetpotato weevil (Cylas puncticollis) has been a major problem to farmers and its actions predisposes roots to rots thereby causing yield loss and low market value. This investigation revealed that sweetpotato roots can be left in the soil for 1 month or more with minimal damage. For in-ground storage methods, sweetpotato plant should be defoliated and ridges or mounds hilled up to close the cracks that could create access for weevils to get to the roots. Storing the roots in-ground following the procedures discussed will prolong storage of roots more than 1 month after maturity to enable the farmers harvest storage roots when need. Also varietal characteristics might have contributed to susceptibility to weevil attach. The two varieties (UMUSPO1 & 3) with high incidence of weevil are hallow rooted and as such more prone to weevil attach as a result of their exposed roots. Sweetpotato breeders may evaluate for deep rooted genotypes that may root beyond soil medium that weevils may have access to. However, more research is recommended to investigate the nutritional quality of the prolonged stored roots.

Table 1: Mean storage root yield (t/ha) at Umudike in 2013 and 2014 cropping season

Variety	In-ground curing method				
	Cured	**Uncured**	**Harvest 1 MAD**	**Harvest 2 MAD**	**Mean**
		2013			
Butter Milk	8.0	10.2	8.1	6.1	8.1
UMUSPO3	17.0	19.0	16.0	14.7	16.7
Ex-Igbariam	5.2	7.7	5.9	4.0	5.7
Kwara	7.2	7.2	6.4	5.3	6.7
UMUSPO1	18.6	14.4	14.2	8.2	13.8
TIS8164	5.3	4.5	4.1	0.7	3.6
TIS87/0087	9.6	9.1	8.0	9.8	9.1
Mean	10.2	10.3	9.0	7.0	
LSD	Var.= 2,77*, curing method =1.71*, Var x curing method = 4.66ns				
			2014		
Butter Milk	6.9	5.4	7.3	6.1	6.4
UMUSPO3	20.7	19.7	13.3	14.5	17.6
Ex-Igbariam	3.3	4.8	7.1	5.2	5.1
Kwara	2.2	1.7	4.8	2.3	2.7
UMUSPO1	12.4	10.9	17.0	10.5	12.7
TIS8164	3.5	3.7	4.3	4.4	4.0
TIS87/0087	8.7	8.6	10.2	7.0	8.6
Mean	8.3	7.8	9.4	8.3	
LSD	Var. = 2.15*, Curing method=1.75ns, Var. x Curing method = 4.38ns				

Table 2: Mean % root rot at Umudike in 2014 cropping season

Variety	In-ground curing methods				
	Cured	uncured	Harvest 1MAD	Harvest 2MAD	Mean
Butter Milk	0.7	0.7	19.0	33.1	13.4
UMUSPO3	1.0	0.0	8.3	4.7	3.5
Ex-Igbariam	0.0	0.0	0.8	7.7	2.1
Kwara	0.0	0.0	0.6	5.8	1.6
UMUSPO1	0.0	0.0	6.0	25.3	7.8
TIS8164	1.2	0.0	7.6	6.8	3.9
TIS87/0087	0.8	0.0	0.0	2.6	0.8
Mean	0.5	0.1	6.0	12.3	
LSD (0.05)	Var. = 8.02*, Storage method = 6.06*, Var. x storage method = 16.04ns				

Table3. Mean % weevil infestation in Umudike

Variety	In-ground curing methods				
	Cured	Uncured	Harvest 1 MAD	Harvest 2 MAD	Mean
Butter Milk	3.0	3.4	0.0	5.3	2.9
UMUSPO3	2.6	2.6	4.3	8.6	4.5
Ex-Igbariam	1.1	0.0	7.7	0.8	2.4
Kwara	0.0	1.2	5.8	3.3	2.6
UMUSPO1	2.8	0.9	16.8	4.1	6.0
TIS8164	1.0	0.0	0.0	2.0	0.7
TIS87/0087	2.0	0.0	0.8	3.3	1.5
Mean	1.8	1.0	5.1	3.9	
LSD (0.05)	Var. = 4.04*, storage method= 3.06*, Var. x Storage method = 10.61ns				

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EVALUATION OF CASSAVA LEAF LITTERS AS A SUPPLEMENT WITH INORGANIC FERTILIZER FOR SUSTAINABLE PRODUCTION AND YIELD OF CASSAVA

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ABSTRACT
A field experiment to evaluate the potentials of cassava leaf residue in sustaining cassava production under a continuous cropping system as an alternative to the use of inorganic fertilizer was carried out in 2011/2012 cropping season at the experimental field of National Root Crops Research Institute, Umudike. The various fertilizer treatments used were sole application cassava leaf residue, sole application of NPK fertilizer at the rate of 400kg/ha, combination of cassava leaf residue and 200kg/ha NPK as well as no fertilizer application which served as a check. Three varieties of cassava (TMS98/0510, TMS98/0581 and TMS96/1632) were used to determine the effect of these fertilizer applications on cassava varieties. The two-factor experiment was laid out in a randomized complete block design with three replications where cassava was planted in 1m x 1m distance in a 4m x 5m experimental unit. Variety, fertilizer rates and some of their interactions had a significant (P<0.05) effect on some of the growth and yield attributes of cassava measured. TMS98/0510 had a significant higher performance than the other varieties, whereas; cassava leaf residue in combination with 200kg inorganic fertilizer application was higher than the other fertilizer treatments. Therefore, cassava leaf residue can serve as an alternative and readily available source of nutrients for cassava production and sustainable soil fertility.
Keywords: Cassava leaf litters, inorganic fertilizer, sustainable production, yield and cassava

INTRODUCTION
Cassava (*Manihot esculenta* Crantz) is the most widely consumed root crop of the tropics (Nweke *et al.*, 1994; Henry 1995). It is a major food source for more than 500 million people in Africa, Latin America and Asia. It is mainly cultivated for its starchy roots with a world production estimated at 152 million tons (FAO, 1996). The total area harvested is about 16 million hectares with 60%, 24% and 16% in Africa, Asia, and Latin America respectively (Bonierbale *et al.* 1997, FAO, 2002). The storage roots are the basic component of the carbohydrate diet and the leaves are consumed as the preferred green vegetable in many parts of Africa, providing protein, minerals and vitamins (Hahn, 1989). Approximately 71% of world cassava production is utilised for human consumption, while the rest is for animal feed and industrial uses (Sarma and Kunchai, 1991).Cassava leaves have potential that can help in sustainable cassava production through its contribution to soil fertility. Considering the constant practice of farmers having to plant and harvest the same piece of land yearly due to inadequate farm land, and with the present high cost of fertilizer. There is, therefore, the need to carry out agronomic practices that can sustain cassava production on the same piece of land. This work aims at determining the contribution of cassava leaf residue to sustain a new crop on the same piece of land as well as contributing to soil improvement.

MATERIALS AND METHODS
Three cassava varieties of specific growth and branching habit were used for treatments of the following cassava leaf residues and inorganic fertilizers as supplement: no cassava leaf residue as control, application of cassava leaf residue alone, application of cassava leaf residue + 200kg inorganic fertilizer and application of 400kg inorganic fertilizer, alone as control in a randomized complete block design (RCBB) with 4 replicates. For the first year of the experiment, planting was done and basal application of inorganic fertilizer carried out in all the plots to ensure good growth and performance of the cassava for the following year work. At harvest of the first year work, the plots were weeded to dispose other leaves other than cassava leaves , the stem and stalk of cassava was removed leaving the cassava leaf only on the needed plots. The leaves were allowed for some time on the plots before the field is prepared for the subsequent cropping. This work will be done for three years on the same piece of land. Data were analysed using Microsoft excel and GenSTAT.

RESULTS AND DISCUSSION
Effect on Germination Count
Varieties affected the establishment rate of cassava but not the fertilizer application and the interaction between the two factors. The three varieties were statistically different in their rate of establishment in the field. TMS98/0510 had the highest establishment rate than the other varieties. Although not significantly different (P>0.05), there was a recorded higher plant establishment count in the check than the fertilizer treatments.

Effect on Vigour

Cassava Vigor was significantly affected by varieties and fertilizer treatments (P<0.05), but not their interaction. TMS98/0510 was the most vigorous of all the varieties used. The mean fertilizer treatment effect on vigor showed that there was an increased vigor with application of fertilizer treatments compared to when there was no fertilizer application. However, the combined application of organic manure and NPK fertilizer at the rate of 200kg/ha (Organic manure+20kg NPK) and sole application of NPK fertilizer at the rate of 400kg/ha were the same.

Effect on number of Tuber

The number of tubers was significantly influenced by the different fertilizer treatments as well as the varieties. There was no significant interaction effect between the two treatment factors. The variety TMS98/0510 had a higher and significant number of roots than the other two varieties. The fertilizer treatments had higher number of roots than the check. The combination of organic and inorganic fertilizer at 200kg/ha supported the highest number of roots than the other fertilizer treatments. Number of roots in TMS98/0581 increased with the addition of organic manure (sole), Organic +200kg NPK and 400kg NPK.

Effect on weight of Tuber

The analysis of variance showed that the tuber yield of cassava was significantly (P<0.05) affected by the varieties of cassava but not with the fertilizer treatments as well as their interactions. TMS98/0510 had the highest tuber yield followed by TMS98/0581 and TMS96/1632 in a decreasing order. Addition of fertilizer treatments had higher yield than the check where no fertilizer was applied. The combination of organic and 200kg of NPK fertilizer had the highest tuber yield than other fertilizer treatments. This combination was highest with TMS98/0510 and the sole addition of 400kg NPK although not significant, reduced yield.

CONCLUSION

The use of cassava leaf residue in maintaining soil fertility has great potential in sustaining cassava production. However, the combined application of cassava leaf residue and inorganic fertilizer at the rate of 200kg/ha proved to be very effective. This therefore, suggests a 50% reduction in the cost of inorganic fertilizer application. TMS98/0510 had an outstanding growth and yield performance in all the parameters measured and should be made available to cassava end users for enhanced cassava production.

Table 1: Effect of the inorganic and organic on the germination count of cassava varieties

Treatment	TMS 98/0510	TMS 98/0581	TMS 96/1632	Mean
No fertilizer	31.75	21.75	22.75	25.42
Organic manure	33.75	16.75	24	24.83
Organic manure + 200kg NPK	33.75	17.75	21.25	24.25
400Kg NPK	33.75	19.75	20.5	24.67
Mean	33.25	19.00	22.13	24.79
LSD (0.05)	V= 3.03**; Trmt. = 3.5^{ns}; Vx Trmt. = 6.06 ^{ns}			

Table 2: Effect of the inorganic and organic fertilizer on the vigour of cassava varieties

Treatment	TMS 98/0510	TMS 98/0581	TMS 96/1632	Mean
No fertilizer	2.50	1.75	2.75	2.33
Organic manure	3.50	2.50	2.50	2.83
Organic manure + 200kg NPK	4.00	3.25	3.25	3.50
400Kg NPK	4.00	3.50	3.00	3.50
Mean	3.50	2.75	2.88	3.04
LSD(0.05)	V= 0.48**; Trmt. = 0.55***; Vx Trmt. = 0.96 ^{ns}			

Table 3: Effect of the inorganic and organic fertilizer on the number of tuber of cassava varieties

Treatment	TMS 98/0510	TMS 98/0581	TMS 96/1632	Mean
No fertilizer	37.8	31.5	34.8	34.70
Organic manure	81.8	40	27.3	49.70
Organic manure + 200kg NPK	101.5	58.8	46.2	68.83
400Kg NPK	78.2	59.8	32.8	56.93
Mean	74.83	47.53	35.28	52.54
LSD(0.05)	V= 14.95***; Trmt. = 17.26**; Vx Trmt. = 29.90 ^{ns}			

Table 4: Effect of the inorganic and organic fertilizer on the weight of tuber of cassava varieties

Treatment	TMS 98/0510	TMS 98/0581	TMS 96/1632	Mean
No fertilizer	31.10	30.60	44.00	35.23
Organic manure	54.10	36.20	26.20	38.83
Organic manure + 200kg NPK	63.60	46.70	39.80	50.03
400Kg NPK	56.30	53.10	29.10	46.17
Mean	51.28	41.65	34.78	42.57
LSD(0.05)	V= 12.10*; Trmt. = 13.97^{ns}; Vx Trmt. = 24.20 ^{ns}			

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EFFECT OF DIFFERENT SOURCES OF BIOCHAR ON NUTRIENT COMPOSITION AND GROWTH PARAMETERS OF OKRA IN UMUDIKE

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ABSTRACT

A Pot experiment were conducted at Umudike Southeastern Nigeria to study the effects of different sources of biochar on growth parameters and leaf/pod nutrient composition of Okra (Abelmoschus esculentus moench). The biochar treatments were prepared from eleven (11) different feed stocks which comprised – bone (BN), Cocoa pod (CP), Cow dung (CD), Goat dropping (GD), Palm bunch (PB),Pig waste (PW), Poultry droppings (PD), Rice mill husk (RMW), Saw dust (SD), Mucuna flagellipes shell (MFP), Wood shaving (WS) and a mixture of all the feed stocks mixed together (MFB) and one control (Ctrl) making it 12 treatments in all. The treatment were applied at the rate of 3 t / ha (equivalent to 86g) in 10kg of soil weighed into poly bags and replicated 4 times using completely randomized design (CRD). Parameters measured were plant height number of leaves at 2, 4, 6 and 8 weeks after planting (WAP) and nutrient composition (N, P, K, Ca and Mg) of okra leaf/pod at 8WAP. The results obtained from the study showed that application of different sources of biochar significantly increased number of leaves, plant height and leaf/pod nutrient (N, P, K, Ca, and Mg) content of okra over the control. Though pots amended with mixed feedstock biochar (MFB) gave best result both in plant height, number of leaves at 2, 4, 6, and 8 WAP (5.62, 14.50, 28.90, and 41.20cm) and nutrient composition of okra, Nitrogen (4.20%), Phosphorus (1.10%), Potassium (3.80%), Calcium (0.72%) and Magnesium (0.48%).

Keywords: Biochar, Nutrient Composition, Growth and Okra

INTRODUCTION

In tropical country such as Nigeria, high cost and scarcity of fertilizers hinder fertilizer use by most resource poor farmers in the rural areas. Hence, attention has shifted to the conversion of organic wastes into biochar for plant nutrition. Biochar is a solid product material produced during a process known as pyrolysis from the thermo-conversion of biomass under little or no oxygen for use in soils as an amendment Lehmann (2009). A lot of studies have been carried out on the direct application of organic wastes for crop production. However the fertilizing values of these wastes when converted to biochar have not received much attention in the tropics. This is not the case in the temperate countries, where use of organic waste biochar have been shown to improve soil physio chemical properties and nutrient status of okra. Novak *et al*., (2009) and Gaskin *et al*., (2008). On lowly fertile soils of Oklahoma, biochar was found to improve the soil chemical properties, growth parameters and nutrients composition of okra. Laird *et al*., (2010). A study was carried out on an Ultisol of umudike in Abia state, Nigeria to investigate the effect of biochar sourced from different organic wastes on growth characteristics and nutrient composition of okra an important tropical and sub-tropical vegetable grown for its leaf/pod.

MATERIALS AND METHODS

The study was carried out at Umudike, Ikwuano LGA of Abia state southeastern Nigeria. Umudike is located on latitude 05° 29' N, longitude 07° 33' E and 122m above sea level. The climate is essentially humid tropical with an average annual precipitation of 2164mm. There are two distinct seasons; the rainy season which starts in March/April and ends in October. Then the dry season which starts in November and ends in March subsequent year (NRCRI Meteorology Centre, 2015). Soil samples were collected at the depth of 0 - 15cm, air dried, crushed and sieved with 5mm sieve then ten kilograms (10kg) of the soil were weighed into experimental polyethylene bag properly labeled and laid out in Completely Randomized Design (CRD). The treatments (biochar) were prepared from 11 different feed stock/sources - Bone (BN), Cow dung (CD), Cocoa pod (CP), Goat droppings (GD), Palm bunch (PB), Pig waste (PW), Poultry Dropping (PD), Rice mill wase (RMW), Saw dust (SD), Mucuna flagellipes (MFP), Wood shavings (WS), Mixed feedstock biochar (MFB) using a slow pyrolysis drum method. The biochar were applied at the rate of 3t/ha with its grams equivalent of 86g. The 12 treatment and one control were randomly assigned to the container and replicated four times to give a total of 52 pots. The treatments were applied and mixed thoroughly with the soil, moistened and allowed to equilibrate for 1 week. Okra seeds (Var. NH 99/28) obtained from National Agric. Seed Council Umudike Regional Office were planted 4 seeds per pot and later thinned to two plants per stand after two weeks. Plant height and number of leaves were determined at 2,4,6 and 8 weeks after planting (WAP); using meter rule. The plants were uprooted, washed, oven dried at 65°C., grinded and digested for nutrients extraction using double acid extraction method by Udo *et al*., (2009). Total Nitrogen (N) was determined my micro Kjeldahl method, Phosphorus (P) was determined by Vanado-molybdate colorimetry on spectrometer, Potassium (K) was determined by flame photometer while Calcium (Ca) and Magnesium (Mg) were determined by titrametric method as described by Udo *et al.,* (2009). Data were subjected to analysis of variance for CRD experiment, significant treatment means were separated using the least significant difference at 5% probability level.

RESULTS AND DISCUSSION

Table 1 show the effect of different sources of biochar on okra height at 2, 4, 6 and 8 weeks after planting (WAP). Plant height increased significantly ($P < 0.05$) across the weeks during the experiment as a result of applying different source of biochar. Okra treated with MFB gave the highest value on plant height across the weeks of the experiment (2, 4, 6 and 8 WAP) (5.63, 14.50, 28.90 and 41.20cm) while the lowest value on plant height were recorded on pots with no treatment (control) (5.03, 13.48, 24.03 and 35.67cm). Data on number of leaves in response to different source of biochar were presented in Table 2. Different sources of biochar increased number of leaves compared with control across the weeks. MFB and MFP gave the highest value on number of leaves across the weeks 2, 4, 6, and 8 WAP (5, 8, 9 and 11) followed by poultry droppings (PD) (4, 8, 9 and 11) while pot with no treatment had the lowest value on number of leaves (3,6,8 and 10). Table 3 contains data on okra nutrient. Different source of biochar increased N, P, K, Ca and Mg contents significantly ($P < 0.05$) relative to the control. The highest value of N, P, K and Ca were obtained from okra treated with MFB (4.20, 1.10, 3.80 and 0.72%) followed by PT (N, P, K and Ca) (3.72, 1.22, 3.6 and 0.65%). Though okra treated with BN gave the highest value on Mg (0.80%) while the control gave the lowest value across all the nutrient (N, P, K, Ca, and Mg) (1.95, 0.28, 1.80, 0.41 and 0.22%). The increase in plant height, number of leaves and nutrient content (N, P, K, Ca, and Mg) of okra due to application of different source of biochar is in accordance with result obtained by Lehmann (2009), Gaskin et *al* (2008) and Laird *et al* (2010).

CONCLUSION

It is concluded that biochar from different source has fertilizing effect in production and can serve as an alternative to the expensive fertilizer for most small-holding farmers.

Table 1: Mean Effect of different source of Biochar on Plant Height (cm) of Okra at 2, 4, 6, and 8 WAP

Treatment	2WAP	4WAP	6WAP	8WAP
Control	**5.03**	**13.48**	**24.03**	**35.67**
BN	**5.23**	**13.88**	**28.40**	**40.28**
CD	**5.25**	**14.10**	**28.00**	**40.20**
CP	**5.33**	**13.85**	**28.50**	**39.93**
GD	**5.20**	**14.00**	**28.00**	**40.18**
PB	**5.20**	**14.10**	**24.43**	**39.83**
PW	**5.63**	**14.50**	**28.48**	**40.65**
PD	**5.50**	**14.33**	**28.63**	**40.83**
RMW	**5.28**	**13.60**	**28.00**	**40.13**
SD	**5.30**	**14.40**	**28.30**	**40.18**
MFP	**5.33**	**14.30**	**28.45**	**40.40**
MFB	**5.62**	**14.50**	**28.90**	**41.20**
WS	**5.18**	**13.70**	**28.43**	**40.35**
LSD (0.05)	**0.33**	**0.40**	**0.66**	**0.86**

Note: BN = Bone; CD = Cow dung; CP = Cocoa pod; GD = Goat droppings; PB = Palm bunch; PW = Pig waste; PD = Poultry dropping; RMW = Rice Mill waste; SD = Saw dust; MFP = Mucuna flagellipes; MFB = Mixed feed stock biochar; WS = Wood shaving; WAP = Weeks After Planting; LSD = Least significant difference.

Table 2: Mean Effect of different source of Biochar on Number of Leaves of Okra at 2, 4, 6, and 8 WAP

Treatment	2WAP	4WAP	6WAP	8WAP
Control	3	6	8	10
BN	4	6	9	11
CD	4	7	9	11
CP	4	7	9	11
GD	4	7	9	11
PB	4	7	9	11
PW	4	8	9	11
PD	4	8	9	11
RMW	4	7	9	11
SD	4	7	9	11
MFP	5	8	9	11
MFB	5	8	9	11
WS	4	7	9	11
LSD (0.05)	0.53	0.80	0.37	0.39

Note: BN = Bone; CD = Cow dung; CP = Cocoa pod; GD = Goat droppings; PB = Palm bunch; PW = Pig waste; PD = Poultry dropping; RMW = Rice Mill waste; SD = Saw dust; MFP = Mucuna flagellipes; MFB = Mixed feed stock biochar; WS = Wood shaving; WAP = Weeks After Planting; LSD = Least significant difference.

Table 3: Mean Effect of different source of Biochar on Nutrient Composition of Okra at 8WAP

	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
Control	1.95	0.28	1.80	0.41	0.22
BN	3.10	0.40	2.60	0.67	0.80
CD	3.30	0.54	2.80	0.50	0.38
CP	3.50	0.62	3.80	0.58	0.40
GP	3.20	0.56	3.00	0.50	0.32
PB	3.62	0.80	3.20	0.61	0.35
PW	3.66	0.81	3.40	0.64	0.43
PD	3.72	1.22	3.60	0.65	0.40
RMW	3.06	0.52	2.80	0.48	0.30
SD	3.00	0.48	3.00	0.51	0.31
MFP	3.80	0.78	3.20	0.63	0.39
MFB	4.20	1.10	3.80	0.72	0.48
WS	2.95	0.49	3.10	0.49	0.32
LSD (0.05)	0.71	0.20	1.20	0.18	0.10

Note: BN = Bone; CD = Cow dung; CP = Cocoa pod; GD = Goat droppings; PB = Palm bunch; PW = Pig waste PD = Poultry dropping; RMW = Rice Mill waste; SD = Saw dust; MFP = Mucuna flagellipes; MFB = Mixed feed stock biochar; WS = Wood shaving; N = nitrogen; P = phosphorus; K = potassium; Ca = calcium; Mg = magnesium; LSD = Least significant difference.

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EVALUATION OF NEWLY INTRODUCED AMERICAN YAM BEAN ACCESSIONS IN NIGERIA

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ABSTRACT
American yam bean (Pachyrhizus spp) (AYB) has been successfully introduced in some African countries with exciting results. Fourteen AYB accessions were received from CIP Lima Peru. The objective was to assess the performance of twelve American yam bean accessions under Nigerian environmental conditions in order to identify and select adapted genotypes with high yield and acceptable culinary qualities. Twelve accessions - 209039, 209016, 209013, 209037, 209019, 209015, 209038, 209018, 209041, 209045, 209042 and 209044 were planted in the field on the 30th of May 2014 in a randomized complete block design with two replications. Results obtained show that percentage emergence (3WAP) ranged from 30% in accession 209041 to – 93.3% in accession 209018. Tuber skin colour ranged from cream, dark cream to purple while tuber flesh colour was mostly milky to milky white. Number of tubers/m² ranged from 0.33 in accession 209045 to 4.17 in accession 209015. Tuber yield ranged from 0.03 to 1.7kg/m² and there were significant differences between accessions. Based on tuber yield, 5 accessions 209013, 209015, 209016, 209018 and 209019 were selected for further evaluation. Yields obtained showed that these selected accessions have the potential to serve as alternative sources of calories to help feed increasing population.

Keywords: *Pachyrhizus spp*, yield, genotypes, rotenone and growth attributes

INTRODUCTION

American yam bean (*Pachyrhizus spp*) (AYB) has been successfully introduced in some African countries (Zanklan *et al*. 2007; CIP, 2014a) but not in Nigeria. Its tubers can be eaten raw or processed into a number of products including garri (Padonou *et al*., 2013). These products are iron dense and have good iron bioavailability (CIP, 2014b). An important characteristic of yam bean Pachyrhizus is the presence in the matured seeds of the isoflavoniod called rotenone, an insecticidal compound. The presence of high levels of rotenone and pachyrhizide make seeds of AYB toxic and unsuitable for human consumption (Zanklan, 2003). Fourteen accessions of AYB were received from International Potato Centre (CIP), Lima in March, 2013. The accessions were received in the form of true seeds. The objective was to assess their performance under Nigerian environmental conditions in order to identify and select adapted genotypes with high yield and acceptable culinary qualities.

METHODOLOGY

Twelve accessions - 209039, 209016, 209013, 209037, 209019, 209015, 209038, 209018, 209041, 209045, 209042 and 209044 were planted in the field on the 30th of May in a randomized complete block design with two replications. Planting distance was 1m inter-row and 0.3m intra-row, giving a population density of 33,333 stands per hectare. No fertilizer was applied. Weeding was manual. Harvesting was carried out in December, 2014. Data were collected on some growth and tuber yield attributes. Nematode symptoms were also assessed. Data was statistically analyzed using genstat software (discovery edition).

RESULTS AND DISCUSSION

Growth Attributes

Data on some growth attributes of AYB are presented in table 1. Percentage emergence (3WAP) ranged from 30% in accession 209041 to – 93.3% in accession 209018. Plant vigour scored on a scale of 1-5 ranged from 1(Very poor) to 5(Highly vigorous). There was a variety of growth habits from erect to creeping and from determinate to indeterminate types. Even within an accession, plants varied in these attributes. Field outlook of some accessions are shown in Fig 1.

Tuber Yield Attributes

Some tuber yield characteristics of AYB are presented in table 2 while freshly harvested tubers are shown in fig 2. Tuber skin colour ranged from cream, dark cream to purple while tuber flesh colour was mostly milky to milky white. Number of tubers/m2 ranged from 0.33 in accession 209045 to 4.17 in accession 209015. Accession 209015, differed significantly from many other accessions in number of tubers/m2. Tuber yield ranged from 0.03 to 1.7kg/m² and there were significant differences between accessions. Zanklan (2003) reported differences between tuber fresh yield of accessions of *Pachyrhizus ahip* but did not find significant differences between numbers of tubers. He however reported significant differences between numbers of tubers in *Pachyrhizus tuberosus.*

CONCLUSION

Based on tuber yield, 5 accessions were selected for further evaluation at 3 different locations in 2015. These accessions are 209013, 209015, 209016, 209018 and 209019.

Table 1: Some growth characteristics of American yam bean at Umudike

Accession	% Emergence @3WAP	Plant vigour*	Plant length	*Plant type
209013	83.3	5	Long	C/I
209015	83.3	5	Medium	E/D
209016	86.7	5	Long	C/I
209018	93.3	5	Medium	C/I
209019	33.3	3	Short	E/D
209037	40.0	4	Short	E/D
209038	40.0	5	Long	C/I
209039	33.3	3	Short	P/D
209041	30.0	1	Short	E/I
209042	70.0	4	Long	C/I
209045	90.0	3	Medium	C/I
209046	73.3	3	Short	E/D

**Plant type: E = erect, C = Creeping, D = Determinate, I = Indeterminate, P = Procumbent;*
**Plant vigour: 1-Verypoor, 2-Poor, 3- Fair, 4- Vigorous, 5- Highly vigorous.*

Table 2: Tuber yield attributes of American yam bean at Umudike

Accession	Number of tubers/m^2	Tuber Yield kg/m^2	Tuber Skin Colour	Tuber Flesh Colour
209013	1.83	0.38	Dark Cream	Light Yellow
209015	4.17	1.70	Cream	Milky White
209016	2.67	0.90	Cream	Milk
209018	3.17	1.23	Cream	Milky White
209019	3.00	0.53	Dark Cream	Milk
209037	1.17	0.07	Purple	Milk
209038	0.67	0.05	Dark Cream	Milky White
209039	0.50	0.03	Cream	Milky White
209041	0.67	0.03	Cream	Milk
209042	0.67	0.10	Cream	White
209045	0.33	0.03	Dark Cream	Milk
209046	1.83	0.23	Cream	Milk
SED	1.06	0.48		
CV%	61.3	47.6		

Fig 2: Freshly harvested tubers of American Yam Bean

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ROOT AND TUBER CROP EXPANSION IN NIGERIA: OVERVIEW AND WAY FORWARD

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ABSTRACT
Roots and tubers provide a substantial part of national food supply and are also an important source of animal feed. This paper relied on secondary data and information to review efforts to increase production of root and tuber crops in Nigeria with emphasis on Root and Tuber Expansion Programme (RTEP) and Research based programmes. RTEP was found to have had a very strong positive impact on production, processing, marketing and utilization of root and tuber crops especially cassava and yam. Farmers took advantage of technologies disseminated through RTEP to expand their acreage and increase productivity which ultimately increased income and reduce poverty amongst participating farmers and communities. The potentials of research based programmes like YIISFWA, HarvestPlus, NEXTGEN, amongst others to enhance production of root and tuber were highlighted. It was suggested that future intervention strategies for root and tuber crops expansion intensification, mechanization, value addition and product development, strengthening extension delivery and advocacy, improvement of rural infrastructure and encouraging the production of minor roots and tubers
Keywords: Root, Tuber, Expansion and Nigeria

INTRODUCTION
Root and tuber crops are grown for their underground modified, thickened root or stem. Those with modified tuberous and fleshy primary or secondary roots are simply referred to as roots (Cassava, Sweetpotato) while those plants with modified thickened tuberous stems are referred to as tubers (eg Yam, Potato, Livingstone potato). Rhizome are underground, horizontally enlarged shoot, more or less fleshy when fresh (eg ginger, turmeric). The principal root and tuber crops of Nigeria are cassava (*Manihot esculenta* Crantz), yam (*Dioscorea* spp.), sweet potato (*Ipomoea batatas* L.), potato (*Solanum* spp.) and cocoyam (*Colocasia* spp. and *Xanthosoma sagittifolium*). Root and tuber crops of minor importance in Nigeria include Livingstone potato (Rizga) (*Plectranthus esculentus*) Hausa potato (*Solenostemon rotundifolius*), and Polynesian Arrowroot (Amora) (*Tacca leontopetaloides* Kuntze). Ginger (*Zingiber officinale L*) and Turmeric (*Curcuma longa* L) are rhizomatous spices. Root and tuber crops share some common characteristics but are also very dissimilar in many respects (Table 1). They differ in plant architecture, maturity period, temperature, soil and fertility requirements and storability.

Table 1: Characteristics of Root and Tuber Crops

Characteristics	Cassava	Potato	Sweetpotato	Ginger	Taro	Yam
Growth period (months)	9-24	3-7	3-8	9-12	6-18	8-11
Annual or perennial plant	per.	ann.	Per.	per.	per.	ann.
Optimal rainfall (cm)	100-150	50-75	75-100	140-200	250	115
Optimal temperature (°C)	25-29	15-18	>24	13-29	21-27	30
Drought resistance	yes	No	Yes	no	no	yes
Optimal pH	5-6	5.5-6.0	5.6-6.6	5.5-6.5	5.5-6.5	5-5.5.
Fertility requirement	low	High	Low	high	high	high
Organic matter requirement	low	High	Low	high	high	high
Growable on swampy, water-logged soil	No	no	no	no	yes	no
Planting material	stem	tubers cutting	vine cutting	rhizomes	corms/ cormels	tubers
Storage time in ground	long	short	long	long	moderate	long
Postharvest storage life	short	Long	Short	long	variable	long

Source: Adapted with modification from Kay, D.E., 1973. Tropical Products Institute, London, as presented in Horton 1988.

Roots and tubers provide a substantial part of the world's food supply and are also an important source of animal feed. They also provide some minerals, essential vitamins, and proteins in variable amounts. In most traditional diets vegetable soups, meat, groundnuts, grain legumes and fish are good sources of protein and are frequently used to supplement root crops and compensate for their protein deficiencies. In some parts of Africa the diet is supplemented with the tender leaves of sweet potato, cassava and cocoyam which are rich sources of protein, minerals and vitamins (Hahn, 1984). The aggregate value of yam, cassava, potato and sweetpotato exceeds all other African staples, including cereal crops (cereals annually producing on average 169 million tons on 108 million ha of land) (Saginga, 2015). Figures 1, 2 and 3 show trends in area under cultivation, yield/ha and production respectively of five major root and tuber crops grown in Nigeria from 1990-2013 (Source: FAOSTAT downloaded 17th July, 2016).

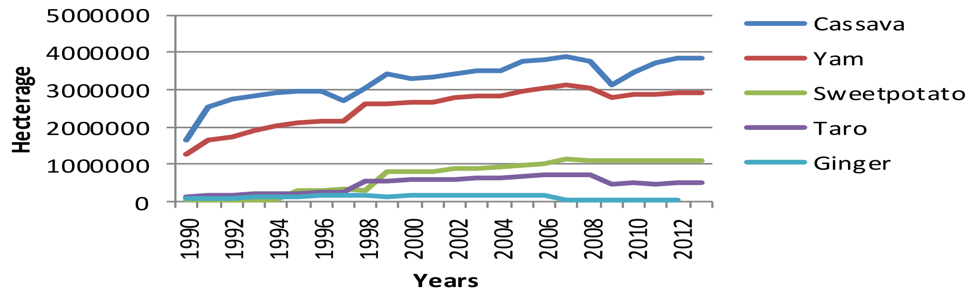

Fig 1: Area under cultivation of Major Root and Tuber Crops in Nigeria

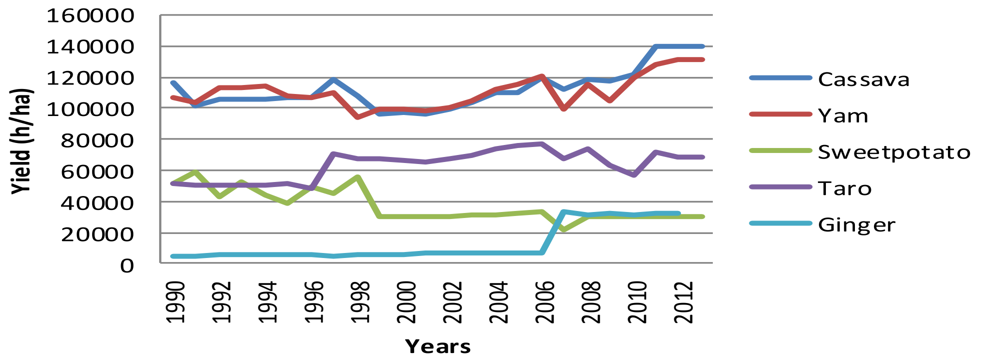

Fig 2: Trend in Yield of Major Root and Tuber Crops

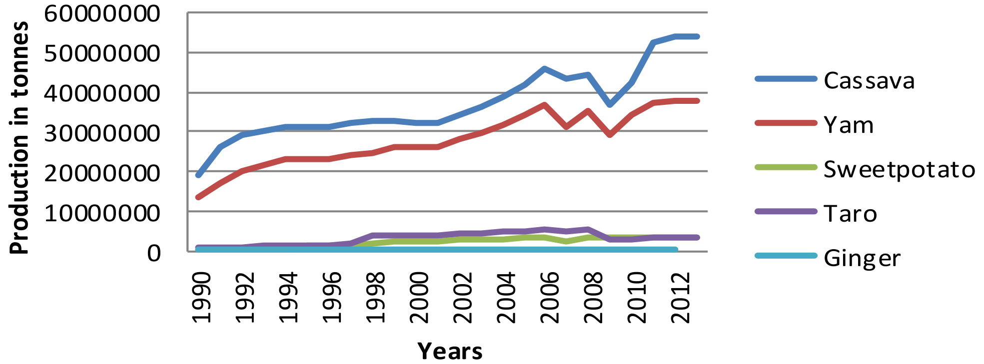

Fig 3:Trend in Production(t) of Major Root and Tuber Crops in Nigeria

Government intervention and the efforts of non-governmental organizations in the root and tuber crop subsector have led to a number of measures that support the production, processing and marketing of root and tuber crops especially cassava, dating back to the 1970s. These include government programmes such as the National

Accelerated Food Production Programme (NAFPP), Operation Feed the Nation (OFN), the Agricultural Development Projects (ADPs), Cassava Multiplication Programme (CMP), Root and Tuber Expansion Programme (RTEP), Presidential Cassava Initiative (PCI), Agricultural Transformation Agenda (ATA), the development of the National Agricultural Research Systems and their close collaboration with the International Institute of Tropical Agriculture (IITA) and other international agricultural research centres and activities of oil companies and church organizations. Through these efforts, appreciable progress has been made in genetic improvement, agronomic practices, root storage and in the development of processing technology and rural infrastructure. For example, National Root Crops Research Institute Umudike in Collaboration with IITA have developed and released 43 improved cassava (Okonkwo, 2015), 19 yam, 3 sweetpotato and 2 potato varieties to farmers. In addition, many rapid seed multiplication techniques, agronomic and post-harvest management packages have also been developed. Concerted efforts have also been made to create awareness, and extend these improved practices to farmers. While these programmes especially CMP, PIC, RTEP and ATA led to significant expansion in the production and utilization of cassava only RTEP cut across other root and tuber crops and as a result will form the main focus of this paper.

Root and Tuber Expansion Programme (RTEP)

RTEP was launched in 2000, drawing on lesson learnt from Cassava Multiplication Scheme (CMS) but effective disbursement of the loan commenced in 2002 (FAO, 2001, Adeniji, 2006). The total project cost of USD 36.09 was funded by IFAD loan USD 23.6 million; US$ 7.18 million from Federal Government of Nigeria; USD 5.85 million from State Governments. This phase of the project ended in 2010 with Federal Ministry of Agriculture and Water Resources (FMAWR) through its Federal Department of Agriculture as the implementing agency (FAO, 2010a). The long-term objective of RTEP is to commercialize root and tuber production to improve the living conditions, income, food security and nutritional health of the poorest smallholder households in the programme area. It particularly targets small-scale farmers with less than 2 hectares of land per household. The programme used the existing extension service system to introduce improved varieties of roots and tubers and better cultivation techniques. Since women play a major role in cassava and other food crop production, processing and marketing, the programme encourages them to participate in research trials and demonstrations (Adeniji, 2009; IFAD, 2010). Specific programme objectives include: developing improved root and tuber production technologies to increase productivity; multiplying improved planting material; developing processing techniques and marketing activities; and collaborating with NGOs to provide training to farmers (FMANR, 2006, Adeniji, 2009). Twenty six states in the root and tuber crops-growing belt participated in RTEP. The overall target group was about 5.2 million small holders with less than 2 to 3 ha of land holding per household in Nigeria (PIM 2001 in Ibrahim and Onuk, 2010). The activities include multiplication and distribution of improved root and tuber planting materials and adding value to root and tuber crops by processing, marketing and linking fabricators with processors (Okeh et al., 2014). In addition, actions and strategies to strengthen downstream activities, check incidences of low prices in producing communities, bridge income disparities, and enhance employment were also incorporated into the programme (Olusegun et al, 2015).

Impact of RTEP

The programme improved the availability and access to new varieties of planting materials, and has also enhanced the processing and marketing of products. It introduces trade policies to expand the breadth of demand for root and tuber products, and cassava in particular. It also helps targeted communities purchase equipment for processing (IFAD, 2010). As a result of RTEP, farmers increased the area under cultivation of root and tubers especially cassava. Tijani and Thomas, (2011) reported as shown in Table 3 that percentage of farmers in Remo area of Ogun State who cultivated between 1 — 3 hectares increased from 50.0% to 71.1%, while farmers with less than one hectare reduce from 38.9% to 28.9% before and after RTEP intervention respectively. This was evident in most other communities that participated in the project as shown by other reports (Mgbakor et al., 2013). In addition, farmers took advantage of RTEP to increase production (Ater et al., 2006, Tijani and Thomas, 2011). Before the intervention the percentage of farmers who had yield of less than 1 ton was 77.8% but with the introduction of RTEP, the percentage of farmers who produced between 2 - 4 tons shoot up from 22.2% to 84.4%. Olusegun et al, (2015) reported that adoption of RTEP increased yield and crop income by a range of about 13.00 to 18.52 metric tons and ₦39,705 to ₦42,133 respectively.

Increased production due to RTEP was not just as a result of expansion of land area under cultivation but also from increased productivity due to awareness, availability and utilization of improved varieties and healthier planting materials. RTEP had a positive impact by widening and improving crop varieties and production; field evidence has shown a relatively high adoption rate (70-80%) for recommended cassava varieties. However, the full yield potential of such improved cultivars is still to be achieved. In addition, it has highlighted the potentials of roots and tubers as industrial raw materials (HQCF, starch and chips; as well as cassava pellets for animal feeds) (IFAD, 2010). By expanding root and tuber crop production RTEP increased income and reduce poverty amongst participating farmers and communities. This has been shown by findings reported by various authors

(Ater et al., 2006; Olujide and Leoto, 2010; Obisesan et al., 2013; Olusegun et al, 2015). Crop income of farmers was increased by a range of about ₦39,705 to ₦42,133 respectively and poverty reduced by a range of about 5 to 20%. Poverty incidence and indices of beneficiaries of RTEP decreased and were lower than those of non-participants. Ugwu (2006) reported that in Enugu State, RTEP contributed to rural livelihood development mainly in terms of increased farm household income, farm input provision, extension contact, additional family/farm assets, food security as well as capacity building/skill training and improved storage/preservation methods. According to the project completion digest (IFAD, 2010a), in terms of physical assets, RTEP contributed to constructing/upgrading a total of 354 cassava processing sheds/centres, of which 166 centres were functional as at RTEP completion, established, owned and operated by small-scale programme beneficiaries. In addition, at RTEP completion, a total of 65 cassava processing factories had been established by medium-scale operators. The findings of the study by Achem et al., (2013) showed that RTEP provided more than 73 percent of total cassava processing equipment in the Kwara State. The study further revealed that there was significant increase in income of RTEP compared to Non RTEP participants. RTEP helped create higher level of awareness about the potentials of roots and tubers, especially cassava, for direct consumption. In addition, the contribution of the programme in increasing the national output of roots and tubers between 2000 and 2009 infers more and greater resources to farming families and, consequently, improved living standards (IFAD, 2010a). From the perspective of crop processing and value addition, the implementation of RTEP has successfully demonstrated the bright future for and the high potential of cassava for household consumption.

RTEP enhanced food security by lowering food insecurity incidence and indices of RTEP farmers compared with non-beneficiaries (Obisesan and Omonona, 2013). This reveals that RTEP improved production technology has the potential to improve food security.

Sustainability post funding

Some well to do farmers and processors have started replicating improved processing shed/centres models. Scale expansion in more in the area of cassava production, as over 75% of farming groups have seen the need to cultivate more than the 1-2 ha allocated to them under the RTEP. In addition, the huge human capacities developed/built, the skills imparted, the orientation and perspectives inculcated in root and tuber farmers/producers, processors, are likely to be long lasting, especially in terms of attracting future investments in the subsector and exploring opportunities especially relating to cassava. According to the project completion digest (IFAD, 2010a), the Nigerian small holder farmers, small processors and medium-scale are willing to continue with activities beyond and after the programme period and IFAD support. It is likely that the beneficiaries may further continue their investments in roots and tubers cultivation and processing, long after programme closure. In addition, with the availability of crop varieties whose potential productivity has only been minimally explored, the effort by farmers to enhance production per unit of land is necessarily a continuing agenda even after RTEP. Federal government launched phase 2 of the RTEP in 2010 to consolidate on the successes achieved in phase 1 and address the problem of production growth experienced each year by farmers after harvest. RTEP unit now exists as a unit in the Federal department of Agriculture.

RESEARCH BASED PROGRAMMES FOR ENHANCED PRODCUTION OF ROOT AND TUBER CROPS

There are a growing number of programs of research in Africa on yam, cassava, potato and sweet potato addressing genetic enhancement, seed systems, production, marketing and nutrition impacts. These programmes include Yam Improvement for Income Generation and Food Security in West Africa (YIIFSWA), Next Generation Cassava Breeding Project (NEXTGEN), Alliance for Green Revolution in Africa (AGRA), HARVESTPLUS, Cassava: Adding Value to Africa (C:AVA) amongst others (Table 2). Different approaches to improve the quality of production technologies used by smallholder farmers have been developed. New varieties were developed and distributed to farmers. Farmers were trained to produce quality seed for their own use, for local seed provision and opportunities for small-scale seed enterprises were explored. Partnerships involving both national and international actors were created to expedite access and availability of the improved technologies to African small holders. Some instances will suffice. HarvestPlus, for example leads a global effort to improve nutrition and public health by developing and disseminating staple food crops that are rich in vitamins and minerals. Over 106, 000 farmers received and planted vitamin A cassava stems in four target and 10 expansion states in 2013 alone, according to Dr. Ilona, HarvestPlus Country Manager, Nigeria. The number, he said, will exceed 350, 000 farmers in subsequent years, as more partners engage in vitamin A cassava stem dissemination to vulnerable households. YIIFSWA uses aeroponics to produce yam vines and minitubers. The vines are used to generate single node cuttings which are then planted to produce minitubers and seed yams. Through this process, millions of seed yams can be produced thus addressing a critical bottleneck in yam production which is scarcity of seed yams (EkeOkoro, O.N, personal commun.). The Next Generation Cassava Breeding (NEXTGEN Cassava) project aims to significantly increase the rate of genetic improvement in cassava breeding and unlock the full potential of cassava using Genomic Selection that relies on statistical modeling to predict cassava performance before field-testing, and dramatically accelerates the breeding cycle (http://www.nextgencassava.org/about.html). Cassava weed management project (CWMP) is seeking to find solutions to the labor-intensive weeding usually performed by women and children and to increase cassava productivity for 125,000 Nigerian farm families (http://www.cassavaweed.org/about-us/). This gender mainstreamed project is evaluating the use of portable machines for weeding of cassava farms, trying out new herbicides and cropping systems.

Table 2: Research Based Projects for increasing the production of root and tuber crops in Nigeria

Name of Project	Crop of Interest	Funding Agency	Achievement
Alliance for Green Revolution in Africa (AGRA)	Cassava, Yam, Sweetpotato	B&M Gates, Rockfeller	Varieties of Cassava, Sweetpotato released
Next Generation Cassava Breeding Project (NEXTGEN)	Cassava	B&M Gates	Reduced breeding cycle, Improved flowering in recalcitrant types
Harvestplus	Cassava	CGIAR	Some pro-vitamin A rich varieties released
Cassava: Adding Value in Africa (C:AVA)	Cassava	B&M Gates	Development of value chain for HQCF
Generation Challenge Project (GCP)	Cassava	CGIAR	Marker assisted selection
Ecologically Sustainable Cassava Plant Protection (ESCaPP)	Cassava	UNDP	Rolled back Cassava Mealybug
African Yam	Yam	B&M Gates	Assembling germplasm Breeding yam
YIIFSWA	Yam	B&M Gates	Increased seed yam production
African Cassava Agronomy Initiative (ACAI)	Cassava	B&M Gates	Enhanced Agronomic management of cassava
IFAD CASSAVA	Cassava	IFAD	Cassava stem multiplication
Cassava Weed Management Project (CWMP)	Cassava	B&M Gates	Weed control in Cassava

WAY FORWARD

Future intervention strategies for root and tuber crops expansion can broadly be grouped under the following headings: Intensification, Mechanization, Value addition and product development, Strengthening extension delivery and advocacy, Improvement of rural infrastructure and encouraging the production of minor roots and tubers

Intensification

- Efforts to develop, rapid multiply and disseminate improved varieties should be encouraged and strengthened in order to enhance the availability and diversity of improved planting materials;
- Along with the above, efforts to develop and extend improved agronomic practices for enhanced productivity of root and tuber crops should be encouraged

Mechanization

- Deliberate efforts to support the development of root and tuber crop production and processing prototypes and identification of applicable and useful technologies and incentives for local entrepreneurs to fabricate them. This will reduce drudgery, save labour and improve the efficiency of production and processing, raise the quality and enhance marketability of products. The design of such machines should be gender-sensitive, bearing in mind the cardinal role of women in production and processing

Value addition and Product Development

- New products of root and tuber crops and improved packaging techniques for existing ones should be developed to reduce spoilage, increase shelf-life and widen their spectrum of acceptability. Roots and tubers because of their high moisture content are perishable and upon harvesting have relatively short shelf life. Cassava – the flagship of roots and tubers is particularly notorious in this respect as it hardly stores beyond three days due to post-harvest physiological deterioration and must be processed into more stable products.
- Promotion of industrial uses of root and tubers and diversification of processing options to encourage increased production and enhance rural household income;

Strengthening Extension and advocacy

- Strengthening of extension-farmer linkage with research to facilitate the ongoing spread of cultivars, management practice and processing techniques. This should lead to the mobilization of farmers through emphasis on a participatory development approach, family- or group-based extension and seed multiplication activities involving due recognition of the role of women in production, processing and marketing and assistance that would enable all farmers to take advantage of development programmes as far as possible; adequate and sustained research funding which must be timely released.
- Promoting greater involvement of the private sector and non-governmental organizations in the use of research and technology in root and tuber production, processing and marketing and in the development of infrastructural facilities.

Improvement of rural Infrastructure

- Feeder roads, water and electricity should be provided for our agrarian rural communities to promote root and tuber production, processing and marketing.

Bringing on Minor Root Crops

- We should as a matter of deliberate policy, encourage production and utilization of minor root and tuber crops like Livingstone potato (Rizga), Hausa Potato, Ploynesian Arrowroot, turmeric, etc. These are alternative crops that can contribute to food security.

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ECONOMIC STUDIES ON HAULM KILLING IN POTATO PRODUCTION ON THE JOS PLATEAU, NIGERIA

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ABSTRACT
This experiment was carried out in 2014 and 2015 rainy season potato production at the experimental field of the Potato Programme of National Root Crops Research Institute. The experimental site is located along Latitude 09^{0} 44'E and Longitude 08^{0} 44'N with an elevation of 1,239.4 m above sea level. The average annual rainfall of the location was 1,289.89 mm. The Soil type is sandy loam with low Nitrogen content. The objective was to study the economics of haulm killing in potato, on treatment combinations of three levels of time of haulm killing, comprising of control HN0, Natural haulm senescence, HN1, Natural haulm senescence at 1 week before natural haulm senescence, HN2, 2 weeks before natural haulm senescence, HN3, 3 weeks before natural haulm senescence and four varieties of potato; Nicola, V1, Bertita, V2, Diamant, V3, and Agria, V. The data collected was analysed using Analysis of Variance Statistics. The study identified, three weeks to natural haulm senescence as the optimum time of haulm killing in seed potato production on the plateau. The responses of varieties to time of haulm killing were significantly different in times of yield and tuber size distribution. ($P<0.001$). The study recommends haulm killing for seed multiplication in potato production on the plateau. The study also suggested that, when the recommended seed size during bulking of potato is reached, the farmer can terminate the bulking of the tuber by killing the haulm. This will reduce cost of production, thereby increasing the profit margin.
Keywords: Economics, Haulom Killing, Potato and Jos Plateau

INTRODUCTION
Haulm killing can be described as the deliberate removal or destruction of the vegetative part of a plant. This will prevent photosynthetic, respiratory, transpiratory and other biological processes taking place in the plant (Tiessen et al., 2002). In literatures, haulm killing is used interchangeably with the words defoliation and de-haulming. Haulm killing is also carried out for the following reasons: to hasten maturity and harvesting (Vinod, et al., 2009), to reduce foliage mass, to obtain suitable tuber size (Virtanen and Seppannen, 2014, Garg and Sarjeet, 1999, Ravichandran and Sarjeet, 2003, Struik and Wiersema, 1999), to strengthen tuber skin before harvesting and to prevent plant pathogens from spreading among foliage and to prevent spreading of soil and seed borne diseases (Kempenaar and Struik, 2007, Miller and Cummings, 2002). There are many known methods of haulm killing (steaming, flaming, electrocutting, vine pulling, Misener and Everett, 1981) but the two methods of haulm killing in potato production that is most popular is the mechanical or chemical methods (Virtanen and Seppanen 2014). In the mechanical haulm killing simple farm implement like the cutlass and machete are used to cut down the vegetative part. This practice is done elsewhere, in small scale production, where the area of land cultivated is small and not large. For mechanical haulm defoliation in large scale production, farm machineries; mower and slasher are used. Chemical haulm killing, is haulm killing method applied in large scale production. It is convenient where the vegetative period of potato crop is long enough. There is paucity of information on haulm killing in literatures, in potato production in Nigeria. Potato farmers have been suffering losses over the years, due to lack of knowledge and application of haulm killing practices, to increase seed supply and manage seed production during outbreak of diseases and pests. In Jos Plateau farmers were not able to manage the damage of over 500 ha of potato crop caused by the potato late blight epidemics in 2014, due to lack of information on haulm killing. The farmers could have terminated the plant vegetative growth thereby reducing the spread of the disease and saving some seed materials. The study therefore, is set out, to determine the following objectives**:** generate information on haulm killing practices and its usefulness in seed potato production, to determine the best time of haulm killing in potato for maximum economic benefits, to compare the costs and returns of haulm killing and harvesting of potato at natural haulm senescence.

METHODOLOGY
The experiment was conducted at the experimental field of the Potato Programme of National Root Crops Research Institute Umudike. The experiment was planted on the 26th May 2014. The experimental site is located along Latitude 09^{0} 44'E and Longitude 08^{0} 44'N with an elevation of 1,239.4 m above sea level. The average annual rainfall of the location was 1,289.89 mm. The Soil type is sandy loam with low Nitrogen content. The experimental design was randomized complete block. The treatment combination was sixteen and replicated three times. The first factor was haulm killing, comprising of three levels with a control HN0 = Natural haulm senescence, HN1 = 1 week prior to natural haulm senescence, HN2 = 2 weeks prior to natural haulm senescence,

HN3 = 3 weeks prior to natural haulm senescence. The second factor comprises of four varieties of potato; Nicola, (V1), Bertita, (V2), Diamant, (V3) and Agria, (V4). The experimental plot size was 4m x 4m and the net plot size was 12m^2. The recommended agronomic practices by National Root Crops Research Institute Umudike for potato production were applied to the treatments before the haulm killing. The haulm killing was done manually with cutlasses. Data was collected on yield and tuber sizes, diseases and pests. The costs and prices of Inputs and outputs from the experiment were also recorded. The data was analysed using Analysis of Variance Statistics (ANOVA) and mean separation was performed using Fischer's least standard deviation (LSD).

RESULTS AND DISCUSSION

Table 1, shows that there significant differences @ P<0.001 in total tuber yield (t/ha) between varieties. The distribution of tuber sizes among varieties was also significantly different between varieties (P<0.001). The table 1, also shows that there is significant differences in haulm killing methods, with the best time of haulm killing of three weeks before natural senescence optimum. In terms of interaction effect of varieties and time of haulm killings on yield and number of tubers, Table 2, showed significant differences in both intra and inter differences in varieties, and also in time of haulm killing. It was found that time of haulm killing positively and significantly influence the distribution of mean tuber number (no/m2), mean tuber yield (t/ha), and also time of haulm killing significantly influence the yield of varieties. Gross margin analysis of main effects of varieties and time of haulm killings, and Gross Margin analysis of Interaction effects of varieties and time of haulm killings on potato table 3 showed that the optimum time of haulm killing in potato is 3 weeks prior to natural haulm senescence. However the Natural haulm senescence remains the best method in terms of costs and return analysis.

CONCLUSION

Haulm killing is a useful farming practice. The optimum time of haulm killing in seed potato production on the plateau is three weeks to full potato maturity. Haulm killing affected varieties cultivated significantly differently. The study also suggested that, when the recommended seed size during bulking of potato is reached, the farmer can terminate the bulking of the tuber by killing the haulm. This will reduce cost of production, thereby increasing the profit margin.

Table 1: Main effects of varieties and time of haulm killings on yield and number of tubers on potato production on the Jos Plateau

Treatments	**Tuber no/m2**	**Total tuber yield (t/ha)**	**Tuber no/m2 (<35mm)**	**Tuber no/m2 (<55 mm)**	**Tuber yield (t/ha) (35mm - 55mm)**	**Tuber yield (t/ha) (<35mm)**	**Tuber yield (t/ha) (>55mm)**
Variety							
V1	10.99	5.62	3.37	1.47	2.68	0.83	1.33
V2	9.86	4.61	3.97	0.37	3.20	0.98	0.45
V3	8.47	4.69	2.69	0.72	2.66	0.72	0.78
V4	12.25	7.61	3.63	1.79	4.0	0.88	2.4
LSD	**2.28*** **	**1.04*** **	**1.12ns**	**0.61*** **	**0.97** **	**Ns**	**0.56*** **
CV	**26.4**	**22.2**	**39.4**	**67.3**	**37.4**	**52.3**	**0.27**
Haulm killing date							
H0	11.82	7.35	3.12	1.68	3.63	0.87	2.04
H1	10.82	5.52	3.61	1.28	3.02	1.06	1.33
H2	8.64	4.43	3.22	0.85	2.70	0.74	0.88
H3	10.29	5.22	3.71	0.56	3.19	0.76	0.67
LSD	**2.28*** **	**1.04*** **	**2.24ns**	**0.61*** **	**0.97ns**	**Ns**	**0.56*** **
CV	**26.4**	**22.2**	**39.4**	**67.3**	**37.4**	**52.3**	**0.27**

Table 2: Interaction effect of varieties and time of haulm killings on yield and number of tubers on potato production on the Jos Plateau

Treatments	Tuber no/m2	Total tuber yield (t/ha)	Tuber no/m2 (<35mm)	Tuber no/m2 (<55 mm)	Tuber yield (t/ha) (35mm - 55mm)	Tuber yield (t/ha) (<35mm)	Tuber yield (t/ha) (>55mm)
Variety							
V1HI	12.66	7.67	2.72	2.67	3.22	1.02	2.45
V1H2	10.84	5.72	2.83	1.95	2.94	0.83	1.60
V1H3	10.44	4.25	5.28	0.78	2.39	1.03	0.67
V1H4	10.0	4.83	2.67	0.50	2.17	0.44	0.61
V2H1	11.11	5.25	4.89	0.72	3.50	0.86	1.17
V2H2	8.33	3.64	4.39	0	2.42	1.17	0
V2H3	9.44	4.97	3.28	0.61	3.33	1.06	0.47
V2H4	10.06	4.58	3.33	0.17	3.55	0.86	0.14
V3H1	10.56	7.17	2.44	0.83	3.42	0.67	1.06
V3H2	9.72	4.44	2.89	0.83	2.56	1.02	0.78
V3H3	3.39	1.80	1.89	0.72	0.89	0.19	0.72
V3H4	10.22	5.33	3.56	0.50	3.78	1.0	0.55
V4H1	12.94	9.33	2.44	2.50	4.38	0.94	3.5
V4H2	13.89	8.28	4.32	2.34	4.17	1.22	2.94
V4H3	11.28	6.71	2.45	1.28	4.19	0.67	1.67
V4H4	10.89	6.11	5.29	1.06	3.28	0.72	1.40
LSD (0.05)	**4.56**	**2.08**	**2.24**	**1.22**	**1.9**	**0.74**	**0.38**

Table 3: Gross Margin analysis of main effects of varieties and time of haulm killings on potato production on the Jos, Plateau

Treatments	Total tuber yield (t/ha)	Value of gross product (₦000)	Total Variable Cost (TVC) (₦000)	Gross Margin (GM) (₦000)
Variety				
Nicola, (V1)	5.62	840	499.80	340.20
Bertita, (V2)	4.61	553.2	329.15	224.05
Diamant, (V3)	4.69	828.0	492.66	335.34
Agria, (V4)	7.61	1520	904.4	615.60
Haulm killing date				
Natural haulm senescence (HN0)	7.35	1323	787.185	535.82
1 week prior to natural haulm senescence (HN1)	5.52	993.6	591.192	402.41
2 weeks prior to natural haulm senescence (HN2)	4.43	797.4	474.45	322.95
3 weeks prior to natural haulm senescence (HN3)	5.22	939.6	559.06	380.54

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BREEDING FOR EARLY BULKING FOR IMPROVED PRODUCTIVITY IN F_1 CASSAVA GENOTYPES

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ABSTRACT

Development of early bulking cassava varieties has become important in national cassava breeding programmes in Africa as a result of increasing demand for such cultivars by farmers. F_1 progenies developed from two elite cassava varieties (TMS98/0505 and TMS98/0581) were evaluated for yield, early bulking and traits associated with early bulking. Result shows that at 7MAP, values for yield and other yield related traits in some of the developed F_1 progenies were higher that their parents. Simple correlation statistics shows that fresh root yield and dry root yield significantly and positively correlated with all the yield related traits evaluated. Principle component coefficient showed that root and stem diameter were major contributors in three PCs out of five PCs considered, dry matter content and biomass were present in two PCs while fresh root yield and dry root yield were present in one PC.

Keywords: Breeding, Early bulking, Productivity and Cassava

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a staple food for nearly a billion people in 105 countries of the world, especially tropical Africa, South America, and Asia (FAO 2008). It ranks second to sugarcane and is better than both maize and sorghum as an efficient producer of carbohydrate under optimal growing conditions. Annual consumption of the crop is highest in Africa. It is drought tolerant; this attribute makes it the most suitable food crop during periods of erratic rainfall and famine. Bulking in cassava is referred to the swelling or thickening of storage roots as they are filled with excess assimilates after the plants might have satisfied the need for vegetative growth (Okogbenin et al 2013). Early bulking (EB) varieties shorten the growth period from planting to harvesting, thus making cassava to be better fitted into environments with short rainy season and risky biotic stresses thereby increasing its productivity. The need for food production to keep pace with the rapidly expanding human population coupled with marginal rainfall in cassava production areas has made it necessary to develop early bulking and drought tolerant genotypes for Africa. Given the expanding demands for cassava as food, feed and industrial raw materials, genotypes with high yield, early bulking genotypes are highly desired. Objectives are to identify traits significantly associated with early bulking and evaluate and select high yield and early bulking cassava varieties.

MATERIALS AND METHODS

The trial was conducted in National root Crops research Institute (NRCRI) experimental field in Umudike. A total of one hundred and eighty F_1 genotypes developed from two elite genotypes (TMS98/0505 and TMS98/0581) were used for the experiment. The parents were used as check. The experimental design was randomized complete block design (RCBD) of twenty plant stands per plot replicated two times. The progeny and their parents were evaluated at 7 MAP for yield and other yield related traits such fresh root yield, biomass, number of tuberous roots, stem diameter and root diameter. At harvest, roots produced by each plant, as well as the above ground biomass (stem and foliage), were weighed. Net plants were harvested during harvest. Plot yield was converted to fresh root yield (FRY t/h) Harvest index (HI) was measured as the ratio between fresh root yield and total biomass. Percentage dry matter content of the roots was estimated using the specific gravity methodology Approximately 3kg of root were weighed in a hanging scale (W_A). The same sample was weighed with roots sub-merged in water (W_W). Dry matter content was estimated as: %DMC = [158.3 x ($W_A/(W_A-W_W)$ – 142]. Where W_A= weight in air and W_W= weight in water (Jaramillo *et al*., 2005). Dry root yield (DRY) was derived by multiplying FRY with percentage DMC.

RESULTS AND DISCUSSION

The result shows that fresh root yield ranged from 0.67 to 44 t/h while mean value across all the F_1 progenies was 13.87t/h (Table1). The highest fresh root yield was attained by the genotype 097B. The maximum yield for fresh root yield, dry root yield, dry matter content and other yield related traits of the F_1 population were found to be higher than that of their parents (checks) (Tables 2). This means that some of the F_1 progenies performed better than their parents. Fresh root yield and dry root yield positively correlated with all agronomic traits studied (Table

3). Among all the traits significantly correlated with FRY, root weight per plot had the highest correlation (r= 1.00) (Table 3). The positive correlation among the yield and yield related traits shows that they make important contributions towards economic yield (Ojulong 2008). It also indicates that all the yield traits were important by positively correlating with each other. This suggests that these traits (root weight, root number, root diameter, biomass, plant vigour, harvest index and stem diameter) are components triggering early yield as a complex trait. This agrees with the study conducted by Okogbenin and Fregene (2002) to investigate traits associated with early bulking where they found that storage root diameter, plant height, harvest index, number of storage roots and plant vigour were all positively correlated with dry storage root yield. Principle components indicated that the first five principle components explained 93.50% of the total variation (Table 4). The PC1 alone accounted for 47% of the total variation mostly contributed by root weight and fresh root yield. Principle component two accounting for 15.3% of the variation had dry matter content, root diameter and dry root yield as the major contributors. PC3 accounted for 15.2% of the total variation had root diameter, stem diameter and root number as the main contributors while PC4 with total variation of 9% indicated that root diameter, biomass, dry matter content, and stem diameter as the main contributors. PC5 which only accounted for 7% of the variation indicated biomass and stem diameter as the most important. Combining these important traits (FRY, RTWT, RTDIAM, DMC, FRY, DRY and STDIAM) as revealed by PCA will help breeders in the selection stage to shorten the time required to complete a breeding cycle and enhance yield productivity. Root diameter and stem diameter were major contributors in the three PCs out of the five PCs, dry matter content and biomass were present in two PCs while fresh and dry root yield were present in one PC indicating their relative importance to yield. This also indicates that breeders seriously should consider including root diameter and stem diameter in their selection indices when evaluating at advanced selection stages.

CONCLUSION

This research was aimed at identifying high yield, early bulking cassava genotypes as well as traits associated with early bulking in the F_1 progenies. Result showed that at 7 months harvest, yield of 44t/h was attained by the genotype 097B. Significant and positive correlations among the traits identified traits associated with early bulking. It also shows interdependence and importance of these traits influencing fresh root yield. Principle component analysis showed important traits that when put together can be used in selecting high yielding cassava genotypes at selection stage. In conclusion, further studies are required to more accurately determine the optimum time for harvesting and also confirm their earliness in other diverse environments.

Table 1: Range of values for yield and yield related traits of F_1 progenies at 7MAP

Variables	Min	Max	Mean
FRY (t/h)	0.67	44.00	13.87
DRY (t/h)	0.46	17.01	5.56
HI (0-1)	0.10	0.85	0.57
DMC (%)	18.35	44.00	25.03
RTDIAM (cm)	4.45	12.58	8.12
BIOM (kg)	0.20	15.00	3.39
SDIAM(cm)	0.90	4.40	1.85
VIG	1.00	5.00	3.39
RTNUMB	2.00	29.00	12.38

FRY= fresh root yield, DRY= dry root yield, HI= harvest index, DMC= dry matter content, RTDIAM= root diameter, BIOM= biomass, SDIAM= stem diameter, VIG= plant vigour, RTNUMB= root number

Table 2: Range of values of yield and yield related traits of checks at 7MAP

Variables	Min	Max	Mean
FRY (t/h)	12.00	25.50	18.75
DRY (t/h)	6.07	6.57	6.32
HI (0-1)	0.58	0.60	0.59
DMC (%)	23.77	25.33	24.55
RTDIAM (cm)	7.44	10.05	8.74
BIOM (kg)	2.60	5.10	3.85
SDIAM(cm)	1.88	2.15	2.01
VIG	3	5	4
RTNUMB	10.50	20.00	15.25

Table 3: Phenotypic correlations of yield and yield related traits of F_1 progenies at 7MAP

Variable	RTWT(kg)	RTNUMB	RTDIAM (cm)	BIOM (kg)	VIG	HI	SDIAM(cm)
FRY	1.00***	0.73***	0.48***	0.55***	0.48***	0.25**	0.12*
DRY	0.69***	0.37***	0.45***	0.32***	0.39***	0.24**	0.17*

*P≤0.05, **P≤0.01, P≤0.001

Table 4: Principle component coefficient of the various traits with principles of the various yield related traits of F_1 progenies at 7MAP

Traits	PC1	PC2	PC3	PC4	PC5
RTWT(kg)	**0.50**	0.03	-0.11	-0.11	-0.12
RTNUMB	0.38	-0.20	**-0.44**	0.10	-0.15
RTDIAM(cm)	0.24	**0.37**	**0.52**	**0.43**	0.36
BIOM(kg)	0.34	-0.29	0.07	**0.42**	**0.75**
DMC (%)	0.01	**0.75**	-0.21	**0.58**	0.04
FRY(t/h)	**0.50**	-0.04	-0.11	0.11	-0.12
DRY(t/h)	0.39	**0.36**	0.04	-0.14	-0.23
SDIAM(cm)	0.16	-0.19	**0.68**	**0.50**	**-0.46**
Eigenvalue	3.72	1.22	1.21	0.70	0.56
% variation	47	15.30	15.20	9.00	7.00
Cumm.% variation	47	62.30	77.50	86.50	93.50

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APPROPRIATE TERMINOLOGIES USED IN CROP PRODUCTION: A CASE STUDY ON CROP PROTECTION

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ABSTRACT
The general trend in education worldwide is towards improvement of effective learning so as to facilitate good understanding of the subject-matter that will enable the practitioner acquire relevant knowledge/experience in equipping him/her for life. This paper therefore examines the appropriate terminologies used in agronomy or crop protection aspect of crop production to foster universal understanding of crop production, facilitate uniformity of information and elimination of contradiction of terms.
Keywords: Terminologies, Crop Production and Crop Protection

INTRODUCTION
Crop production is the branch of agriculture that deals with the principle of crop husbandry. It involves production and consumption. From these involvements it entails, it has many areas or disciplines like agronomy, crop science, soil science, crop protection, horticulture, forestry and wood technology, post-harvest technology and biology. Also, contemporary disciplines in crop production are sericulture, viticulture, agricultural biotechnology etc. Crop protection on the other hand, is an aspect of crop production that deals with the prevention of crops and stored products from attack by pests, disease causing organisms and weed interference in order to prevent reduction in yield and the value of crop and produce. It entails the study of insect (entomology), fungi (mycology), bacteria (bacteriology), virus (virology), nematodes (nematology) and weeds (weed science). (Durojaye, 2002). Abeke (2010) asserted that, every profession has its own terminology and this describes the operation and content of practice of such given profession. Terminology as the body of specialised words relating to certain field of study or particular field of human endeavour, its understanding and usage is expected to:

I. Ease information passage from resource persons to clients.
II. Fast-track communication with better clarity.
III. Guide against erosion of appropriate use of the right phrase or terminology in both teaching and research.
IV. Facilitate better understanding of the subject-matter.
V. Reflect trend in production, new knowledge and innovations brought about by changes in terminology over the years. (Abeke, 2010)

It is against this background that, this paper attempts to discuss appropriate terminologies used in crop protection with a view to educate the practitioners (such as teachers and students) and would be-farmers for better understanding of the subject matter so that there is uniformity of information and elimination of contradiction of terms.

MATERIALS AND METHODS
The review of the terminologies used in crop protection as well as its benefits was emphasized. This information was obtained from periodicals website and textbooks from libraries.

DISCUSSION
Terminologies used in Crop Protection
Allelopathy: Direct or indirect harmful or beneficial effects of one plant on another through the production of compounds (toxic substance) that escape in the environment.
Active ingredients (ai): Constituent of a preparation or formulation (insecticidal or herbicidal) to which all or part of its effectiveness is attributed or biologically active component of a formulated pesticide.
Adjuvant: Biologically inactive substance that is capable of modifying the physical or physico-chemical properties and hence the effectiveness of a plant projection, preparation or a compound added to a pesticide to increase its efficacy.
Antagonism: A substance's ability to reduce by means of the presence biological activity of aj,lnother substance.
Abscission: Falling off or shedding of leaves (or any other part) due to development of a layer of cells that cuts off the organ. It occurs in a zone where hydrolytic enzymes reduce cell adhesion.
Blight: Rapid discolouration and death of tissue over a large area.
Bacteria: Microscopic organisms which are used in fermentation, putrefaction and are causative agent of diseases in both plants and animals.
Biological control (bio-control): Pest control strategy making use of living natural enemies or competitors and other self-replicating biotic entities.

Canker: Dead area on the stem of plant, surrounded by living cortical tissues.
Chlorosis: Severe yellowing and loss of green colouration due to chlorophyll destruction.
Concentrated emulsion: Commercial preparation in the form of an emulsion which must be diluted at time of use in dispersant liquid.
Contact herbicides: A herbicide which, if applied to the aerial part of the plants to be controlled, causes visible necrosis (scorching). It penetrates the plant tissues to a greater or lesser extent, spread to a limited degree, if at all and is fast-acting.
Control: Suppression, containment and maintaining a population of parasites, pests or weeds at an acceptable rate/level.
Disease: Any disturbance of plant that interferes with its normal structure, function or economic value caused by pathogen.
Diagnosis: The act of discovering or identifying the exact cause of a disease
Drift: Movement or spread of sprayed liquid to areas where it is not intended to fall.
Dosage rate: Recommended rate of a chemical for a particular soil type, pest and crop expressed in mass (kg) or volume (litre) of product per treated hectare.
Defoliating: Removal of shoots and leaves.
Dusts: Pesticides in which active ingredient is formulated into dry, very fine powder for direct application.
Emulsifiable concentrate (ec): Pesticides in which the active ingredient (in the solid phase) is dissolved in an organic solvent which are then diluted in water for application.
Epinasty: Stiff, downward growth or bending of petiole, without flaccidity.
Epiphyte: A plant which grows or is parasitic on another plant.
Etiolate: Pale spindly growth resulting from lack of light.
Exudates: Toxic substance incorporated in a preparation and intended to adjust the concentration of the active ingredients.
Eradication: Application of phytosanitary measures to eliminate a pest from an area.
Facultative parasite: parasite that can exist as saprophyte and they kill their host.
Fumigation: The use of smoke or fumes to destroy insects and other pests. Mainly used in enclosed areas such as grain stores.
Fungus: A group of primitive types of plants including mushrooms, moulds, mildews, rusts and smuts. They are non-green and feed on living or dead organic matter. Many fungi are responsible for diseases of crop plants and are controlled with the use of fungicides.
Flow rate: Is the rate at which the spray liquid is emitted through the nozzle and is expressed in multilitters per second (ml/sec) or liters per minute.
Gall: An overgrowth (swelling) resulting from excessive local proliferation of abnormal cells without tissue differentiation caused by insects, diseases etc.
Granule: Substances presented in the form of particles of which the largest are between 0.150mm and 5mm in diameter.
Gynophores: Plants bearing ova or pistils.
Herbicides: Chemical substances/preparations for controlling weeds synonymous to weed killer.
Herbicides tolerant: Ability of a plant to survive and reproduce after herbicide treatment. Often used interchangeably with herbicides resistant.
Host-plant resistance: Genetically controlled innate or bred phenotypic or physiological property of a plant that enables it to withstand injury from insect feeding and pathogenic infection.
Host-range: Species of plants capable, under natural conditions of sustaining a specific pest.
Hyperplasia: Abnormal cell division that may result in enlargement of plant parts caused by diseases etc.
Hypoplasia: Abnormal cell division, resulting in reduction in the number of cell produced. It may be related to stunting.
Infestation: The presence of insect's pests or organisms in large numbers which often causes damage or disease.
Infection: The act or process of causing damage or disease.
Integrated pest management (IPM): The ecologically based decision support system for managing weeds, plant pathogens and insect pests while minimizing use of agrochemicals. Combines complementary and compatible biological, chemical and cultural control tactics to make pest management economical, environmentally sound and socially acceptable.
Introduction of pest: The entry of a pest, which could result in its establishment.
Leaf spot: A definitely delimited necrotic area that does not expand beyond a given size.
Lesion: a necrotic area (dead cells).
Lodging: Breaking or falling over of stalks of crops due to effects of pests, disease, wind or water erosion and heavy/excessive nitrogenous fertilization which reduce straw strength.
Mixture: Liquid ready for use by spraying, sprinkling or soaking and in which the pesticide to be applied is disposed.

Moulds: Fungi develop and feed on vegetative material, appearing on the surface as a white downy mass of fine fibres. Moulds particularly affect stored products.
Micro-organism: A protozoan, fungus, bacterium, virus or microscopic self-replicating biotic entity.
Necrosis: Burning of leaves causing dry scorched or twisted leaves resulting n death of cells usually due to diseases or unfavourable condition.
Nocturnal: Organisms that is active during night time
Natural enemy: An organism which lives at the expense of another organism and which may helps to limit the population of its host (includes parasitoids, parasites, predators and pathogens).
Non-Selective herbicides: chemical compound that is generally toxic to all plants treated, used to kill a wide range of plant species that usually includes crop species in the treated area.
Occurrence: The presence in an area of a pest officially reported to be indigenous or introduced and or not officially reported to have been eradicated.
Oleaginous plants: Plants which produce oil.
Organism: Biotic entity capable of reproduction or replication, vertebrate or invertebrate animal, plant and micro-organism.
Oviparons: Laying of eggs in which the embryo have not developed
Outbreak: A recently detected pest population or a sudden significant increase of an established past population in an area.
Pest: An injurious, destructive or troublesome plant or animal.
Pesticides: Chemical substances which are used for destroying pests of crops or harvested products.
Persistence: Period for which pesticide remains effective after application.
Predator: A natural enemy that preys and feeds on other animal organisms.
Pheromone: Chemical produced by one member of a species that has a physiological effect on members of the same species. Sex pheromones attract males to females or vice versa. Aggregation pheromones attract box sex.
Plant pathogen: Fungi, bacteria, viruses, nematodes or oomycetes that infect plants and cause injury and or disease.
Parthenogenesis: Production of young ones without mating (fertilization) e.g. Aphids.
Quarantine: Official confinement of plants, plant products or regulated articles for observation and research or for further inspection, testing and or treatment.
Residual herbicide: A herbicide that persists in the soil and injuries or kills germinating weed seedlings for a relatively short period of time after application.
Rot: disintegrated/decay of tissues caused by some organism or naturally and gradually.
Saprophyte: Organism that feed on dead organic matter i.e. dead body of plant. The parasite could be obligate when it cannot live outside the host and do not kill its host but cause diseases, symptoms of which only result in growth reduction.
Selective herbicide/pesticide: A chemical compound that kills only certain species of plants (weeds) or plant pathogens (but leaves certain crops untouched) broad or narrow spectrum, depending on the compound.
Stunting: Smallish size of plant due to reduction in the growth or as a result of underdevelopment.
Symptoms: External evidence of disturbance by disease resulting in change in appearance.
Systemic pesticide: Ability of certain pesticides to spread within the plant.
Susceptibility: An inherent weakness that makes an organism opens to attack.
Total herbicide: A herbicide of varying persistence which is used at the dosages recommended for the application in questioning is capable of destroying or preventing the growth of vegetation on uncultivated land.
Toxins: Chemicals secreted into the plants or which the plant is induced to secrete. Such chemicals have deleterious effect on the host.
Toxicity: A substance's ability to cause by means of penetrating into the organism in one application or via repeated doses, temporary or lasting alterations in one or more functions of that organism.
Transience: Presence of a pest that is not expected to lead to establishment.
Translocated: Term describing a pesticide that is capable of acting after penetrating and spreading within the plant.
Tolerant: The inherent ability of a plant to survive and reproduce after application of herbicides or during infestation by plant pathogens. Many either be inherent (natural) or acquired through genetic manipulation. Often used synonymously with Resistant, this implies that a plant is either immune to or unaffected by a particular biotic or abiotic stresses
Varietal resistance: Resistance of a particular variety to injury caused by herbicides, pathogens or insects. Resistance to the same pest may be expressed at different levels among different varieties of the same species.
Vector: Disease carriers e.g. Aphids as vectors of various virus diseases.
Wettable powder: Powdery product intended o be dispersed in a liquid for application.
Wilting: Loss of turgidity, resulting in flaccidity of leaves and other parts of the plants.
Weed control: The process of reducing weed growth and or infestation to an acceptable level. Often synonymous with weed management.

CONCLUSION

Today farming is a business involving many scientific practices, which has become highly organised, specialised and mechanized. Production, management and marketing problems are becoming more complex and competition between farmers becomes Keener each year.

Therefore the use of appropriate terms is desirable and attainable to foster universal understanding of crop production. However, this should be updated regularly as the lists here are far from being exhaustive.

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EVALUATION OF NEWLY INTRODUCED HERBICIDES IN THE MARKET FOR WEED MANAGEMENT IN AN OIL PALM PLANTATION

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ABSTRACT
Evaluation of newly introduced herbicides in the open market for weed management in an oil palm plantation was investigated at the Nigerian Institute for Oil palm Research (NIFOR) main station in 2013. The experiment was conducted during the early and late growing season prior to planting of food crops in the experimental area. Newly introduced herbicides with the trade names of Uproot, Delsate, Bush fire and Round-up were tested. Herbicide application was done at the rate of 200ml of the test product per 20 litres of water using a knap sack sprayer and this was done in the morning at the onset of sunshine. Data was collected on the duration of visible herbicide action on the weed species, effectiveness of the herbicide and time it took for re-growth. The preliminary results indicated that the newly introduced herbicides (Uproot, Delsate and Bush fire) had a similar effect as Round-up. However, in terms of duration before weed re-emergence, round-up had more lasting effects while the least was uproot.
Key words: newly, herbicides, market, weed and oil palm

INTRODUCTION
Weed competition has been identified as a major production constrain in crop production in Nigeria (FAO, 2006). Uncontrolled weed growth has been reported to cause yield reduction of 34-55% in maize production, 28-100% in rice production, 40-46% in grain and legume production, 52% in oil palm and fibre crops, 65-91% in root and tuber crops (Akobundu, 1987). It has been observed that for successful crop production, many factors such as quality seeds, proper fertilization and weed control are indispensable. The common weeds of oil palm plantation can be shrubs, trees, regrowth from stumps, climbers, grasses and uncontrolled legume covers. Weed management in oil palm plantations involves provision of weed free zones round the palms, inter and intra row maintenance and the removal of epiphytes, parasitic weeds and other climbers from the palm trunks and crowns. All over the world, more attention is being given to the production and use of herbicides to control weeds. Under the prevailing conditions in Nigerian agricultural sector (inadequate labour, poor cultural practices and the need to conserve energy), the task of weed control without the use of herbicides become very difficult. Nowadays, herbicides are commonly being used to control weeds and new herbicides are being released on a daily basis into the market by the manufacturers without being properly screened for use. Attah *et al*., (2010) reported that continous use of a particular herbicide year-in, year-out on the same piece of land could result in the formation of resistant races in some weed species. Thus observation were corolaborated by Stalow, (2003) who reported that over 30 species of other weed species had become resistant to Triazine in Europe and America. There are likely to be more weed species resistant to the available herbicides as crop production becomes intensified. At the Nigerian Institute for Oil palm Research (NIFOR) the commonly used post emergence herbicide is Touchdown which is a brand of glyphosate. However, at present this herbicide is not readily available and if available usually very expensive, thus many oil palm farmers are resulting to the use of readily available and cheaper brand of glyphosate products such as uproot, delsate, Bush fire e.t.c. There is therefore a need to investigate the efficacy of these newly introduced herbicides in the market in control of weeds in oil palm plantation order to minimize the cost of field maintenance.

MATERIALS AND METHODS
The experiment was conducted at field 23 located at the Nigerian Institute for Oil palm Research (NIFOR) main station in 2013 cropping season. Three newly introduced herbicides were tested along with the conventional herbicide at 200 ml / 20 litres of water. The herbicides tested are Uproot, Delsate, Bush fire and Round up. Spraying was done in the morning at the onset of sunrise. Data was collected on the number of days it took from treatment application to the day visible signs of herbicide action were noticed on the affected weed species. Data was also taken on the herbicide effectiveness and duration of weed control.

RESULTS AND DISCUSSION
The preliminary results obtained from the trial, indicates that the newly introduced herbicides could be used as herbicide in weed management in oil palm plantation. All the tested herbicides showed effective weed control in oil palm plantation. The herbicide's effects on weeds were not noticed until the third day after treatment

application. The effect of the herbicides on the weeds was visible on the third day on areas sprayed with uproot, on the fifth day in areas sprayed with bush fire, while areas sprayed with Delsate and Round up took seven days before any noticeable symptoms were observed (Table 1). It was also observed that total weed control was achieved for a period of 30-37 days before any visible form of re-growth was noticed. All herbicides used acted on broad leaf weeds, sedges and grasses. In terms of effectiveness or rating in order of performance, it was in this order: Round up>Delsate>Bush fire>Uproot. The effectiveness of the tested herbicides in weed control may be attributed to the fact that they all contain glyphosate as their active ingredient, and only differ in terms of their trade name. Uproot contains 360g glyphosate/litre in the form of 450g glyphosate 150 polyamine salt (sl), Bush fire contains 380g glyphosate/litre in the form of 480g/litre soproplylamine salt of soluble liquid (sl), Delsate contains 360g glyphosate/litre in the form of 480g/litre glyphosate isoproplylamine salt as well as Round up. They were all foliarly applied and are systemic non selective post emergence herbicides for the control of annual and perennial weeds weeds which includes grasses, broad leaves, aquatic and woody shrubs. `

Table 1: Time taken for the weeds to react to herbicide application

Herbicide Name	No. of days to action	Total weed control	Duration before Re-growth
Uproot	Three (3)	20 days	30
Delsate	Seven (7)	20 days	35
Bush fire	Five (5)	20 days	33
Round up	Seven (7)	20 days	37

CONCLUSION

The preliminary results of the tested newly introduced herbicides in the market for weed control shows that Delsate, Bush fire and Uproot performed equally well as Round up. Thus they could be used for weed control in Oil palm plantation.

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LABORATORY ASSESSMENT OF THE TOXICOLOGICAL PROPERTIES OF LATTICES OF SELECTED PLANTS AGAINST THE MAIZE WEEVIL *SITOPHILUS ZEAMAIS* (MOTSCHULSKY) (COLEOPTERA: CURCULIONIDAE) ON MAIZE IN STORAGE

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ABSTRACT
Laboratory experiments were conducted to evaluate the toxicological properties of Hevea brasiliensis W. And Carica papaya L. lattices against the maize weevil Sitophilus zeamais (Motschulsky) (Coleoptera: Curculionidae) on stored maize at two concentrations (4 and 6 mls). The experiment consisted of five treatments and four replications in a Completely Randomized Design (CRD). Results revealed significant differences (P < 0.05) on the effect of test plant lattices on the mortality of the insect. The most toxic plant latex was the higher concentration (6%) of H brasiliensis, while the least efficacious was C papaya at 4%. Both H brasiliensis and C papaya lattices significantly suppressed the F1 progeny of S zeamais when compared with the control. The highest percentage progeny (32.46%) emerged in jars treated with 4% latex of C papaya and the least emergence of 14.54% was observed at 6% level of H. brasiliensis latex. Among the trial plant lattices, the highest percentage weight loss of grains was observed on seeds treated with 4% latex of C. papaya, which were however statistically heavier than the untreated control grains. Lattices of the two plants significantly (P < 0.05) provided protection to the grains against damage by the weevil. Percentage grain damage (49.89%) was highest in untreated control jars. The least grain damage (11.97%) was recorded by H. brasiliensis at 6% dosage level. Results of the phytochemical study of the test lattices revealed the presence of the phytochemical constituents at varying degrees. It is therefore, apparent that these phytochemical are likely responsible for the toxicological properties exhibited by these plant lattices. The present study confirms the toxicological activities of plant latex, their effect on S. zeamais and potential future use in biopesticide formulation for safe control on insect pests of stored products in an environment friendly manner.

Keywords: Toxicological Properties, Maize Weevil and Maize Storage

INTRODUCTION

Maize (*Zea mais L.)* is an annual crop belonging to the family poaceae. In many countries, it has almost replaced earlier grown cereals such as sorghum, millet etc (Onwueme and Sinha, 1991). Maize is the world's most widely grown cereal and essentially a food source of millions of the world's poor (Ferris and Graver, 2000). According to Food and Agricultural Organization FAO (2013), 589 million tonnes of maize was produced worldwide in 2000 on 138 million hectares of land. Maize is an important crop of West Africa including Nigeria (Onwueme and Sinha, 1991). *Bonsall (1999) reported* that maize is also a versatile crop that grows across large agro-ecological zones. Maize is one of the main cereal crops of West Africa and one of the most important cereal crops in Nigeria. Nigeria produces 30 million tonnes of maize per year (FAO, 2013). It comes after wheat and rice in terms of world importance (Ferris and Graver, 2000). Maize has been of great importance in providing food for man, feed for livestock and raw materials for agro-based industries. *Maize* is a staple food in many regions of the world particularly in developing countries (FAO and ILO, 1997). Maize is number one feed grain in the world; it is used extensively as the main source of carbohydrate in animal feeds and feed formulation (Wikipedia, 2006). Post-harvest crop management is critical in crop production. This is due to the fact that substantial losses occur during storage of produce in developing countries, a major part of which is due to insect attack. A serious pest of maize in the field and storage is the maize weevil *Sitophilus zeamais* Motsch. The beetle causes characteristic damage to maize by making holes on the grain *that is about 1mm* in size in which the adult female deposit eggs. Maize weevil damage results directly in lost food ready for consumption or lost cash from farmers pocket ready to buy other valuable resources for the family. Damage of grains by *S. zeamais* has resulted to about 5% - 10% losses after 6 months storage period (Nilsa and Perez, 1995). *Cabi (2010)* stated that maize weevils population builds up the longer the maize is kept in store, resulting to weight loss of 30% - 40%. Many control strategies have been adopted for the control of this notorious stored product pest of cereals crops including the use of synthetic pesticides with varying degrees of success. synthetic insecticides are generally preferred due to easy availability and potency, but their indiscriminate use has resulted in the development of pesticides resistance, longer residual persistence in the environment, poison the food chain, generate undesirable effects against humans, toxicity to fish and beneficial organisms. Thus alternatives to synthetic chemicals have been explored in the form of pesticides of natural or plant origin, which have low impact on the environment, exhibit low toxicity to humans and have low costs. Onolemhemhem and Oigiangbe (1991) revealed that various plant materials and plant extracts have been used effectively to control storage pests of cereals, legumes and to a limited extent field pests. Plant latex is a natural plants polymer secreted by highly specialized cells known as laticifers (Hagel *et al*; 2008). Studies have revealed the insecticidal potential of latex – bearing plants. Plant latex show deleterious effects like toxicity, antifeedant, growth and reproduction inhibition on a number of insect species (Carlini and Grossi-de-sa,2002). According to Ogunleye and Omotoso (2011), *Jatropha curcas* offered 100% mortality of adult *S. zeamas* at the rates of 0.3mls and 0.4mls after 24 hours *of application*. The insecticidal activity of *Calotropis procera* have been tested and reported by Vikash (2003). The plant latex of *C. procera* at the rates of 1.5mls and 2.0 mls evoked 100% mortality of adult *Callosobruchus maculatus* after 4 days. Bragay *et al*. (1997) reported that *Hevea brasiliensis* latex protected the seeds of cowpea (*Vigna unguiculata L*) against *C. maculatus.* Latex from few plant families possess phytochemicals, which showed insecticidal activity (Shaalan*et al;* 2005). Thus the import of this study was to determine the efficacy of two latex bearing plants *H. brasilensis* and *C. papaya* and their phytochemicals against the maize weevil *S. zeamais.*

MATERIALS AND METHODS

The experiment was conducted in the Pest Management Technology Laboratory of Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria. A culture of *S. zeamais* motsch was maintained on a susceptible maize variety TZSR – Y. The insect was reared in a growth chamber (5L) in the laboratory at 28 + 2^{0c}, 70 + 5% relative humidity with a light/dark photoperiod of 12:12 hours. The test crop maize grain was fumigated with phostoxin for 48 hours to obtain an insect free grain. Latex was obtained from the stems of both plants in separate aseptic glass vessels. Lattices were collected by tapping method, in which sharp incisions were made on tree trunks to open the latex vessels. In the bark to collect unconjugated latex in sterile plastic vessels following the method adopted by Buranov and Elmuradov (2010). The lattices were thereafter stored under refrigeration at – 20^{0c} until used. Using an electric balance, 50g maize grain was weighed into each of the kilner jars. With a syringe, lattices derived from para rubber *H. brasiliensis* and *C. papaya* plants were collected at two volumes 4 and 6mls each and dropped into 500mls measuring cylinder. Thereafter, the products (lattices) were homogenized in water through a serial dilution of each of these volumes by pouring 100mls of distilled water into each cylinder of the latex corresponding to 4 and 6% concentrations of the lattices. The 50g uninfested maize grains in kilner jars were steeped in solutions of 4 and 6 mls latex treatment concentrations in 100mls beaker for 30 seconds and latex air-dried for 4 hours. Maize grains immersed in sterile water served as control. Thereafter, each jar was inoculated with 20 two day old adults of *S. zeamais* and later covered with muslin white cloth with perforated lid to ensure ventilation. Treated and untreated jars were arranged in a completely randomized design (CRD) with four replications on laboratory table undisturbed.

Adult mortality of the weevil was assessed at 1, 3 and 7 days after insecticidal treatment. Data obtained was arcsine transformed. After adult mortality assessment, the maize grains were carefully returned to the jars and allowed to stay for 35 days for progeny developments. A count of the emerging adults was taken and square root transformed. At the end of the storage, weight loss of grains was determined by re-weighing the grains left in each experimental jar. The differences in weight between the weight at the commencement of the study and at the end of the experiment constitute loss in weight due to the insect pest activity. Percentage weight loss was calculated by the method of FAO (1985) as:

% weight loss = (UaN – (U +D) x 100 UaN x 1

Where

U = weight of undamaged fraction in the sample

N = total number of grains in the sample

Ua = average weight of undamaged grains

D = weight of damaged fraction in the sample. Grain damage was observed through a random selection of 100 grains from each treatment and a count of the number of grains with adult emergent holes.

Data obtained were subjected to analysis of variance (ANOVA) and significant means were separated using the Least Significant Difference test at 5% level of probability. Thereafter, the phytochemical composition of the plant materials (*H. brasiliensis* and *C. papaya*) studied was analyzed following the method of Oberlease (1973).

RESULTS AND DISCUSSION

Following the statistical analysis of data, results in Table 1 showed that there were no significant differences among the treatments on insect mortality 1 day post – infestation. However, at days 3 and 7 after insect infestation, potencies of the plant derived products different statistically such that by 7, the highest percentage mortality (74.11%) of the weevil occurred in jars treated with the higher dose (6%) of *H. brasiliensis* latex, which was followed by the lower concentration (4%) of *H. brasiliensis*, 87.50% and the higher rate 6% of *C. papaya* with toxicity of 73.75%. the least potent of the trial plant lattices was 4% *C. papaya* with 45.75% mortality, which was however statistically more toxic than the untreated control, which did not record any mortality. The lattices of both *H. brasiliensis* and *C. papaya* significantly suppressed the F1 progeny of *S. zeamais* when compared with the control (Table 2). Among treatments, the most effective in protecting grains against post embryonic development was 6% concentration of *H. brasiliensis* with 14.54% progeny emergence, while the least efficacious was *C. papaya* at 4% (32.46%). Progeny emergence was concentration dependent. The lowest percentage weight loss of the grains was recorded by *H. brasiliensis* latex at 6% (Table 3), which was significantly ($P < 0.05$) different from the 4% concentration of *H. brasiliensis* and the higher rate of *C. papaya* at 6%. The highest percentage weight loss of grains was found on seeds treated with 4% latex of *C. papaya*, which were however statistically heavier than the untreated control grains. Table 4 revealed the effect of the test lattices on grain damage, in which the plant lattices of both *H. brasiliensis* and *C. papaya* significantly provided protection to the grains against *S. zeamais* damage. Percentage grain damage (49.89%) was highest in untreated control jars. The least grain damage (11.97%) was recorded by *H. brasiliensis* at 6% dosage level, which statistically differed with the rest treatments. The result of phytochemical study shown in Table 5 revealed the typical compositions of the plant materials assayed including alkaloids, flavonoids, saponins, tannins, oxalates and phenols but in different proportions. Toxicity of the plant lattices to the weevil was concentration-dependent and increased with duration of exposure. Conversely, progeny emergence decreased with increase in the concentration of the plant lattices. It could be observed that the low progeny emergence largely is the consequence of high adult mortality few days after infestation. This result could be due to the insecticidal properties contained in members of the family Euphorbiceae and other latex bearing plants (Adebowale and Adedire, 2006). Different latex proteins seem to participate in defensive approaches against insects (Konno *et al*; 2004). The result corroborates the findings of Ogunleye and Omotoso (2011) who reported 100% adult mortality of *C. maculates* on cowpea seeds treated with drops of *J. multifida* latex 24 hours after application. Similarly, the plant latex of *C. procera* at the rates of 1.5mls and 2.0mls evoked 100% mortality of adult *C.maculatus* after 4 days (Vikash 2003). Furthermore, it is in agreement with the work of Suleimen *et al;* (2012) who reported zero percent adult emergences of *S. zeamais* when sorghum grains were treated with *J. curcas* latex. *H. brasiliensis* latex protected the seeds of cowpea (*V. unguiculata L.*) against *C. maculatus* damage (Bragay *et al*; 1997). Phytochemical analysis of the trial plant materials showed that the more potent latex derived from *H. brasiliensis* had a high content of flavonoids, phenols and tannins, *and lower proportions of alkaloids, saponins and oxalates*, which could be responsible for the insecticidal properties. Studies performed aimed at understanding the biochemical profile of latex have offered convincing evidence for a defensive role played by the saps (Ramos *et al*, 2009). According to Sabu and Vinod (2009) plant latex is a complex mixture of proteins, alkaloids, starch, sugars, oils, tannins, resins and gums. Latex bearing plant species from few families possess diverse phytochemicals having very high insecticidal activity (Shaalan *et al*, 2005) against many insect pests such as *C. quinquefasciatus* and *Musca domestica* (Morsy *et al;* 2001). Therefore, it is likely that the phytochemicals contained in these plant lattices could be associated with their potencies.

CONCLUSION

The result of this study suggest that test plant lattices obtained from *H. brasiliensis* and *C. papaya* could be used to cause insect toxicity and deter adult emergence of *S. zeamais* on maize in storage. They could also reduce percentage weight losses and grain damage due to insect infestation during storage. These plant materials are readily available, cheap and could be employed as a component of integrated pest management in environment friendly manner. Their phytochemical constituents are likely responsible for their insecticidal properties.

Table 1 Effect of Latex on Adult Mortality of *sitophilus zeamais* at Days 1, 3 and 7 after treatment.

Treatments	Conc. (mls/50g, grains	No of insects inoculated	Mean No of dead insects in days 1,3and 7			Mean % mortality in days		
			1	3	7	1	3	7
H. brasiliensis	4.00	20	0.25(0.392)	0.5(0.785)	17.50(4.2128)	1.25(6.55)	2.50 (9.10)	87.5 (69.30)
H. brasiliensis	6.00	20	0.5 (0.785)	1.00 (1.5708)	18.50 (4.3008)	2.50(9.10)	5.00 (12.9)	92.5 (74.11)
C papaya	4.00	20	0.00(0.00)	0.25 (0.39)	10.25(3.0800)	0.00 (0.00)	1.25(6.55)	51.25(45.75)
C papaya	6.00	20	0.00(0.00)	0.25(0.39)	14.75 (3.8391)	0.00 (0.00)	1.25 (6.55)	73.75(59.12)
Control	20		0(0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00(0.00)	0.00 (0.00)
LSD (0.05)			**NS**	**0.69**	**0.97**			

Figures in parenthesis are arcsine values to which LSD is applicable.

Table 2: Effect of latex on progeny emergence

Treatments	Conc.(mls/50g Grains	No of insects inoculated	Mean F1 generation	%F1 generation
H brasiliensis	4.00	20	2.75 (1.6526)	13.75 (21.81)
H. brasiliensis	6.00	20	1.25 (1.1036)	6.25 (14.54)
C. papaya	4.00	20	5.75 (2.3961)	28.75 (32.46)
C. papaya	6.00	20	4.25(2.0590)	21.25 (27.49)
Control		20	17.25 (4.1530)	86.25 (68.28)
LSD			**0.2076**	

Table 3: Effect of latex on weight loss of grains after 3 months of storage

Treatments	Conc.(mls/50g	Initial Weight 0f grains	Final weight of grains	Weight loss of grains	% weight loss
H. brasiliensis	4.00	200	163	37.00(6.08)	18.50(24.48)
H. brasiliensis	6.00	200	186	14.00(3.74)	7.00(15.34)
C. papaya	4.00	200	126	74.00(8.60)	37.00(37.47)
C. papaya	6.00	200	143	57.00(7.55)	28.50(32.27)
Control		200	49	151.00(12.29)	75.50(60.33)
LSD(0.05)				**0.13**	

Table 4: Effect of latex on grain damage

Treatment	Conc.(mls/50g) Grains	Number of grains sampled	Mean number of grains with adult emergent holes	% grain damage
H. brasiliensis	4.00	100	14.00 (3.7417)	14.00 (21.97)
H. brasiliensis	6.00	100	4.25 (2.0509)	4.25 (11.97)
C. papaya	4.00	100	20.00 (4.47)	20.00 (26.56)
C. papaya	6.00	100	19.00 (4.36)	19.00 (25.84)
Control		100	58.50 (7.65)	58.50 (49.89)
LSD(0.05)			**0.08**	

Table 5: Results of phytochemical analysis of C. papaya (pawpaw) and H. brasiliensis (Rubber)

Plant materials	Alkaloid	Flavonid	Saponins	Tannins	Oxalate	phenol
	%	%	%	%	%	%
Pawpaw leaves	3.78	0.66	2.48	0.48	1.82	0.045
Pawpaw stem	0.84	0.48	0.22	0.76	0.34	0.020
Pawpaw seed	2.52	2.26	1.40	1.12	2.24	0.58
Rubber leaves	2.34	0.84	1.06	0.54	1.65	0.066
Rubber sap	0.42	3.86	0.62	0.08	0.34	2.38
Rubber bark	1.14	2.10	0.75	1.24	0.24	1.36

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EFFECT OF EMPTY PALM BUNCH AND PALM BUNCH ASH ON CURCUMIN CONTENT AND SOME NUTRIENT PARAMETERS OF TURMERIC RHIZOME

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ABSTRACT

A wide range of soil amendments improve soil nutrients which are known to influence the production of plant secondary metabolites. Curcumin is one of the secondary metabolites of turmeric (Curcuma longa Linn) responsible for its multipurpose uses. Turmeric rhizomes were harvested from a split plot experiment in a randomized complete block design (RCBD) at the western farm of National Root Crops Research Institute, Umudike. Where empty palm bunch (EPB) treatments (0 (12 t/ha elephant grass), 4, 8 and 12 t/ha EPB) occupied the main plots, while palm bunch ash (PBA) treatments (0 (60 kg N + 13 kg P + 25 kg K), 4, 8 and 12 t/ha PBA) occupied the sub plots. Composite primary rhizomes were collected from the treatment plots for the analysis of curcumin, dry matter and ash contents (%). Results obtained showed that application of 4 t/ha EPB significantly (P < 0.01) yielded the highest amount of curcumin (7.96%). Highest amount of dry matter (84.09%) was achieved using 8 t/ha EPB. Application of PBA at 8 t/ha significantly (P < 0.01) yielded the highest amount of curcumin (7.24%). Highest amounts of dry matter (84.36%) and ash (9.37%) were produced with 12 t/ha PBA. Significant treatments interaction effect was also observed. Application of 4 t/ha EPB + 8 t/ha PBA yielded significantly (P < 0.05) highest amount of curcumin (9.44%). Significantly optimum amounts of dry matter (85.94%) and ash (10.63%) contents were achieved from rhizome grown with 4 t/ha EPB + 12 t/ha PBA. It was recommended that EPB and PBA are good sources of organic manure and fertilizer for increased curcumin, dry matter and ash yields in turmeric production.

Keyword: Empty palm bunch, palm bunch ash, curcumin, turmeric rhizome and Umudike

INTRODUCTION

Turmeric (*Curcuma longa* Linn) is a perennial herbaceous plant grown primarily for the rhizome and is regarded as the golden spice. Turmeric spice is the principal ingredient in curry powder. The rhizome has been used extensively in cooking, medicine, cosmetics and fabric dying for more than 2000 years (Ammon and Wahl, 1991). Curcuminoids are the polyphenols responsible for the turmeric yellow colour. Curcumin, the principal curcuminoid of turmeric has potent anti-oxidant (Masuda *et al*., 1993), wound healing (Srimal, 1997), anti-malarial (Nandakumar *et al*., 2006), anti-carcinogenic (Gupta *et al*., 2012) anti-inflammatory properties (Gupta *et al*., 2013). A wide range of soil amendments improve soil nutrients which are known to influence the production of plant secondary metabolites (Morison and Lawlor 1999). Thus, variation in secondary metabolites with respect to different soil amendments will play a critical role in their increasing multipurpose uses and export potentials in the international market. In Nigeria, oil palm is widely grown and is a valuable economic crop (Lua and Gua, 1998). However, palm oil mills produce large amounts of solid wastes consisting of huge amount of lignocellulosic material such as empty palm bunch (EPB) . The uses of EPB in agriculture has not been fully exploited and farmers are becoming aware of the use palm bunch ash (PBA) in cultivation of root and tuber crops because it is rich in potassium, magnesium, phosphorus and calcium (Adjei-Nsia 2012). A study was carried out to analyze the effect of EPB and PBA on curcumin and some nutrient parameters of turmeric.

MATERIALS AND METHODS

Turmeric rhizomes were harvested from a split plot experiment in a randomized complete block design (RCBD) at the western farm of National Root Crops Research Institute, Umudike. Empty palm bunch treatments (0 (12 t/ha elephant grass), 4, 8 and 12 t/ha EPB) occupied the main plots, while PBA (0 (60 kg N + 13 kg P + 25 kg K), 4, 8 and 12 t/ha PBA) occupied the sub plots. Composite primary rhizomes were collected from 16 treatments combination plots for the analysis of curcumin, dry matter and ash contents (%). Standard methods of A.O.A.C. (1990) were used for the determination of dry matter and ash contents. Curcumin content was determined by the method of Thimmaiah (1999). Data generated were subjected to analysis of variance (ANOVA). Significant treatment means were separated using Fischer's least significant difference (FLSD) at 5% probability level.

RESULTS AND DISCUSSION

Table 1 shows the simple effect of EPB and PBA on the curcumin, dry matter and ash contents of turmeric rhizomes. Curcumin content was significantly (P < 0.01) influenced by EPB. Optimum amount (7.96%) was recorded with 4 t/ha EPB. Highest amount of dry matter (84.09%) was obtained from rhizomes grown with 8 t/ha

EPB. This amount differed significantly with those obtained with 0 or 4 t/ha EPB (82.82 and 81.64%, respectively). There was no significant difference in ash content due to EPB. However, ash content ranged from 8.22 – 8.43%. According to Udoetok (2012), EPB is a lignocellulose material that contains 25% lignin, 50% cellulose and 25% hemicellulose in its cell wall and consequently undergoes differential decomposition. High curcumin content in the rhizome of turmeric may have resulted from nutrients released from EPB at different decomposition rates. Effect of PBA on curcumin content and some nutrient parameters are also shown in Table 1. Application of 8 t/ha PBA yielded the highest amount of curcumin (7.24%) which differed significantly with those obtained using other treatments. Lowest amount of curcumin (5.88%) was obtained from rhizomes of 4 t/ha treatment. Hikaru *et al*, (2007) reported potassium (K) and nitrogen (N) to be the key elements in the formation of curcumin. Lim and Zahara (2000) reported that PBA contains over 30% of potassium oxide and is used as fertilizer. Palm bunch ash is 100% organic fertilizer and is used commercially in neutralizing acidic soil effectively (Udoetok, 2012). Sandeep *et al*. (2015) implicated soil N as the precursor for phenlypropanoid pathway which leads to curcumin production in turmeric. They reported a curcumin yield of 1.4 to 5.0% due to variations in environmental and soil nutrient factors, pointing out that high N, P and K contents in the soil inhibit curcumin production. Percentage dry matter increased with increase in PBA. Highest amount of dry matter (84.36%) was obtained using 12 t/ha PBA and the least (81.37%) with NPK fertilizer. High dry matter depicts a good keeping quality on the turmeric flour. The ash content measures the amount of mineral element in a plant. Udoetok (2012) corroborated this when he posited that oil palm bunch ash contains appreciable concentration of anions like nitrate (97.6 mg/kg), phosphate (47.5 mg/kg), chloride (2280.0 mg/kg) high concentration of potassium (139.35 mg/kg), calcium (146.15 mg/kg) and high pH value (10.9). There was a similar increase in ash content as the rate of PBA increased. Application of 12 t/ha PBA recorded the highest ash content (9.37%), while NPK fertilizer recorded the least (6.79%). Effect of EPB and PBA interaction on curcumin yield, dry matter and ash contents of turmeric are as shown in Table 2. Application of 4 t/ha EPB + 8 t/ha PBA yielded significantly ($P < 0.05$) highest amount of curcumin (9.44%). Significantly optimum amounts of dry matter (85.94%) and ash (10.63%) contents were achieved from rhizome grown with 4 t/ha EPB + 12 t/ha PBA. Interaction results obtained showed that application of 12 t/ha PBA to 4 t/ha EPB improved the yield of dry matter and ash content, whereas, the application of 8 t/ha PBA to 4 t/ha EPB resulted in highest yield of curcumin. These increases show the relevance of EPB at 4 t/ha in the curcumin, dry matter and ash contents of turmeric.

CONCLUSION

From the study, it could be concluded that the use of 12 t/ha straw mulch (Nwokocha *et al*., 2009a) and/or 60 kgN + 13 kgP + 25 kgK/ha fertilizer (Nwokocha *et al*., 2009b) for turmeric production did not improve the yield of curcumin, dry matter and ash content of turmeric rhizomes. Application of 4 t/ha EPB as a mulch material improved curcumin yield, while at 8 t/ha, dry matter yield was significantly improved. Application of 8 and 12 t/ha PBA significantly improved curcumin yield and dry matter/ash contents, respectively. This may be attributed to the potassium oxide content of the PBA. The curcumin contents in this report are higher than values reported in other experiments.(Kamal and Yousuf 2012; Sandeep et al., 2015). It could be recommended that EPB and PBA are good sources of organic manure and fertilizer for increased curcumin, dry matter and ash yields in turmeric production, while maintaining cheap and readily available sources of nutrients to the plant.

Table 1: Simple effect of EPB and PBA on curcumin, dry matter and ash contents (%) of turmeric rhizome.

Treatment	Curcumin (%)	Dry matter (%)	Ash (%)
EPB rate (t/ha)			
0 (12 t/ha straw)	6.111	82.82	8.431
4	7.957	81.64	8.258
8	6.487	84.09	8.235
12	5.810	83.05	8.215
LSD (0.05)	0.58**	1.18*	NS
PBA rate (t/ha)			
0 ($N_{60}P_{13}K_{25}$ kg/ha)	6.660	81.37	6.792
4	5.882	82.84	8.469
8	7.244	83.03	8.508
12	6.579	84.36	9.371
LSD (0.05)	0.49**	0.86**	0.43**

*, ** = Significant at 5 and 1% probability levels, respectively; NS = Not significant at 5% probability level.

Table 2: Effect of EPB and PBA interaction on curcumin, dry matter and ash contents (%) of turmeric rhizome

EPB x PBA interaction	Curcumin (%)	Dry matter (%)	Ash (%)
0 t/ha EPB x PBA 0	6.715	82.07	7.350
0 t/ha EPB x PBA 4	6.060	82.93	9.275
0 t/ha EPB x PBA 8	7.940	82.55	8.050
0 t/ha EPB x PBA 12	3.730	83.72	9.050
4 t/ha EPB x PBA 0	7.735	78.03	5.800
4 t/ha EPB x PBA 4	7.430	82.02	8.325
4 t/ha EPB x PBA 8	9.435	81.95	8.283
4 t/ha EPB x PBA 12	7.230	84.56	10.625
8 t/ha EPB x PBA 0	8.160	83.53	6.517
8 t/ha EPB x PBA 4	6.045	84.07	8.675
8 t/ha EPB x PBA 8	4.267	82.82	8.625
8 t/ha EPB x PBA 12	7.475	85.94	9.125
12 t/ha EPB x PBA 0	4.030	81.86	7.500
12 t/ha EPB x PBA 4	3.995	82.35	7.600
12 t/ha EPB x PBA 8	7.335	84.77	9.075
12 t/ha EPB x PBA 12	7.880	83.21	8.863
LSD (0.05)	0.97**	1.78**	0.87**

** = Significant at 1% probability level.

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INFLUENCE OF SOIL PARENT MATERIAL ON YIELD AND NUTRIENT UPTAKE OF SWEET POTATO: IMPLICATION FOR FOOD SECURITY

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ABSTRACT

The influence of soil parent material on the root yield and on N, P and K uptake responses of different sweet potato varieties was assessed in a greenhouse study conducted at NRCRI Umudike, Southeast Nigeria. Treatments were soils formed from four soil parent materials (Sandstone, Coastal Plain Sands, Shale and Fresh Water Alluvium) in factorial combinations with three sweet potato varieties (TIS 87/0087, TIS 2532.OP.113 and Ex-Igbariam). Both soil parent material and sweet potato variety significantly influenced root yield and N, P and K uptake responses of sweet potato. Across the three varieties, soils formed on shale parent material gave highest mean root yield response of 18.3 t/ha while the least yield outcome of 12.8 t/ha was recorded on soil formed from sandstone. TIS 87/0087 followed by TIS 2532.OP.113 sweet potato varieties were more adaptable to soils of diverse parent materials than Ex-Igbariam variety.

Keywords: Soil, Parent Material, Yield, Sweetpotato and Food Security

INTRODUCTION

Sweet potato is ranked 3rd most important root crop after cassava and yam in Sub-Saharan Africa (Han and Hozyo, 1998). Sweet potato is reported to possess the highest energy-fixing efficiency; producing up to 20 t/ha in 4 – 5 months (Han, 1977). In some parts of northern Nigeria, the crop plays a vital role as a food security crop because of its resistance to drought. It has tremendous potential to be an efficient and economic source of food energy. Average yield of sweet potato in Nigeria is 3 t/ha (Stathers *et al*., 2013). This yield figure is very low compared to the yields obtainable from other countries of the world. Low soil fertility has been adduced as part of the reasons responsible for low yields of sweet potato in Nigeria as majority of the soils in Nigeria are formed from low nutrient parent material rock types. The character and chemical composition of the parent material plays an important role in determining soil properties, especially during the early stages of development. As soils form, nutrients are being continually removed from and added to the soil with time. The conditions that are present during soil formation ultimately determine how much and what kind of nutrients the soil can naturally supply and hold and this has implications on soil fertility and productivity. For example, if parent materials are low in soluble ions, water moving through the soil removes the bases and substitutes them with hydrogen ions thus making the soil acidic and unsuitable for agriculture. Soils developed over sandstone are low in soluble bases and coarse in texture. Such soils tend to have high rate of leaching and require proper management manipulation to achieve sustainable crop growth and yield. Soils which were weathered from basalt tend to be finely textured, as well as fertile when not highly weathered. In contrast to basalt, granite is coarse-textured rock that generally weathers into coarsely-textured soils. Granite is the parent material of most soils in Nigeria. Parent material affects soil fertility in many ways. First, the type of parent material determines which minerals will predominate in the soil. Secondly, as parent material weathers, nutrients are released into soil solution, which subsequently can be taken up by plants and other organisms or leached from the soil. The implication of such variations in soil parent materials on crop growth and yield is not well understood. The objective of this study therefore, is to assess the influence of soil parent material on the root yield and N, P and K uptake responses of three sweet potato varieties under greenhouse condition.

MATERIALS AND METHODS

The study was conducted in 2012 in the greenhouse of the National Root Crops Research Institute, Umudike in Southeast Nigeria. Selected physico-chemical properties of the soils from different parent materials used for the study are shown in Table 1. Treatment comprised soils formed from four parent materials {Sandstone (SS), Coastal Plain Sands (CPS), Shale (SH) and Fresh Water Alluvium (FWA)} in factorial combinations with three sweet potato varieties (TIS 87/0087, TIS 2532.OP.113 and Ex-Igbariam). The soils were collected with a soil auger. The Soils were collected from Okigwe (Sandstone), Umudike (CPS), Amaeke (Shale) and Owerrinta (Fresh Water Alluvium) all in Abia State, Nigeria. The soils were air-dried, crushed and sieved with a 2 mm sieve mesh. Three (3) kg of the air-dried soil were weighed into a 5 liter plastic bucket. The soil in each bucket was mixed thoroughly and moistened to 70 % field capacity with distilled water. Pre-planting laboratory analyses of the soils to determine their chemical compositions were made using standard methods. The soils were planted up with 3 node-vine cuttings of three sweet potato varieties (TIS 87/0087, TIS 2532.OP.113, and Ex-Igbariam). After 8 weeks of growth, NPK fertilizer was added at a rate equivalent to 400 kg/ha. The fertilizer was solubilized and added into the soil in each bucket in solution form. Data on fresh rhizome yield and on N, P, and K nutrient uptake were collected after 3 months of growth in the greenhouse. Nutrient uptake was measured by multiplying tissue N, P and K concentrations with biomass yield. Data were analyzed using ANOVA and treatment means with significant differences were detected using Least Significant Difference (LSD) at 5 % level of probability.

RESULTS AND DISCUSSION

The physico-chemical properties of the soils of the different parent materials are shown in Table 1. The soils varied in their chemical properties with soil formed from shale parent material having the highest amounts of total N, available P and exchangeable basic cations. Generally, the soils were of low to medium fertility as indicated by their chemical characteristics. The results of this study in Table 2 are indicating that both soil parent material and sweet potato variety are important factors for consideration in designing intervention measures for increased sweet potato productivity in Nigeria as both factors significantly affected the root yield response of the crop. Across the three varieties, soils formed from shale parent material gave highest mean root yield response of 18.3 t/ha while the least yield outcome of 12.8 t/ha was recorded on soil formed from sandstone. The exceptionally very low level (below 2%) of organic matter content and low exchangeable cations of soil formed from sandstone implies that sustainable sweet potato yield is only achievable if large and regulated quantities of organic inputs are regularly applied on them. Variety TIS 87/0087 was superior to TIS 2532.OP.113 and Ex-Igbariam in terms of root yield response. Highest interactive yield result of 21.6 t/ha was recorded when TIS 87/0087 was grown on soil formed from shale while the lowest yield result of 10.3 t/ha was obtained when Ex-Igbariam was grown on soil formed from sandstone. The significantly higher root yield response recorded on soil formed from shale over soils from other parent materials is attributed to increased nutrient N and K uptake characteristics exhibited by shale in this study (Tables 3 and 5). In the agronomy of sweet potato, nitrogen is one of the most important soil nutrients for efficient vegetative growth (Havlin et al., 2004). Apart from being a template for protein synthesis, N is also an integral part of chlorophyll, which is the primary absorber of light energy needed for photosynthesis. Being a short duration crop, adequate supply of N is important for enhanced photosynthetic activities and vigorous vegetative growth of sweet potato crop. Potassium ions are needed for root bulking (Okwuowulu and Asiegbu 2000). The better yield performance of TIS 87/0087 and TIS 2532.OP.113 over Ex-Igbariam variety is assumed to be due to differences in genetic composition. While Ex-Igbariam is a local variety, TIS 87/0087 and TIS 2532.OP.113 are improved varieties with improved traits that make for better adaptation in most soil types in Nigeria.

CONCLUSION

Soil parent material and sweet potato variety are important factors for consideration in designing intervention measures aimed at increasing sweet potato productivity in Nigeria as both factors significantly affect the root yield response of the crop. Soils formed from shale are better in terms of root yield and N and K nutrient uptake response outcome of sweet potato than soils from sandstone, coastal plain sands and fresh water alluvium. TIS 87/0087 followed by TIS 2532.OP.113 sweet potato varieties are more adaptable to soils of diverse parent materials than Ex-Igbariam variety.

Table 1: Selected Physico-chemical Properties of Soils used for the Study

Soil Parent Material	Total N (%)	Av. P (mg/kg)	Exch. K	Exch. Ca	Exch. Mg	Org. M (%)	pH	Texture
			……………..(cmol/kg)……………………..					
Sandstone	0.11	9.0	0.16	1.5	2.1	1.6	5.4	Sandy clay loam
Coastal Plain Sands	0.24	10.6	0.22	3.8	3.3	2.8	6.2	Loamy Sand
Shale	0.26	14.7	0.30	4.8	3.8	2.9	6.6	Clay Loam
Fresh Water Alluvium	0.18	13.2	0.42	2.5	2.8	2.6	5.6	Loamy Sand

Table 2: Effect of Soil Parent Material on the Varietal Root Yield (t/ha) Response of Sweet Potato in South Eastern Nigeria

Parent Material	Sweet Potato Variety			
	TIS 87/0087	TIS 2532.OP.113	Ex-Igbariam	Mean
Sandstone	15.7	12.4	10.3	12.8
Coastal Plain Sands	18.4	16.6	13.1	16.0
Shale	21.6	18.9	14.3	18.3
Fresh Water Alluvium	12.2	13.5	14.7	13.5
Mean	17.0	15.4	13.1	-
	LSD(0.05):			
	Parent Material = 1.086			
	Variety = 1.200			
	Parent Material x Variety = 0.654			

Table 3. Effect of Soil Parent Material on the Varietal Nutrient N Uptake of Sweet Potato in South Eastern Nigeria

Parent Material	**Sweet Potato Variety**			
	TIS 87/0087	**TIS 2532.OP.113**	**Ex-Igbariam**	**Mean**
Sandstone	150.5	120.4	108.4	126.4
Coastal Plain Sands	112.4	102.3	96.5	103.7
Shale	161.5	122.2	122.5	135.4
Fresh Water Alluvium	96.6	98.9	136.8	110.8
Mean	130.3	111.0	116.1	-
	LSD (0.05):			
	Parent Material = 5.764			
	Variety = 3.432			
	Parent Material x Variety = 2.122			

Table 4: Effect of Soil Parent Material on the Varietal Nutrient P Uptake of Sweet Potato in South Eastern Nigeria

Parent Material	**Sweet Potato Variety**			
	TIS 87/0087	**TIS 2532.OP.113**	**Ex-Igbariam**	**Mean**
Sandstone	76.8	84.4	84.9	55.4
Coastal Plain Sands	96.6	92.4	98.6	95.9
Shale	54.7	96.6	94.5	81.9
Fresh Water Alluvium	68.7	100.0	86.8	85.2
Mean	74.2	93.4	91.2	-
	LSD (0.05):			
	Parent Material = 6.062			
	Variety = 3.331			
	Parent Material x Variety = 2.421			

Table 5: Effect of Soil Parent Material on the Varietal Nutrient K Uptake of Sweet Potato in South Eastern Nigeria

Parent Material	**Sweet Potato Variety**			
	TIS 87/0087	**TIS 2532.OP.113**	**Ex-Igbariam**	**Mean**
Sandstone	132.3	112.2	86.9	110.5
Coastal Plain Sands	115.0	104.0	77.8	98.9
Shale	85.6	88.3	98.2	90.7
Fresh Water Alluvium	92.9	76.8	132.4	100.7
Mean	106.5	95.3	98.8	
	LSD (0.05):			
	Parent Material = 3.330			
	Variety = 1.122			
	Parent Material x Variety = NS			

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ORIGIN, UTILIZATION AND FACTORS INFLUENCING GINGER ADOPTION BY FARMERS IN NIGERIA

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ABSTRACT
Ginger production in Nigeria started in 1927 and has been on for many years. Ginger has enormous potentials for export, income generation and creation of employment opportunities. As a crop that is well cherished the world over due to its spicy taste and anti-oxidant properties, ginger has found wide application in many pharmaceutical, brewery and food industries. However, despite its numerous potentials, the crop is not popular among most small scale farmers in Nigeria. This review paper is an attempt to highlight the numerous benefits of ginger, its uses and factors responsible for low adoption of the crop among farmers in Nigeria. The underlining objective of this review is to reposition ginger so as to play a leading role in agricultural diversification programme of the Federal Government of Nigeria.
Keywords: Origin, Utilization, Adoption and Ginger

Historical Origin of Ginger

Ginger (*Zingiber officinale Rosc.*) is an herbaceous perennial plant belonging to the family *Zingiberaceae*. It is a tuber crop and is extensively grown across the world for its pungent aromatic under-ground stem or rhizome (Ajibade and Dauda, 2005). The origin of ginger is not well established though it is generally believed to be a native of Asia, where it was first cultivated (Kaduna State Ministry of Agriculture, 2007). It was also cultivated in the tropical regions of America. Ginger was introduced to Europe by Arab traders from India in the first century AD. The Arabs also took the plant from India to East Africa in the thirteenth century while the Portuguese took it to West Africa and other part of the tropics in the sixteen century. Ginger was introduced to Nigeria in 1927 (Kaduna State Ministry of Agriculture, 2007). The spice was known in Germany and France in the ninth century and had become common in trade as pepper by the thirteenth century. The plant is now cultivated in different parts of Nigeria, though the major producing areas include Kaduna, Nassarawa, Sokoto, Zamfara, Akwa Ibom, Oyo, Abia and Lagos states although southern Kaduna still remains the largest producer of fresh ginger in Nigeria (KADP, 2000, KADP, 2004;Bernard, 2008). Ginger grows best in tropical areas that have high rainfall and hot and humid conditions.

Uses of Ginger

Ginger can be used in a variety of ways:

(i) Ginger adds to the flavour of a meal creating a fresh, spicy pungent taste which is now becoming a valued commodity all over the world. It is revered as one of the most important and valued spices of the world.

(ii) Ginger is now used in many different ways and is a complement to many different dishes and flavours. It complements coconut milk curries, lemon grass and gravy.

(iii) It can be used raw, fried, dried, pickled or as a juice and is a favourite in tea and ale.

(iv) Ginger is now grown as a cash crop in Nigeria especially in Southern part of Kaduna State where the crop is mostly grown. Recently ginger has been introduced in a crystallized form creating a type of sweet appropriate for dessert or snack.

Medicinal Value

For over 5000 years ginger has been recognised as the "universal medicine" by the ancient Orientals of China and India. Today ginger remains a component of more than 50% of the traditional herbal remedies and has been used to treat nausea, indigestion, fever and infection and to promote vitality and longevity. The report of Authority Nutrition (2012 – 2016) identified several health disorders and illnesses which ginger can help to remedy. These health disorders include: (a) Flatulence; (b) Nausea; (c) Intestinal infection; (d) Food poisoning; (e) High blood pressure; (f) Chilblains; (g) Fever Clotting; (h) Motion sickness, (i) Morning sickness Cold and Flu; (k) Arthritis pain; (l) Skin cancer; (m) Weight Loss; (n) Thirst; (o) Depression; (p) Gastrointestinal disorders; (q) Bone fragility.

Anti-Oxidant Properties of Ginger

Ginger's anti toxic properties have an anti viral, anti fungal, anti histamine and anti bacterial effect, which is basically the effect of an anti biotic, cold and flu tablet or an aspirin. Ginger has played an important role in Asian medicine as a folk remedy to promote cleansing of the body through perspiration, to calm nausea and to stimulate the appetite. Ancient Indians used ginger root to treat digestive problems. Chinese sailors chewed ginger root to combat seasickness. Chinese women drank ginger tea to alleviate menstrual pain. Ginger contains no fat or sugar and so can be added to foods to heighten flavour without adding calories. Ginger tea brewed from the fresh root has not only a weight loss purpose but has been used for centuries in India and China as an after meal drinks to aid digestion. Ginger's enzymes catalyse protein digestion in the stomach quickly and leave little time for nausea. Ginger also contains moderate amounts of magnesium, calcium, protein, calcium, iron, sodium, potassium and phosphorus. Together they act as a remedy for muscle spasms, depression, hypertension, muscle weakness, convulsions, confusion, personality changes, nausea and gastrointestinal disorders. The high level of potassium in ginger protects the body from bone fragility, paralysis, sterility, muscle weakness, kidney damage and damage to the heart. Ginger also has a high content of antioxidants which means it also has anti-inflammatory properties.

Value-Addition and Alternative Product Development

Ginger can and has been used in many different products. Ginger tea has been used as a carminative and for the treatment of colds at their onset for centuries. It has been used in China as a tonic. The Greeks, after a large meal, wrap bread around a piece of ginger and eat it to ease indigestion. This practice gave rise to the production of ginger bread. In England, ginger was added to beer, forerunner to ginger ale, as a remedy for diarrhea, nausea and vomiting. The Chinese also considered ginger root to be an antidote for shellfish poisoning, explaining why it is found in so many seafood dishes. Ginger is important in many homes because of its pungent flavour. It is a complement to many meals, drinks and desserts. Unfortunately, despite the fact that ginger has a diverse scope for product development and multiplicity of uses, the crop is not very popular among most farmers in Nigeria. Many reasons have been adduced for this unpopularity of the crop among small scale farmers. The following are some of the identified reasons or factors responsible for low adoption of ginger among farmers and hence, low ginger productivity in Nigeria:

Misconception about the adaptability of ginger to different ecologies in Nigeria

Most smallholder farmers are yet to understand that ginger can grow in many ecologies in Nigeria apart from Southern Guinea Savanna. Research efforts by National Root Crops Research Institute, Umudike have shown that ginger grows well even in the rainforest ecology of Nigeria.

Lack of basic information on the agronomic requirement of the crop

There is paucity of information on modern and sustainable ways of growing ginger taking into cognisance differences in soil types, income base of the farmers and community behavioural change dynamics. Information is scanty on ginger cultural management and agronomic requirements (plant population, fertilizer rate, disease management etc) for sustainable yield in Nigeria.

Inadequate information on the marketing channels and market potentials of ginger

There is inadequate information on the value-addition potentials of the crop and available marketing channels for disposing of ginger produce.

Rampant disease and storage problems of the crop

Due to the high moisture content of ginger rhizomes, microbial deterioration of rhizomes is very fast and this poses a very great problem to small scale ginger farmers. In addition, the crop is susceptible to many fungal and bacterial diseases which reduce its nutritional and market values thereby predisposing farmers to great economic loss.

High labour requirement for ginger production

Ginger requires high labour input. Apart from the very close planting distance of 20 cm x 20 cm which calls for high rate of labour to achieve, the compulsory requirement of mulching in ginger production scares away most prospective ginger farmers.

Low Soil Fertility

Most soils in Nigeria are of low to medium fertility classification (Agboola, 1986) and therefore, cannot adequately support sustainable yield of crops without external fertilizer input. Being a high nutrient-demanding tuber crop, ginger requires high level of soil fertility with adequate organic matter content. Meeting the nutrient needs of ginger is a big task especially for the resource poor farmers in Nigeria.

Other factors responsible for low adoption and hence low productivity of ginger crop in Nigeria include: low multiplication ratio, narrow genetic base and low house-hold consumption of the crop due to its spicy nature.

CONCLUSION

Restoring the lost glory of ginger in the light of the above facts would therefore, require a systemic and pragmatic approach and refocusing of our research priority agenda to address the identified gaps. There should be an increased advocacy on the potential economic and health benefits of ginger crop as a way to stimulate interest of farmers in its production. Research studies aimed at identifying sustainable ways of growing ginger without mulch application, intensifying and creating more marketing channels, increasing the multiplication ratio and storage should be embarked upon. Government (Local, State or Federal levels) should fund ginger research and development activities as a way of diversifying Nigerian agriculture and creating employment opportunities.

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PRELIMINARY YIELD EVALUATION OF NEW SWEETPOTATO (IPOMOEA BATATAS (L.) LAM) GENOTYPES FOR FRESH ROOT YIELD, ROOT FLESH COLOUR AND INCIDENCE AND SEVERITY OF SWEETPOTATO VIRUS DISEASE

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ABSTRACT
Field trial was conducted during the raining season of 2015 at the National Root Crops Research Institute (NRCRI) Umudike to evaluate 52 breeding lines developed in 2014 with three checks. The experimental design was randomized complete block replicated 3 times. The root yield ranged 5.21 – 16.24 t/ha with an overall mean root yield of 8.44 t/ha for the 52 breeding lines. The top thirteen breeding lines with yields above 10 t/ha were selected. TIS 87/0087 with 16.24 t/ha had the highest root yield. Of the 13 top lines, five were orange-fleshed sweetpotato (OFSP), while out of the 52 breeding lines evaluated, 54% were OFSP. Only 19 of the 52 breeding lines showed symptoms of sweetpotato virus disease (SPVD), while 14 of the susceptible 19 lines had SPVD severity score of above 3, of which score 5 means severe damage.
Keywords: Sweetpotato, Yield evaluation, genotype, virus disease

INTRODUCTION
Sweetpotato is an important food security crop in Nigeria. It is grown in all agro-ecologies of the country. With 3.48 million metric tonnes of production (FAOSTAT, 2015), Nigeria is the highest producer of sweetpotato fresh roots in Africa and the second highest producer in the world after China. While root production has increased ten-folds over the last 25 years, yield has declined progressively to approximately 3.0 tonnes per hectare (Anderson et al. 2012). Some of the production constraints militating against high yield include low genetic ability of the old farmer cultivars, susceptibility of popular farmer cultivars to the sweetpotato virus disease (SPVD), random drought, and insect-pest issues of which Cylas puncticollis is the main problem. Low use of fertilizer and poor field management also contribute to the observed low productivity. Some of these production challenges as well as combating vitamin A deficiency among urban and rural dwellers in Nigeria can be tackled using plant breeding approach. Preliminary yield trial is the first replicated yield evaluation phase in the development of new varieties. It is at this stage that the true yield potential of newly developed genotypes is first determined. Therefore, the objectives of the work are:

- to evaluate the 2014 cycle breeding lines for their root yield, virus disease resistance and root flesh colour attributes, and
- to select the promising lines that will be advanced to advance yield trial stage in 2016.

MATERIALS AND METHODS
Fifty-two newly-bred sweetpotato lines selected from clonal evaluation trial were evaluated using randomised complete block design (RCBD) with three replications in Umudike. Plot size was 9m^2 while plant spacing used was 1m X 0.3m, giving plant density of 33,333/ha. First weeding was carried out at four weeks after planting (WAP) while NPK 15:15:15: at the rate of 400kg/hectare was applied immediately after first weeding. Supplemental rouging was carried out at 8 WAP. Harvesting was done at 4 months after planting. Data collected were:

- Total weight of fresh roots (kg/plot but later converted to tons/ha);
- Incidence of sweetpotato virus disease (SPVD) at 10 WAP per plot;
- Severity of SPVD at 10 WAP per plot on a scale of 1-5 where 1 = no observed symptoms and 5 = severe symptoms on all leaves with reduced leaf size ad stunting;
- Root flesh colour.

RESULTS AND DISCUSSION
Total root yield (t/ha)
The root yield of the 52 lines ranged from 5.21 to 16.24 t/ha, while the combined mean root yield was 8.44 t/ha. Genotype TIS 87/0087, a check material, had the highest yield of 16.23 t/ha. Its yield was not significantly (P>0.05) different from those of lines A 005 (14.19 t/ha), E 016 (13.49 t/ha), D 075 (13.36 t/ha), A 097 (12.72 t/ha), C 081 (12.13 t/ha) and A 097B (11.41 t/ha). Lines A 005, E 016 and D 075 had significantly (P<0.05) higher root yield than the other two checks (UMUSPO/1 - 8.3 t/ha and UMUSPO/3 – 7.43 t/ha). Previous authors

(Afuape et al., 2011; Nwankwo and Afuape, 2013; Yahaya et al., 2015) had reported significant ($P<0.05$) variation in root yield among different genotypes. The observed variation among the lines for root yield provides the chance for selection.

Root flesh colour

There were five orange-fleshed sweetpotato (OFSP) genotypes in the top best 13 lines (Table 1). All the five OFSP lines had fresh root yields of 10/ha and above compared to the two OFSP checks of UMUSPO/1 (8.31 t/ha) and UMUSPO/3 (7.43 t/ha). Figure 1 shows that in total, more than half (54%) of the 52 breeding lines belong to the OFSP class – light orange (22%) and orange (32%). While 26% were white, 18% were yellow and only 2% were purple-fleshed. The development of bio-fortified sweetpotato has been receiving breeding attention of recent at the National Root Crops Research Institute, Umudike Nigeria. So, the more than 50% OFSP in the breeding lines confirms the attention being given to developing new OFSP varieties, while other flesh colours are not totally discarded. Orange flesh is known to be associated with beta-carotene in sweetpotato.

Incidence and severity of sweetpotato virus disease (SPVD)

Figure 2 shows the mean proportion of stands per genotype that expressed SPVD. Only 19 of the 52 genotypes evaluated showed SPVD symptoms (Figure 2). Four breeding lines (A058, Mother's Delight, Mozambique and E054) had most of their stands (100%, 100% 100% and 91% respectively) expressing SPVD symptoms. Breeding line C071 (6%), A060 (7%), D002 (8%) and ZC002 (9%) had the fewest plants showing SPVD symptoms.

Figure 3 shows the severity score of the 19 genotypes showing SPVD symptoms. Fourteen of the 19 genotypes with SPVD symptoms had severity score above 3.0. All the genotypes with >3.0 score will be discarded. The SPVD is the economically most important sweetpotato disease. Yield lose of up to 90% due to SPVD had been reported (Gutiérrez et al., 2003). Breeding for resistance has been identified as the best approach to control the virus (Gibson and Krueuze, 2015).

CONCLUSION

Genotypes with good root yield, low or no virus incidence and severity, as well as possess acceptable flesh colour will be selected for advanced yield trials in 2016. All the seven OFSP lines will be advanced to the next evaluation stage. Their nutritional and processing qualities will also be determined in during the advanced yield trial stage.

Table1: Fresh root yield (t/ha) and flesh colour of top 13 genotypes with above 10t/ha evaluated at PYT stage in Umudike in 2015.

Genotypes	Total root yield (t/ha)	Flesh colour
A 005	14.19	orange
E 016	13.49	Yellow
D 075	13.36	Yellow
A 097	12.72	Light orange
C 081	12.13	white
A 097B	11.41	orange
D 115B	11.06	orange
A 176	11.04	white
I 012	10.88	yellow
A 035	10.55	white
D 077	10.38	white
A 098	10.33	orange
K 003	10.09	yellow
TIS 87/0087 (check)	16.23	white
UMUSPO/1 (check)	8.31	Light orange
UMUSPO/3 (check)	7.43	orange
$FLSD_{0.05}$	4.98	

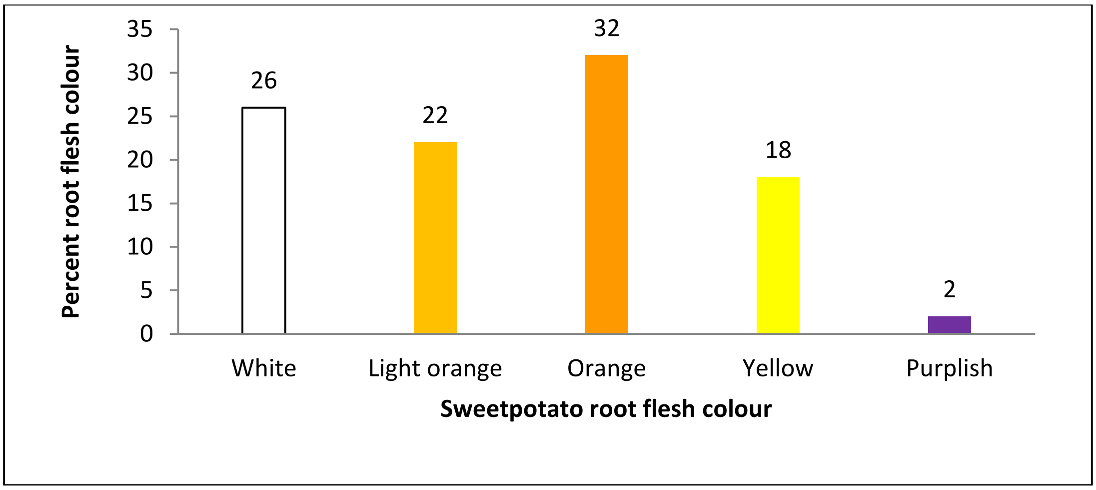

Figure 1: Flesh colour distribution of sweetpotato breeding lines at PYT stage.

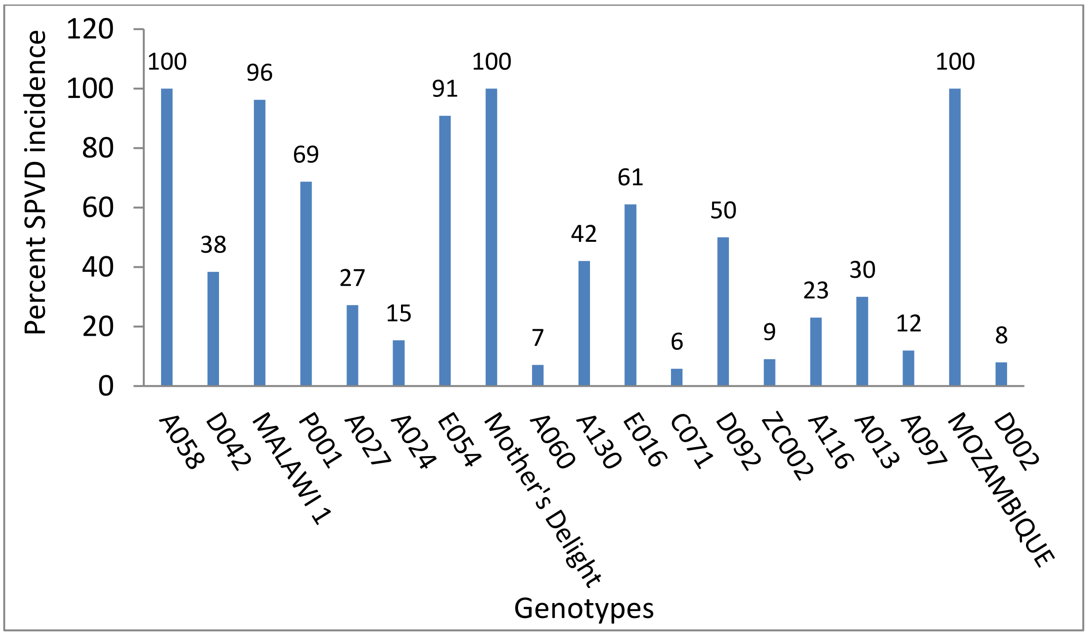

Figure 2: Mean percent of sweetpotato plants per genotype expressing SPVD symptoms at PYT stage

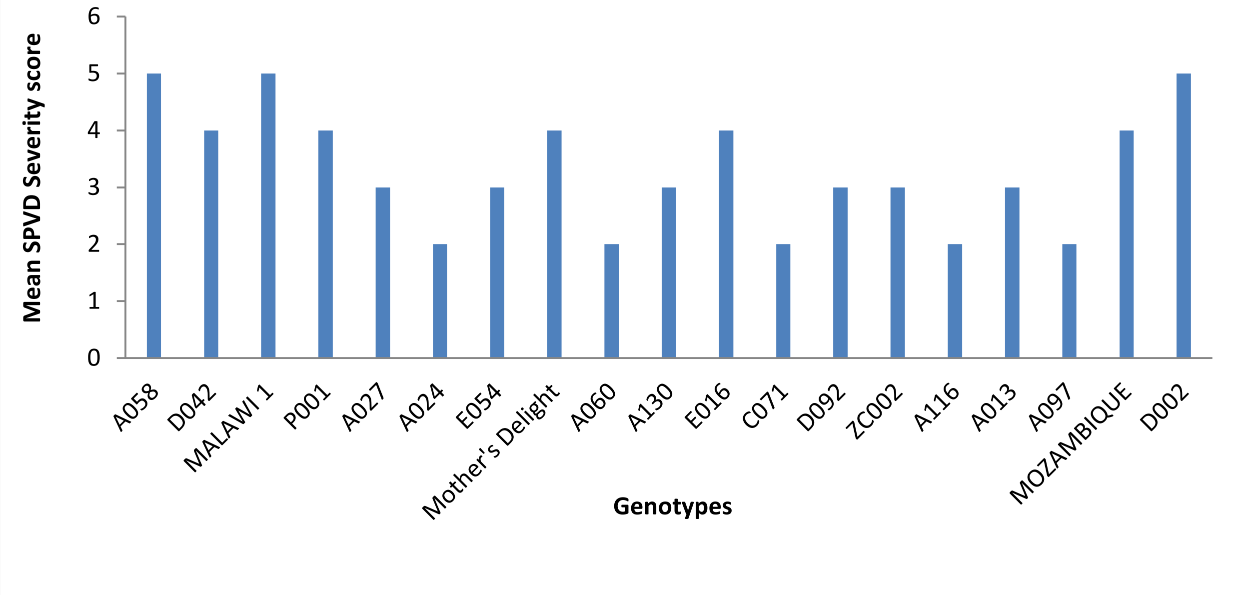

Figure 3: Mean sweetpotato virus disease severity score of genotypes evaluated at PYT stage in 2015.

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EFFECT OF DIFFERENT LEVELS OF POULTRY MANURE ON THE GROWTH AND YIELD OF OKRA (ABELMOSCUS ESCULENTUS)

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ABSTRACT
The field experiment was conducted during the early growing season of 2015 at Kabba College of Agriculture, Ahmadu Bello University on student experimental plot in the Horticultural section to determine the effect of different levels of poultry manure on the growth and yield of Okra (Abelmoscus esculentus). The objectives of the study were to determine the effectiveness of the different levels of poultry manure on the growth and yield of okra, and to identify the optimum rate of poultry manure for the growth of Okra. The experiment consisted of five treatments fitted into Randomized Complete Block Design (RCBD). Each treatment was replicated three times. The treatments were 0g, 5.0 g, 10.0 g, 15.0 g and 20.0 g per plant. The parameters measured were plant height, number of leaves, stem girth, weight of fruit per plant, number of fruit per plant and fruit diameter. All data were subjected to analysis of variance (ANOVA) and mean were separated using New Duncan Multiple Range Test at P<0.05. The results of this experiment showed that 15.0 and 20.0 g of poultry manure per plant had significant effect on the growth and yield of okra.
Keyword: Okra, Abelmoscus esculentus, poultry manure, growth and yield

INTRODUCTION
Okra (Abelmoscus esculentus L.Moenh) belongs to the family Malvaceae. Okra was domesticated in west and central Africa. It is one of the numerous vegetable crops cultivated in Nigeria covering an estimated land are*a of 1-2 million hectares (FMAW*&RD, 1989). The plant is cultivated in tropical, subtropical and temperate regions around the world. The economic importance of okra cannot be overemphasized. Okra contains carbohydrate, protein and vitamins in large quantities. For consumption, young mature fruits are important vegetables that can be boiled, fried or cooked. In Nigeria okra is usually boiled in water, resulting in sliming soups and sauces. The fruit also serves as soup thickeners (Schipper, 2000). Okra is an important vegetable crop which plays important roles in human nutrition. According to (FAOSTAT, 2006), the production of okra in Nigeria depends on the farming capacity of poor peasant farmer who often cannot bear the exorbitant cost of large scale production. The cultural and management practices and the problem of okra production needs to be addressed in order to boost the crop output to meet market demand.

Tropical soils are adversely affected by sub-optimal soil fertility and erosion, causing deterioration of the nutrient status and changes in soil organisms' populations (Economic Commission for Africa, 2001). Use of inorganic fertilizers can improve crop yield and soil pH, total nutrient content and nutrient availability, but its use is limited due to scarcity, high cost, nutrient imbalance and soil acidity. Use of organic manures as a means of maintaining and increasing soil fertility has been advocated (Rodale, 1984; Alasiri and Ogunkeye, 1999; Smil, 2000). Animal manure, when efficiently and effectively used, ensures sustainable crop productivity by immobilizing nutrients that are susceptible to leaching. Nutrient contained in manure are released more slowly and are stored for a longer time in the soil, ensuring longer residual effect, improved root development and higher crop yield (AbouEl Magd et al., 2005). Manures are usually applied at higher rates, relative to inorganic fertilizer. When applied at high rates, they give residual effects on the yield of succeeding crops (Makinde and Ayoola, 2008). Improvements of environment conditions as well as the need to reduce cost of fertilizer use are reasons for advocating use of organic materials (Bayu et al., 2006). Organic manures improve soil fertility by activating soil microbial biomass (Ayuso et al., 1996). Application of manures sustains cropping system through better nutrient recycling (El-Shakweer et al., 1998). Manure provides a source of all necessary macro and micronutrient in available forms, thereby improving the physical and biological properties of the soil (Abou El-Magd et al., 2006). Mixing organic and inorganic fertilizer may be a sound soil fertility management strategy in many countries. Akande et al. (2003) reported that combined use of ground rock phosphate applied together with poultry manure significantly improves growth and yield of okra (Abelmoschus esculentus) L. Moench) compared to application of each material separately.

Justification of the Study

Vegetable crops such as okra play an important role especially in the supply of essential nutrients in the body such as protein, carbohydrate and vitamin C in large quantity. It also serves as a mean of revenue generation to peasant farmers. Increasing the yield of okra in farmers' fields using cost-free nutriet sources is important to enhance farmers' well-being and food security. Organic manure, especially poultry manure are usually available in most communities as waste, constituting environmental nuisance. The current study is therefore undertaken to determine the effectiveness of different levels of poultry manure on the growth and yield of okra, and to identify the optimum rate of poultry manure for the growth of okra.

MATERIALS AND METHOD

The experiment was conducted during the 2015 cropping season at the student's experimental field, Kabba College of Agriculture at the Horticultural Section. Kabba College of Agriculture is located in the Southern Guinea Savannah ecological zone of Nigeria on latitude 07^0 53'N and longitude 06^0 80'E with average rainfall of about 1850mm per annum, temperature of 18-30^0C and altitude of 420 meters above sea level (Kabba College of Agriculture Meteorology Station Field Survey, 2014). The okra seeds used were collected from Kogi state Agricultural Development Program (ADP) office at Aiyetoro Gbede, Ijumu Local Government of Kogi State. The okra variety used was NHAE 47-4.

Experimental Design and Treatment Allocation

The experimental design for this experiment was Randomized Complete Block Design (RCBD). The treatments were five poultry manure rates replicated three times. The poultry manure rates were applied randomly within the experimental plots.

Treatments: Control (0g) per plant stand; 1 t/ha (5g) per plant stand; 2 t/ha (10g) per plant stand; 3 t/ha (15g)per plant stand; and 4 t/ha (20g) per plant stand. The land was cleared manually using cutlass to clear the grasses and shrubs after which the soil was tilled manually using hand hoe. The experiment was conducted on a gross plot of 9m x 8m ($72m^2$) with 1m spacing between the blocks. Each block consisted of five plots, and each plot measured 1m x 2m ($2m^2$) with 1m spacing between plots. Each plot contained eight (8) plants and 4 plants were tagged per plot for data collection. Then the total tested plants were 60 plants. Three to four seeds were sown per hole 2-3cm deep at intra-row spacing of 25cm and inter-row spacing of 60cm. The seedlings were later thinned to two plants per stand. Weed control: Weeds were manually controlled with the use of hoe at two weeks interval. The okra plants were attacked by flea beetles. The insect-pest was controlled using an insecticide called Auesthrin. Harvesting was done manually by hand-picking and the use of sharp knife to detach pods from the stem. This was done at five days interval. There were three pod harvests in all. Harvested pods were gathered per plot and weighed for each harvest time.

Data collection

Other data collected included:

i. Plant height: This was done using a tape rule to measure the length of each of the four tagged plants from the base to the tip of the last leaf in each plot at 3, 4, 5 and 6 weeks after sowing (WAS).
ii. Stem girth: The diameter of the stem was measured using a Vanier calliper at 3, 4, 5 and 6 weeks after sowing (WAS).
iii. Number of leaves: The number of leaves was obtained by counting the leaves of the four tagged plants and the average was recorded.
iv. Diameter of fruit per plant was measure using tape rule at five days interval.
v. Number of fruit per plant: Number of pods per plant at five days interval was counted.
vi. Weight of fruit per plant (fresh weight): pods per plant at each harvest were weighed and recorded.

RESULTS AND DISCUSSION

The effects of the different poultry manure rates on plant height are presented in Table 1. At 3, 4, 5, and 6 weeks after planting, it was observed that there were significant differences in plant height among the different poultry manure rates. Poultry manure rates 15 and 20 g/plant showed significantly higher mean plant height (cm) than other rates, except at 6 WAP where the means of all poultry manure treatments were not statistically different from one another, but were all significantly higher than the control (0g rate).

Table 2 shows the effect of poultry manure at different levels on the number of okra leaves at different stages of growth. While the poultry manure rates had no significant effects on the number of okra leaves at 5 and 6 WAP, the treatments had significant effects on the measured attribute at 4 WAP. At 4 WAP, 20g/plant poultry manure rate had the highest mean number of leaves of nine which was higher ($P<0.05$) than the other rates. The control (0g/plant had the least mean number of leaves of 6. The mean number of leaves at 5 WAP for all the poultry manure treatments were not different, but were all statistically higher than the control.

Effects of poultry manure application at different levels on stem girth (Table 3) showed that stem girth was significantly influenced by the different poultry manure levels at each period of measurement. At 3, 4 and 5 WAP, 15 ad 20 g/plant poultry manure had significant effects on stem girth compared to the other rates. At 6 WAP, 5, 15 and 20 g/plant rates had no significant mean stem girth. However, the range of stem girth at 6WAP was 1.000 – 1.208 cm. The control had the least stem girth across all sampling periods.

The effects of poultry manure treatments on mean weight of fruits (g) per plant, mean number of fruits per plant and diameter of fruits per plant at 8weeks after planting are presented in Table 4. Poultry manure rates of 15 and 20 g/plant had the highest weight per plant of 0.767 and 0.833g respectively. For mean number of fruits per plant, 15 and 20 g/plant with mean number of fruits of 6.167 and 6.433 respectively also had the highest values. Same trend was observed for mean fruit diameter. Rates 15 and 20 g/plant with mean fruit diameter of 3.333 and 3.400 respectively, had the widest fruit diameters. In all the measured attributes, the control had the least values.

CONCLUSION

This trial was conducted in order to study the effect of poultry manure at different rate on the growth and yield of Okra. With the parameters such as plant height, leaf numbers stem girth weight of fruit/fruit/plant fruit with regards to the test crop, poultry manure rate of 15 and 20 g/plant were found to have the best growth parameters and yield components. Based on this preliminary result, 15 g/plant poultry manure can be recommended to farmers that have access to poultry manure for okra production.

Table 1: Effect of different rates of poultry manure on plant height (cm) of okra

Poultry manure treatments	3rd WAP	4th WAP	5th WAP	6th WAP
0g	15.25^{c}	18.17^{c}	21.67^{c}	25.42^{b}
5g	16.35^{bc}	20.17^{b}	24.17^{b}	29.42^{a}
10g	16.96^{b}	21.50^{bc}	25.00a^{b}	27.92^{a}
15g	18.50^{a}	22.58^{a}	26.42^{a}	29.67^{a}
20g	18.76^{a}	22.33^{a}	27.00^{a}	29.58^{a}

Means with the same alphabet(s) in the same column are not significantly different at P < 0.05 according to New Duncan's Multiple Range Test.

Table 2: Effect of poultry manure at different levels on the numbers of leaves of okra

Poultry manure treatments	3rd WAP	4th WAP	5th WAP	6th WAP
0g	4$_{b}$	6^{c}	8^{a}	9^{a}
5g	5^{ab}	7^{b}	8^{a}	10^{a}
10g	5^{ab}	7^{b}	8^{a}	10^{a}
15g	5^{ab}	7^{b}	9^{a}	9^{a}
20g	6^{a}	8^{a}	9^{a}	10^{a}

Means with the same alphabet(s) in the same column are not significantly different at P < 0.05 according to New Duncan's Multiple Range Test.

Table 3: Effect of poultry manure rates on the stem girth (cm) of okra

Poultry manure treatments	3rd WAP	4th WAP	5th WAP	6th WAP
0g	0.358^{c}	0.600^{d}	0.916^{b}	1.000^{c}
5g	0.525^{b}	0.833^{bc}	1.008^{b}	1.150^{ab}
10g	0.500^{b}	0.791^{c}	0.958^{b}	1.091^{bc}
15g	0.633^{a}	0.916^{ab}	1.108^{a}	1.150^{ab}
20g	0.683^{a}	0.941^{a}	1.116^{a}	1.208^{a}

Means with the same alphabet(s) in the same column are not significantly different at p<0.05 according to New Duncan's Multiple Range Test.

Table 4: Effect of poultry manure on the yield of okra

Poultry manure treatments	Mean weight of fruits/plant at 8 WAP	Mean number of fruits per plant at 8 WAP	Mean diameter of fruits per plant at 8 WAP
0g	0.567^{b}	4.633^{c}	2.700^{d}
5g	0.600^{b}	4.833^{c}	2.833^{c}
10g	0.633^{b}	5.267^{b}	3.033^{b}
15g	0.767^{a}	6.167^{a}	3.333^{a}
20g	0.833^{a}	6.433^{a}	3.400^{a}

Mean with the same alphabet(s) in the same column are not significantly different at p<0.05 according to New Duncan's Multiple Range Test.

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INHIBITORY EFFECT OF TWO PLANT EXTRACTS ON FUNGI ASSOCIATED WITH ROTTED YAM TUBER (DIOSCOREA ROTUNDATA) IN ISHIAGU, EBONYI STATE, NIGERIA

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ABSTRACT

Yam (Dioscorea rotundata; family Discoreaceae) is among the most important staple foods in the world, especially in some parts of the tropics and subtropics. In Nigeria, rot is a major factor limiting the storage life of yams, and losses can be very high. Rotted yam tubers were collected from three markets and taken to the Laboratory of Plant Pathology, Federal College of Agriculture, Ishiagu. The fungi were cultured on Potato Dextrose Agar and the effects of the two plant extracts were studied on the fungi at 50% and 70% concentration. The fungi isolated were Aspergillus flavus, Fusarium solani, Sclerotium species and Rhizopus stolonifer. A. flavus (50.00%) had the highest percentage of occurrence while Sclerotium species had the least (7.14%). The efficacy of the extracts differed with the materials, concentrations and with the tested fungus. The variations were due to different active compounds present in these plants. Therefore, the use of Ocimum. gratissimum and azadirachta. indica extracts has a viable prospect as alternative substitutes to synthetic chemical for the control of yam rots.

Key words: Extracts, Fungal, Yam, Rot, Ishiagu

INTRODUCTION

Yam, (Dioscorea rotundata) belongs to the family Discoreaceae. It is a herbaceous annual climbing plant with edible underground tubers (Orkwor et al., 1998). It is among the most important staple foods in the world especially some parts of the tropics and subtropics (Okigbo and Ogbonnaya, 2006). The most cultivated varieties in Nigeria are the D. rotundata (white yam), D. cayenesis (yellow yam) and D. alata (water yam) (Amusa, 1999). Nutritionally, yams are mainly carbohydrate foods. It is one of the most important dietary sources of energy produced in the tropics (Ekefan, 1999). White yam (D.rotundata) is the most important and cultivated variety found in Africa. It is much preferred to other yam varieties and it is believed to constitute about 80% of the total yams produced in Nigeria. It is generally believed that over 50% of the yam tubers produced and harvested in Nigeria are lost in storage. The disease-causing agents not only reduce the quantity of yam produced, but also reduce the quality by making them unappealing to the consumers. There are many microorganisms associated with yam in Nigeria, some of which may include, Rhizopus stolonifer, Geotriclum candidum, Aspergillus flavus, Aspergillus niger, Aspergillus fumigatus, Botryodiplodia theobromae, Fusarium oxysporum, Fusarium solani, Penicillium chrysogenum, Rhizoctonia spp, Penicillium oxacilum, Trichoderma viride and Rhizopus nodosus (Adeniji, 1970; Okigbo and Ikediugwu, 2002; Aidoo, 2007).

Scent leaf, (Ocimum gratissimum) is a tropical aromatic plant which is known to exert high antimicrobial activities, and is widely consumed by man. There is little or no fear of poisoning even at very high concentrations (Adegoke et al., 2002). Ocimum gratissimum leaf has been shown to have several medicinal uses (Ojeifo and Denton, 1993). Its leaves have been reported to exhibit high antifungal activities against Fusarium moniliforme, Aspergillus flavus and Aspergillus fumigatus (Nguefack et al., 2004). Neem (Azadirachta indica) is a common tropical tree widely distributed in Africa and Asia. Its medicinal uses have been known for several centuries. A. Indica contains photochemical compound such as azadirachtin, betasiterol, b-desacetyl, nimbinene and 3-deccacetyl alamine which exhibited antifungal properties (Verma et al., 2006).

Rot is major factor limiting the post – harvest life of yams, and losses can be very high. It is estimated that an average of 25- 50% of yam tubers produced in Nigeria are lost to pests and diseases (FAO, 2005). Losses due to post- harvest rot significantly affect farmers' and traders' income, food security and seed yams stored for planting. This work was carried out to isolate and identify fungal organisms associated with Yam (Dioscorea spp) in Ishiagu; and to determine the effect of Scent (O. gratissimum) and Neem (A. indica) leaf extracts on the growth of the fungal organisms.

MATERIALS AND METHODS

The study was conducted at the Plant Pathology Laboratory of the Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria. The rotted yam tubers were collected from three different markets within Ishiagu: Ekeh, Mile2 and Ayaragu markets in Ivo Local Government Area of Ebonyi State, Nigeria. The collected yam samples were taken to the Laboratory. Healthy leaves of Scent (O. gratissimum) were obtained from Ekeh market while Neem (A. indica) was obtained from the premises of the College.

Preparation of Potato Dextrose Agar (PDA)

The Potato Dextrose Agar (PDA) was prepared by weighing 39g of PDA powdered into distilled water in a conical flask and made it up to 1.0 litre. The flask was swirled gently and the conical flask was plugged with cotton wool and covered with aluminum foil paper. This was sterilized in an autoclave at 121˚C for 15minutes. The sterilized medium were subsequently allowed to cool to 45˚C and streptomycin at the rate of 10 drops was added and poured aseptically into 9cm diameter Petri dishes, covered and allowed to gel.

Isolation of fungi from infected leaves

Rotted yam samples (2 x 2mm) were cut between the advancing edge of infected and healthy tissues and surface-sterilized (soaked in 1% NaOCl for 1min and rinsed in five changes of sterile distilled water), dried on sterile tissue paper and plated on 0.3ml streptomycin amended PDA medium. Three replicate pieces from each of the rotted yam tuber were incubated at 28-30^{o}C for 3-4 days. Fungal growths associated with the infected tissues were observed and detailed structural features of each isolate were compared with those described in a standard manual of fungi (Barnett and Hunter, 1999).

Determination of percentage occurrence of fungal isolates. To determine the percentage occurrence of the fungal isolates, the occurrence of the fungi organisms was recorded as follows:

$$\%\ occurence\ of\ isolates \quad = \frac{Total\ number\ of\ plates}{Total\ number\ of\ fungal\ occurrence} x100$$

Preparation of Aqueous Extracts of the Leaves

Fresh, clean and fully expanded Scent and Neem leaves were washed thoroughly under running water and surface-sterilized (1% NaOCl for 2 minutes) and rinsed in several changes of sterile distilled water and air dried at room temperature for 2 hours. Two different water extract concentrations were prepared by blending 50g and 70g of leaves each in 100ml of sterile distilled water to produce 50% and 70% extract concentrations respectively.

Effect of the extract on fungal growth

Food poisoning techniques were used to determine the effect of the extract on fungal growth (Okigbo et al., 2009). One milliliter of each extract concentration of extract was dispensed into 9ml of molten PDA to obtain an agar-extract mixture in petri dish. The plates were gently rotated to ensure even dispersion of the extracts. The agar-extract mixture was allowed to solidify and 6mm diameter mycelia disc obtained from the colony edge of 7 day old culture of each test fungi was inoculated into the centre of each petri dish. The control consisted of an inoculated agar plates containing no extracts. There were three (3) replicate plates of extracts agar per isolate and concentration which were incubated at 27^{o}C. Radial growth was measured daily for 7days. Colony diameter was taken as the means along two directions on two pre-drawn perpendicular lines on the reverse side of plates.

Percentage inhibition was calculated according to the method described by Whipps (1987)

$$Percentage\ inhibition \quad = \frac{R1\ -\ R2}{R1R1} x100$$

Where R1 = furthest radial distance of the pathogen in control plates

R2 = Furthest radial distance of the pathogen in extract incorporated plates

Inhibition percentage was determined as a guide in selecting the minimum inhibitory concentration that was effective in controlling yam tuber rot disease caused by fungi.

Statistical design and analysis

The experimental design used was Completely Randomized Design (CRD) with the three (3) replicates. Data collected were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) Version 91, Institute 2002, USA and the treatment means separated using LSD at $p \leq 0.05$.

RESULTS AND DISCUSSION

The result reveals that four fungal organisms were isolated and identified from the rotted yam tubers from the three markets within Ishiagu. They include Aspergillus flavus, Fusarium solani, Sclerotium species and Rhizopus stolonifer. The findings of Liamngee et al (2015) and Okigbo and Ikediugwu, (2002) that A. niger, A. flavus, A. fumigatus, F. solani and Botryodiplodia theobromae were fungi associated with rotted white yam tubers supports the findings of this work. The organisms occurred at a various levels. A. flavus had the highest (50.00%) percentage of occurrence, followed by F. solani (28.57%) while Sclerotium species had the least (7.14%) percentage of occurrence (Fig: 1). Most of these microorganisms usually infect yam tubers in the field and subsequently manifest in storage barn. The presence of anti-fungal active ingredient in the leaves of O. gratissimum and A. indica was demonstrated on the four fungi organisms isolated from rotted yam tuber. This was revealed by their ability to inhibit the growth of the four tested fungi at the two levels of concentration (Tables 1 and 2). This agrees with the findings of Akpa et al (1991) who reported significant inhibitory property of A. indica extract on most fungal pathogens, just as Amuchi, (1999) found the extract of O. gratissimum to reduce the growth of Rhizopus spp. However, the efficacy of the extracts differed with the materials, concentrations and with the tested fungus. The results also buttress the potential of natural plant products in the management of rotted yam disease in storage.

CONCLUSION

Therefore, it is recommended that further study should focus on the pathogenicity of these four fungal organisms on the rotted yam tuber. Also, the use of O. gratissimum and A. indica extracts has a viable prospect as alternative substitute to chemical for the control of yam rots.

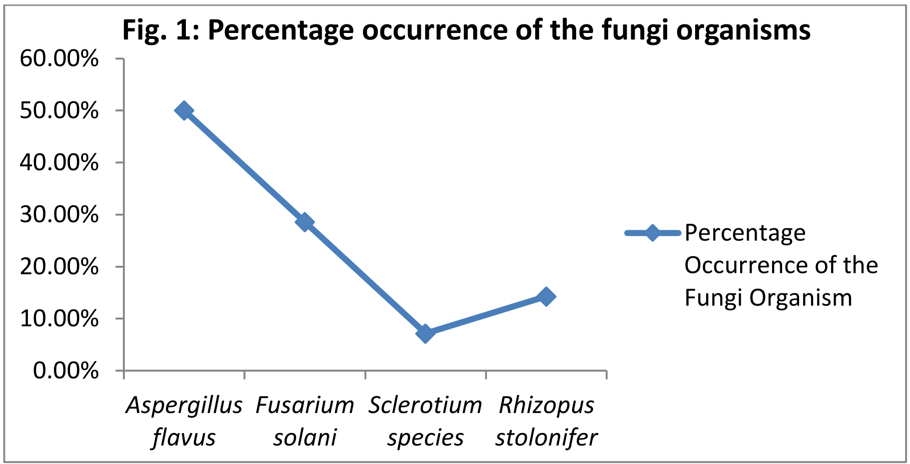

Table 1: Effect of the aqueous extract of Scent leaves and Neem at 50 % Concentration on isolated fungi species

Fungi	50% Scent leaf extract			50% Neem leaf extract		
	3DAI	**5 DAI**	**7 DAI**	**3 DAI**	**5 DAI**	**7 DAI**
Aspergillus flavus	37.98	36.06	30.23	34.47	38.21	39.39
Fusarium solani	47.75	48.92	49.77	44.42	42.94	42.30
Sclerotium species	46.30	48.99	49.04	50.00	44.56	43.47
Rhizopus stolonifer	56.36	58.48	61.05	46.76	56.65	59.09
LSD (P < 0.05)	**28.77**	**23.48**	**26.61**	**27.15**	**23.89**	**35.54**

DAI = Days After Incubation

Table 2: Effect of the aqueous extract of Scent leaves and Neem at 70 % concentration on isolated fungi species

Fungi	70% Scent leaf extract			70% Neem leaf extract		
	3 DAI	**5 DAI**	**7 DAI**	**3 DAI**	**5 DAI**	**7 DAI**
Aspergillus flavus	57.42	54.44	44.79	37.33	38.70	42.98
Fusarium solani	61.18	60.96	59.68	56.98	62.47	64.43
Sclerotium species	48.56	55.89	56.46	68.05	64.58	63.40
Rhizopus stolonifer	67.68	68.98	70.75	53.18	55.38	56.09
LSD (P < 0.05)	**16.17**	**16.61**	**23.61**	**43.86**	**31.29**	**25.54**

DAI = Days After Incubation

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SURVEY OF CASTOR SEED PHYSICAL CHARACTERISTICS AND SEEDLING ESTABLISHMENT AT BADEGGI, NIGER STATE, NIGERIA

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ABSTRACT
Castor oil plant (Ricinus communis L.) is one of the most versatile oil crops with high socio-economic values around the world. The crop has been demonstrating its economic potentials by earning notable foreign exchange credits to many countries. However, following the incorporation of castor into national research mandate in Nigeria, poor seedling establishment and low yield have been identified as some of the limitations to its commercial production in the country. Based on this background, 51 local and 48 exotic castor germplasm were surveyed on seed physical characters and evaluated for field seedling establishment at three locations. The collections revealed high divergence in seed colour, seed shape, seed mottle, seed caruncle and seed sizes. Variability observed in 100 seed-weights among the accessions ranged from 8.51g to 65g with average of 26.48g. High significant variability in seedling establishment was observed among the accessions. The highest establishments (87 – 89 %) were recorded in Acc. 002 and Acc.062 across the locations and the least (10 – 17 %) was recorded in Acc.104. Significant genotypic effect and no significant effect of genotype X location were recorded. High broad sense heritability of 88 and 22.51 per cent genetic gain show good expected gain from selection programs.
Keyword: Ricinus communis, Germplasm, Nigeria, Establishment, Characteristics

INTRODUCTION
Castor (Ricinus communis L., 2n = 20) is an oil crop with high economic values (Anjani, 2012). The recent rapid increase in demand of castor seed/oil in local and international markets (Mutlu and Meier, 2010) has aroused the interest of Nigerian farmers to cultivating the crop. Unfortunately, castor is presently receiving little or no active research attention in Nigeria, resulting in lack of improved production technologies for farmers. This has necessitated integrated castor research efforts among Nigerian scientists (Salihu et al., 2014). Therefore, the aim of this research is to survey the NCRI castor germplasm for seed physical characteristics and seedling establishment.

MATERIALS AND METHODS
Seed Physical Characteristics: In 2014, the seeds of all the collections were multiplied and 100 seeds weights were taken from three replicate samples per accession. The seeds were characterized based on the seed shape, seed colour, mottle, caruncle, seed size and seed weight using INDIA Castor Descriptors (2004). The seed colour was determined using Graf Colour Chart (2012).
Seedling Establishment: 99 castor accessions including 51 local and 48 exotic collections were evaluated on experimental fields at three different locations: NCRI Mokwa (Lat. 9º 12'N, Long. 5º 20'E), NCRI Badeggi (Lat. 9°45'N, long. 6°07'E) and Mina (Lat. 9º 36'50"N, Long. 6º 33'25"E) . The treatments were laid out on Alpha Lattice Design with 3 replications. Each plot size was 3m X 1.5m in dimension with inter-row and intra-row of 75cm. Thirty (30) intact seeds, pre-treated for seed-borne diseases, were planted at two seeds per hole in each of the replicate plots, resulting to 90 seeds planted per location and total of 270 seeds across the locations. The planting was done in Mid-June 2015, when rainfall has completely stabilized at the locations. Insecticide (Cypermethrin) was applied at 5, 15, 25 and 35 days after planting to prevent seedling lose due to insect attacks. Seedling establishment was taken (at 40 days after planting) as the number of plant stands expressed in percentage. Descriptive statistics was used to summarize the date. Combined Analysis of Variance was performed across the locations. Genotypic effect, and GXE effect were tested using -2 log-likelihood ratio test procedure of PBtools 1.3. Broad-sense heritability was estimated according to Eckebil et al. (1977). Genetic advance (at 10% selection differential) as described by Johanson et al. (1955) and Genetic gain (%) as genetic advance (GA) expressed in percentage of the population mean were estimated.

RESULTS AND DISCUSSION

Seed physical characters of castor accessions at NCRI, Badeggi

The accessions reveal high divergence in seed colour, seed shape, seed mottle, seed caruncle and seed sizes. Exotic collections comprise of 17 large seeded (diameter > 15mm), 23 medium (diameter, 9mm – 15mm) and 13 small seeded (diameter < 9mm) castor types (Table not included). Variability observed in 100 seed-weight among the accessions ranged from 8.51g to 65g with average 26.48 (Table not included). The result obtained is in conformity with result of 1033 accessions reported by Wang et al., (2010).

Field seedling establishment

High significant variability in seedling establishment was observed among the accessions (Table 2). The highest establishments (87 – 89 %) were recorded in Acc. 002 and Acc.062 across the locations and the least (10 – 17 %) was recorded in Acc.104 (Table 3).

Analysis of variance revealed no effects of blocks and location, and genotype variation has the highest value among the sources of variation (Table 1). Significant genotypic effect and no significant effect of genotype X location were recorded (Table 2). High broad sense heritability of 88.00%, and 22.51 per cent genetic gain show good expected gain from various kinds of selection programs.

Inherent problem of castor seedling establishment caused by poor seed germination is an issue that deserves attention from scientists. Machado et al., (2010) reported seed internal morphology and apparent level of reserved food as two important factors for fast germination and seedling establishment. Low soil temperature is one of the factors that also influence poor germination and seedling establishment in castor.

CONCLUSION

The diversity in seed weight and seedling establishment observed in the germplasm provides good sources of variability upon which selection can be made to generate improved genotypes. Although the results reported here may justify the aim of the research, however there is need for proactive research in seed technology and genetic improvement to enhance the seedling establishment of the present castor cultivars among Nigerian farmers.

Table 1: Combined analysis of variances for seedling establishment of castor at three locations

Sources of Variation	Variances	Std. Deviations
Genotype X Location	**11.686**	**3.419**
Genotype	**158.165**	**12.576**
Rep X Block X Location	**4.013e-13**	**6.335e-07**
Rep X Location	**24.857**	**4.986**
Location	**0.000**	**0.000**
Residual	**42.099**	**2.052**

Table 2: Genotypic and genotype x location effects on seedling establishment of castor at three locations

Genotypic Effect					Genotype X Location Effect						
Df	Sum Sq	Mean Sq	F value	Pr (>F)		AIC	BIC	logLik	Chisq	Df	Pr(>Chisq)
97	158835.5	1637.479	3.9002	0.0000	Model2	6940.53	7422.24	-3368.26			
					Model1	6942.42	7428.85	-3368.21	0.113	1	0.7363

S/N	Treatment	Badeggy	Mokwa	Minna	S/N	Treatment	Badeggi	Mokwa	Minna
1	Acc.001	77.513	77.898	77.720	53	Acc.059	75.042	73.790	74.838
2	Acc.002	88.779	88.623	89.265	54	Acc.060	78.508	78.622	79.536
3	Acc.003	83.270	82.843	83.328	55	Acc.061	83.838	84.764	84.731
4	Acc.004	86.512	87.167	86.322	56	Acc.062	87.307	88.233	87.793
5	Acc.005	72.653	72.091	71.922	57	Acc.063	71.272	71.579	70.522
6	Acc.006	69.710	69.959	70.331	58	Acc.064	87.307	87.692	88.334
7	Acc.007	74.921	74.494	73.919	59	Acc.065	69.811	70.296	69.365
8	Acc.008	73.854	73.292	72.853	60	Acc.066	57.674	58.194	58.190
9	Acc.009	77.053	75.949	76.998	61	Acc.067	71.850	72.535	71.554
10	Acc.010	74.109	74.629	74.595	62	Acc.068	83.178	83.021	83.800
11	Acc.012	65.971	67.302	66.727	63	Acc.069	66.376	67.032	66.592
12	Acc.015	62.383	62.226	62.057	64	Acc.070	82.959	83.298	83.904
13	Acc.016	85.310	85.560	85.797	65	Acc.071	73.584	73.292	73.123
14	Acc.017	38.456	38.224	38.130	66	Acc.072	75.581	75.695	75.391
15	Acc.018	84.650	84.764	83.919	67	Acc.073	75.095	75.377	75.520
16	Acc.019	80.911	81.431	80.991	68	Acc.074	73.766	73.959	73.469
17	Acc.020	25.500	30.598	29.888	69	Acc.075	81.842	82.362	82.463
18	Acc.021	17.147	21.589	15.930	70	Acc.076	81.745	82.265	81.931
19	Acc.022	57.323	55.544	57.133	71	Acc.077	61.816	61.774	62.572
20	Acc.023	20.910	31.411	32.744	72	Acc.078	75.581	75.965	75.120
21	Acc.024	81.707	82.632	82.328	73	Acc.079	84.515	84.088	84.731
22	Acc.026	83.449	82.887	83.665	74	Acc.080	77.188	76.896	75.916
23	Acc.027	80.251	79.959	79.790	75	Acc.081	80.521	79.959	79.520
24	Acc.028	81.046	81.025	81.261	76	Acc.082	45.446	45.019	46.202
25	Acc.029	85.716	85.695	85.255	77	Acc.083	83.043	83.292	83.665
26	Acc.030	28.288	35.658	26.035	78	Acc.084	73.904	73.952	73.783
27	Acc.031	30.892	38.991	32.987	79	Acc.085	66.782	66.896	66.322
28	Acc.032	82.524	82.250	82.333	80	Acc.086	76.782	76.761	76.457
29	Acc.033	26.217	26.467	25.972	81	Acc.087	84.130	83.297	83.857
30	Acc.034	69.033	70.500	70.467	82	Acc.088	79.980	80.635	79.384
31	Acc.035	53.839	54.900	54.595	83	Acc.089	85.581	85.560	85.526
32	Acc.036	81.587	81.296	80.450	84	Acc.090	54.524	54.705	55.423
33	Acc.037	65.987	65.154	65.526	85	Acc.091	76.512	77.167	76.322
34	Acc.038	62.112	62.632	61.922	86	Acc.092	77.385	77.926	77.487
35	Acc.039	74.587	74.863	74.532	87	Acc.093	71.587	71.431	70.315
36	Acc.040	67.307	67.827	68.199	88	Acc.094	73.746	72.305	73.400
37	Acc.041	37.702	38.221	36.952	89	Acc.095	81.920	82.180	82.812
38	Acc.042	39.439	40.094	40.466	90	Acc.096	81.046	81.025	81.262
39	Acc.043	39.455	38.487	38.724	91	Acc.097	86.190	85.976	86.406
40	Acc.044	69.726	68.622	68.318	92	Acc.098	59.726	59.164	57.777
41	Acc.045	48.525	47.692	47.117	93	Acc.099	82.248	81.956	82.463
42	Acc.046	59.757	59.600	59.521	94	Acc.100	62.924	61.821	61.922
43	Acc.047	72.367	72.649	72.447	95	Acc.101	62.175	61.883	61.958
44	Acc.048	80.596	81.228	80.947	96	Acc.102	55.581	56.236	54.850
45	Acc.050	57.984	58.368	56.982	97	Acc.103	65.851	65.289	65.526
46	Acc.052	66.647	66.355	66.998	98	Acc.104	15.087	17.028	10.910
47	Acc.053	80.074	78.627	79.671	**OVERALL MEAN:**				**71.071**
48	Acc.054	77.578	77.962	77.793	**S.E. OF DIFFERENCE**				**10.489**
49	Acc.055	72.637	73.292	74.070	**HERITABILITY (%):**				**88.000**
50	Acc.056	81.317	80.619	81.397	**GENETIC ADVANCE:**				**16.270**
51	Acc.057	80.438	80.590	81.368	**GENETIC GAIN (%):**				**22.513**
52	Acc.058	67.537	66.975	69.117					

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ADVANCED YIELD PERFORMANCE OF HYBRID WHITE YAM (DIOSCOREA ROTUNDATA) GENOTYPES FOR EXPORT POTENTIAL AND TOLERANCE TO MAJOR FIELD PESTS AND DISEASES OF YAM

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ABSTRACT
Eleven hybrid white yam genotypes plus three landraces of white yam were evaluated in the Western Experimental Field of National Roots and Crops Research Institute (N.R.C.R.I.), Umudike in 2014 and 2015. The objectives were to select high yielding genotypes with high fresh weight gain for export and tolerant/resistant to field pests and diseases. The experiment was laid out in a randomized complete block design with three replications. Yam setts weighing 40g were sown 45 cm x 100 cm on ridges at 10cm depth, on 20m^2 plots. Data were collected on tuber weight at planting (kg), tuber weight at harvest (kg), mean total tuber yield, tuber size and tuber shape index. Pests and diseases reactions of the tubers were scored using severity rate of 1 to 5. Tuber yield was analyzed using analysis of variance and means separation was done using standard error of difference between means. Tuber shape and tuber surface texture was scored after determining the tuber shape index, while weight gain index was computed by dividing weight at harvest by the initial weight of tuber planted. The result showed that yam genotypes (OKG08/002, GLD08/008, GLD08/0023 and UM08/037) with weight gain index of above 3.0 were selected as yam with export potential. Their mean tuber shape index was 3.44, an indication that they were cylindrical in shape, with a good shape for export. They are equally tolerant to field pests and diseases and could be produced without investing much in pesticides.
Keywords: Export potential, weight gain, pests and diseases, tuber weight and tuber shape index

INTRODUCTION
Yam (Dioscorea spp.) constitutes a primary food source in a number of households in Nigeria particularly amongst populations of rural communities and selected few rich households in urban centres (Cristina et al, 1999). The cultivation of yam is becoming more important because of its great potential as food and for export (FAO, 2009). It is important to develop and select yam tubers with heavy tuber weight for export since yam for export is by weight and not by number as is sold in Nigerian local markets. The crop needs inputs and it has potentially high yields which made it an expensive food (Bovell-Benjamin, 2007). Yams can be processed into food products for people and animals. Research objectives are to increase the yield of yam and area under cultivation so that excess produce will be exported. As a result of this, trials are conducted for careful selection of new varieties which showed greater photosynthetic efficiency, stability and excellent market characteristics (Cristina et al, 1999). Genotypes which also met acceptable breeding and agronomic requirements are selected for release to farmers and consumers. The release of the new varieties that display the characteristics required by subsistence and commercial farmers will be of benefit to farmers.
In Nigeria, the yam crop is grown for its enlarged tuber which can be boiled, baked, fried or processed into chips. The tuber may be boiled or fried for use in soups and salads (James, 1994). Not all fresh tubers with the same length and diameter have the same weight or fresh matter accumulation. Weight gain/fresh matter accumulation in yam depends on varieties. Therefore, newly bred yam varieties need to be tested for weight gain before being advanced to another stage of evaluation. The study was initiated with the objectives to select high yielding genotypes with higher fresh weight gain for export and response to major field pests and diseases of yam.

MATERIALS AND METHODS
Eleven hybrid white yam genotypes plus three landraces of white yam were tested in the Western experimental field of NRCRI, Umudike in 2014 and 2015. The experiment was laid out in a randomized complete block design with three replications. The land was mechanically ploughed, harrowed and ridged at 1m apart. Yam setts weighing 40 g were sown 45cm x 100 cm at a depth of 10 cm. The plot size was 20 m^2. The plots were kept weed-free manually. There was no Fertilizer application. Pre-emergence herbicide (Diuron) was used immediately after planting and complemented with manual weeding at 12 weeks after planting (WAP). Data were collected on tuber weight at planting (kg), tuber weight at harvest (kg), mean total tuber yield, tuber size and tuber shape index. Pests and diseases attack on the tubers were scored using severity rate of 1 to 5. Tuber yield was analyzed using analysis of variance and means separation was done using standard error of difference between means. Tuber shape and tuber surface texture was scored after determining the tuber shape index

(Nwankwo, 2014). Weight gain index was computed by measuring weight at harvest over the initial weight of tuber planted, thus:

$$WG = \frac{\text{Tuber weight at harvest}}{\text{Weight at planting}}$$

RESULTS AND DISCUSSION

Total tuber yield: The result on indicated high significant (P0.01) yield variability among the hybrid white yam genotypes (Table 1). Yield of the genotypes varied from 3.0 t/ha (OKG08/022) to as high as high as 27.8t/ha (UM08/037). However, 19 out of 22 genotypes yielded more than Nwopoko a check variety. In breeding for export potential genotypes, weight gain index is used to determine the efficiency and profitability of yams for export since yams for export are determined by weight and not by number of tubers. Yam tubers that gain more at harvest should be selected for further evaluation. The higher the weight gain index, the higher the tuber yield efficiency and the profitability of yams for export. Therefore, yam genotypes with weight gain index of 3.0 and above were selected for further evaluation as genotypes with advantageous tuber yield potential for export.

Tuber size: Significant variability exists in the tuber length and tuber width of the genotypes. The tuber sizes determine the size of fresh weight of carbohydrate accumulation. The highest length of the tuber from various genotypes ranged from 12.37 to 25.80 cm while the width ranged from 4.15 to 7.34 cm. However the mean tuber shape index of the genotypes was 3.44 cm an indication of cylindrical shape, a good shape for yam with export potential.

Pests and diseases reaction:

Table 2 shows the field reaction of the white yam clones to foliar and tuber pests and diseases. There were very mild reaction of the genotypes to yam mosaic virus diseases (with mean score of 1.16) and very mild infestation of crickets), having a mean score of 1.03. Generally, the result indicated that most of the white yam genotypes were field tolerant to the pests and diseases.

CONCLUSION

Based on the result obtained, yam genotypes with weight gain index > 3.0 were selected as yam with export potential. The genotypes were OK08/006 with yield of 14.2t/ha and weight gain index of 3.09, OKG08/002 with yield of 27.6t/ha and weight gain index of 3.42, GLD08/008 with yield of 19.2t/ha and weight gain index of 3.42, GLD08/023 with yield of 22.4t/ha and weight gain index of 3.17t/ha, UM08/037 with yield of 27.8t/ha and weight gain of 3.39 and UM08/039 with yield of 9.0t/ha with weight gain of 3.46. These genotypes have grand mean tuber length of 18.67cm and width of 5.23cm. Their mean tuber shape index is 3.44 an indication that they were cylindrical in shape, a good shape for exportable yam. They are equally tolerant to field pests and diseases and could be produced without investing much in pesticides.

Table 1; Total tuber weight at planting, tuber weight at harvest, weight gain index, size of the tubers and tuber shape index of the hybrid white yam genotypes

S/N	Clones	Weight of yam at planting	Tuber weight at harvest (kg)	Weight gain index at harvest	Tuber yield (t/ha)	Maximum tuber length (cm)	Maximum tuber width (cm)	Tuber shape index
1	OKG08/001	3.7	7.6	2.05	15.2	25.80	6.42	4.02
2	OKG08/054	3.0	5.0	1.70	10.0	20.73	5.42	3.82
3	OTOB08/008	3.3	7.8	2.36	15.6	16.15	4.56	3.54
4	UM08/003	2.2	5.0	2.27	10.0	19.53	6.82	2.86
5	**OKG08/006**	**2.3**	**7.1**	**3.09**	**14,2**	**19.83**	**5.15**	**3.85**
6	OTOB08/014	2.5	5.4	2.16	10.8	12.37	5.66	2.19
7	**OKG08/002**	**4.3**	**13.8**	**3.21**	**27.6**	**20.60**	**5.66**	**3.60**
8	OKG08/010	2.9	6.9	2.38	13.8	12.66	4.58	2.76
9	**GLD08/008**	**2.8**	**9.6**	**3.42**	**19.2**	**12.67**	**5.68**	**2.23**
10	GLD08/030	2.4	3.3	1.38	6.6	16.43	5.62	2.93
11	OKG08/040	3.8	6.3	1.66	12.6	18.63	4.76	3.91
12	OKG08/022	3.2	1.5	**0.46**	3.0	14.25	5.03	2.83
13	**GLD08/023**	**3.6**	**11.4**	**3.17**	**22.4**	**21.03**	**5.95**	**3.53**
14	GLD08/019	2.2	5.2	2.36	10.4	17.78	4.88	3.66
15	OKG08/003	3.2	8.3	2.59	16.6	18.60	5.32	3.50
16	**UM08/037**	**4.1**	**13.9**	**3.39**	**27.8**	**23.20**	**6.92**	**3.35**
17	GLD08/021	2.3	3.5	1.52	7.0	22.96	7.34	3.12
18	**UM08/039**	**1.3**	**4.5**	**3.46**	**9.0**	**19.21**	**5.17**	**3.72**
19	GLD08/011	1.6	3.2	2.00	6.4	22.81	6.13	3.72
20	OKG08/064	1.1	2.4	2.18	4.8	16.32	5.20	3.13
21	GLD08/035	2.7	6.4	2.37	12.8	22.96	9.44	2.43
22	Nwopoko(check)	2.2	2.5	1.14	5.0	16.3	4.32	3.77
	Range	1.1-4.3	1.5-13.8	0.46-3.46	3.0-27.6	12.37-25.8	4.15-7.34	2.23-4.71
	Mean	-	6.39	-	13.82	18.67	5.72	3.26
	Sig. level	-	P<0.05	P<0.01	P<0.01	P<0.05	P<0.05	-
	CV%							

TSI Tuber Shape Index= Less than 1.0 = fair shape, 1.0 = very good shape, 2.0 = good shape 3.0 = moderately good shape, 4.0 = poor shape, 5.0 = very poor shape

Table 2: Pests and Diseases reaction of the hybrid yam genotype

Clones	Yam mosaic virus	Anthracnose	Leaf spot	Cricket	Yam beetle	Termites	Scale insects	Mealybug	Nematodes
OKG08/001	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/054	1.2	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0
OTOB08/008	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UM08/003	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/006	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OTOB08/014	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/002	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/010	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
GLD08/008	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
GLD08/030	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/040	1.2	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0
OKG08/022	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
GLD08/023	1.2	1.0	1.0	1.0	1.0	.1.0	1.0	.1.0	1.0
GLD08/019	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/003	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UM08/037	1.2	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0
GLD08/021	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
UM08/039	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
GLD08/011	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
OKG08/064	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
GLD08/035	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Nwopoko(check)	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Mean	1.16	1.0	1.0	1.03	1.0	1.0	1.0	1.0	1.0

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EVALUATION OF FRESH ROOT YIELD, DRY MATTER AND STARCH CONTENT OF NINE SWEETPOTATO GENOTYPES IN THE HIGH RAINFOREST ECOLOGY OF SOUTHEASTERN NIGERIA

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ABSTRACT

The study evaluated the fresh root yield, dry matter and starch content of nine sweetpotato genotypes in the high rainforest ecology of Southeastern Nigeria. The genotypes were laid out in a randomised complete block design with three replications while the plot size was 9m² (3mx3m) containing 30 plants per plot with plant spacing of 1 m x 0.3m, giving plant density of 33,333 stands per hectare. NPK fertilizer 15:15:15 was applied at the rate of 400kg/ha. Harvesting was done at four months after planting and three medium dominant root samples from each plot were collected, bagged in black polythene, labeled and analyzed in the laboratory. The analysis was for the determination of the dry matter content, starch content and moisture content. Results show that all the sweetpotato genotypes evaluated had high dry matter content (≥ 30%) except UMUSPO/3 (23.05%), SOLO-2 (24.11%) and PYT/12/053 (26.04%). The starch content is generally low. This is an indication that they are good enough for flour production and also for sugar syrup production in the pharmaceutical industry. They are likely to reduce poverty for food insecure generation.

Keywords: Fresh root yield, dry matter, starch content, sweetpotato, genotypes, rainforest

INTRODUCTION

The sweetpotato (Ipomoea batatas [L.] Lam) is an important staple crop in many parts of the tropics. In Nigeria, most of the roots are consumed in various forms. Road-side fries, fried chips and kunnu (non-alcoholic drink) are the few ways the roots are processed. The low industrial processing is often associated with low dry matter and starch contents of the cultivars produced by farmers. Dry matter is one of the most important traits that influence acceptability of sweetpotato varieties for consumption and processing. Processing industries require high dry matter greater than 30% (Rees et al., 2003) and high starch content and quality. Sweet potato is rich in carbohydrates and vitamins (Villareal, 1982) and is a potential in the fight against vitamin A deficiency. Indeed, recent research results indicate increased availability of beta-carotene (Provitamin A) and crude protein for good nutrition and health (Ukom et al., 2009). Sweet potato blends with rice, cowpeas and plantain in Nigeria diets. It may be boiled or steamed, fried or roasted and eaten with sauce. It can be reconstituted into fufu or blended with other carbohydrate flour sources such as wheat (Triticum aestivum) and cassava (Manihot esculenta) for baking bread, biscuits and other confectioneries (Nwankwo et al., 2012). The leaves which are used in cooking soup and stew are rich in protein (27%), starch (8%), sugar (4%) and ash (10%). Smaller roots, peels and leaves constitute excellent food to livestock (Anyaegbunam et al., 2008).

MATERIALS AND METHODS

Nine varieties of sweetpotato with various flesh colours (white/cream, orange and yellow) were evaluated at Umudike, southeastern Nigeria in 2015. The genotypes were laid out in a randomised complete block design with three replications. The plot size was 9m² (3mx3m) containing 30 plants per plot with plant spacing of 1 m x 0.3m, giving plant density of 33,333 stands per hectare. NPK fertilizer 15:15:15 was applied at the rate of 400kg/ha after the first weeding at five weeks after planting. Harvesting was done at four months after planting. At harvest, three medium root samples (which were the dominant root size) from each plot were collected, bagged in black polythene, labeled and sent to the laboratory for immediate analysis. Standard methods of the official methods of analytical chemist (AOAC, 2010) were used for the determination of the dry matter content, starch content and moisture content.

RESULTS AND DISCUSSION

The flesh colour of the fresh root of each of the nine genotypes evaluated in the trial was presented in Table 1. Four of the genotypes were in the orange flesh group (two light orange, one orange and one deep orange). There were four white-fleshed as well as one yellow-fleshed genotype. Flesh colour is an important attribute that is correlated with carotenoid accumulation. Orange-fleshed genotypes usually have high carotenoid content than the yellow-fleshed, which also is higher in carotenoid than the white-fleshed ones.

The dry matter, starch and moisture content of the genotypes are presented in Figure 1. All the sweetpotato genotypes evaluated had high dry matter content (≥ 30%) except UMUSPO/3 (23.05%), SOLO-2 (24.11%) and

PYT/12/053 (26.04%). The starch content is generally low. It ranged between 10.42 and 28.63% with only four genotypes having 20% and above starch content. Usually, root and tuber crops are known to contain high moisture content and that is why the high range of 59.4 – 76.95% is not surprising. Moisture content is known to be one of the root causes of low shelf life of sweetpotato as it creates an atmosphere conducive for rot organisms to develop and multiply.

CONCLUSION

UMUSPO/1,PYT/12/012, PYT/12/121, TIS/87/0087 and Ex-Igbariam have high starch and high dry matter contents. This is an indication that they are good enough for flour production and also for sugar syrup production in the pharmaceutical industry. They are likely to reduce poverty for food insecure generation.

Table 1: Flesh colour characteristics of the experimental sweetpotato genotype evaluated in the rainforest belt of Umudike

Genotype	Flesh colour
UMUSPO/1	Light orange
PYT/12/012	White
PYT/12/053	White
PYT/12/121	White
TIS/87/0087	White
SOLO2	Light orange
EX-IGBARIAM	Yellow
CENTENNIAL	Orange
UMUSPO/3	Deep orange

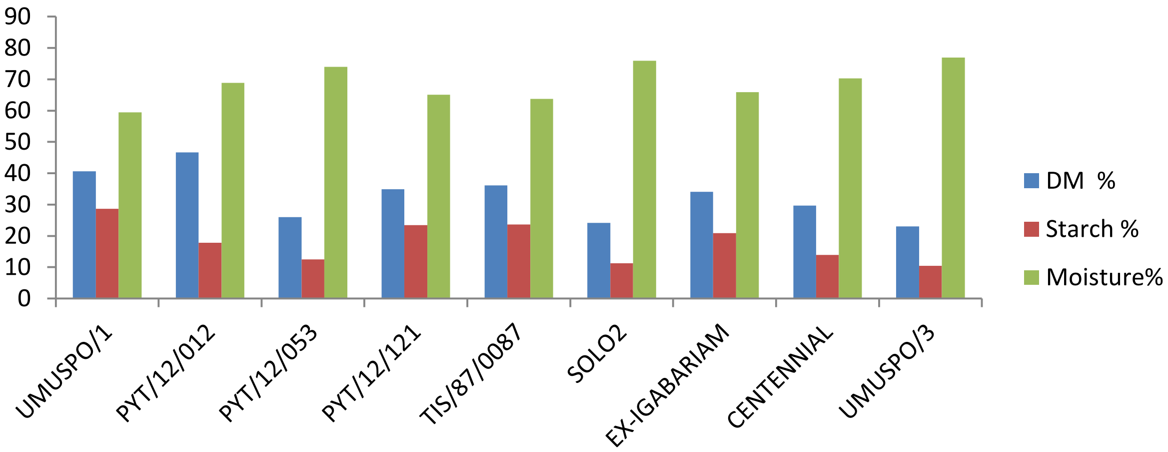

Figure 1: Means of dry matter, starch and moisture content of nine important sweetpotato genotypes evaluated in the rainforest belt of Umudike.

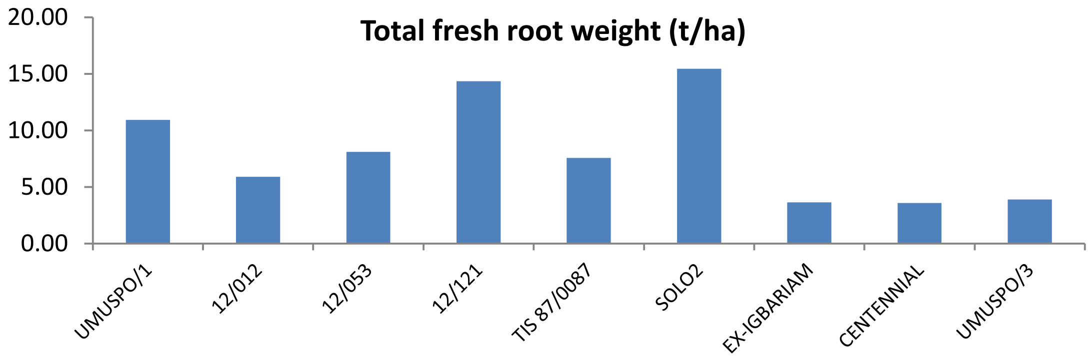

Figure 4: Total fresh root weight (t/ha) of nine important sweetpotato genotypes evaluated in the rainforest belt of Umudike

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IN VITRO ANTAGONISTIC ACTIVITIES OF TRICHODERMA HARZIANUM AS BIOCONTROL AGENT OF FUSARIUM OXYSPORUM, CAUSAL AGENT OF TUBER ROTS IN WHITE YAM (DIOSCOREA ROTUNDATA)

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ABSTRACT
In vitro studies on biological control using dual culture method was carried out to assess the antagonistic activities of Trichoderma harzianum as a biocontrol agent of Fusarium oxysporum, the causal agent of dry rot disease of white yam in storage. The antagonist was introduced at three different times (same time with the pathogen, 2days before the inoculation of the pathogen and 2days after the inoculation of the pathogen) with the pathogen on potato dextrose agar. The experiment was conducted in the Advanced Plant Pathology Laboratory of Federal University of Agriculture, Makurdi. The plates were incubated for 192 hours and measurements of mycelia radial growths were done at 24 hours intervals beginning from the third day. Observation on the dual culture plates showed competition for nutrient and space which subsequently starved the pathogen to death. The result of the interactions showed that the highest percentage growth inhibition of mycelia of the pathogen (77.99%) was recorded when T. harzianum was introduced two days before the inoculation of F.oxysporum, followed by introduction of T. harzianum same time with F.oxysporum (45.69%) and the least percentage growth inhibition (13.72%) was observed when the antagonist was introduced two days after inoculation of the pathogen. In all the treatments, T. harzianum was able to significantly ($P \leq 0.05$) inhibits the growth of A.niger at the three different times of introduction of the antagonist and this continued throughout the period of incubation. T. harzianum was observed to be effective in reducing the mycelia growth of F. oxysporum in culture in all the treatments and therefore showed the potential for biological control of the pathogen.
Key Words: In vitro, T. harzianum, biocontrol, F. oxysporum, yam, inhibition

INTRODUCTION
Yam (Discorea spp.) is a major staple food crop in West Africa, where it provides food for over 60 million people (Nweke et al., 1991). FAO (2000) estimated that the World production of yams is around 20 million tons per year. Inspite of the high volume of yam production, rotting of yam in storage continue unabated. Fungi organisms commonly involved in yam rots includes: Aspergillus niger, Botryodiplodia theobromae, Fusarium solani, Fusarium oxysporum Penicillium spp. Rhizopus stolonifer and Mucor spp. (Okoro and Nwankiti, 2004; Aidoo, 2007; and Okigbo et al., 2015). Losses due to post-harvest rot significantly affect farmers' and traders' income, food security and seed yams stored for planting. Okigbo and Ikediugwu (2000) indicated that between 20 and 39.5 % of stored tubers in storage may be lost to rot organisms. The use of synthetic chemicals such as sodium orthiophenylphenate, mancozeb and borax has been found to reduce storage rot in yam (Okigbo, 2005; Aidoo, 2007)). However, biological control is generally favoured as a method of plant disease management (Siameto et al., 2011). This is because it is selective in action, produces no side effect and cost less. Resistance to biological control is rare and biological control agents are self- propagating and self-perpetuating (Okigbo and Ikediugwu, 2000). The aim of this research was to study the antagonistic activities of a bioagent, T. harzianum introduced at different times in vitro to control Fusarium oxysporum, the causal agent of dry rot of yam tubers

MATERIALS AND METHODS
The experiment was conducted at the Advanced Plant Pathology Laboratory, Federal University of Agriculture, Makurdi, Nigeria. T. harzianum used in this study was obtained from yam Pathology Unit of University of Ibadan, Oyo State, Nigeria. Stock cultures of the isolate were maintained on slants of acidified potato dextrose agar (PDA) in McCartney bottles for subsequent studies. Rotten tubers of white yam varieties (Dioscorea rotundata) showing various diseased symptoms of dry rots were obtained from yam farmers from various storage barns in Zaki- Biam, Ukum local government area of Benue State, Nigeria. The rotten yam tubers were packaged in sterile polyethylene bags, taken to the laboratory and protected using wire mesh to prevent rodent attack. Potato Dextrose Agar (PDA) was the medium used. Test fungus for this study was Fusarium oxysporum. It was isolated from naturally infected yam tubers. Small sizes of approximately 2x2mm were cut out with sterile scalpel from yam tubers infected with rot at inter-phase between the healthy and rotten portions of the tubers. The cut tissues were soaked in 5% sodium hypochlorite for 2 minutes for surface sterilization and then rinsed in four

successive changes of sterile distilled water. The infected tissues were later picked onto sterile filter paper using a sterile forceps and then wrapped with filter paper for 2–3 minutes. The dried infected tissues were plated on several prepared sterile plates of acidified potato dextrose agar (PDA) and the plates were incubated at ambient room temperature (30±5°C) for 192 hours. The different fungi that grew from infected tissues were sub-cultured on separate sterile acidified PDA plates and incubated to obtain pure cultures of pathogens. Macroscopic and microscopic examination and morphological characteristics and identification were made and compared with existing authorities (Burgess et al., 2008).

The assay for antagonism was performed on Potato Dextrose Agar (PDA) on Petri dishes by the dual culture method (Evans et al., 2003). Percent Growth Inhibition (PGI) of pathogen was also calculated as described by Korsten and De Jager, (1995).

$$PGI\ (\%) = \frac{R - R_1}{R} \times 100$$

Where,

PGI = Percent Growth Inhibition

R = the distance (measured in mm) from the point of inoculation to the colony margin in control plate,

R_1 = the distance of fungal growth from the point of inoculation to the colony margin in treated plate in the direction of the antagonist. And the width of zone of inhibition (ZI) measured as the smallest distance between the colonies in the dual culture plate if any was determined (Singh and Sharma, 2014).

The experimental design was Completely Randomized Design (CRD) with three replicates. Test of variance was calculated using Analysis of variance (ANOVA) and statistical F-tests were evaluated at $P \leq 0.05$. Differences among treatment means for each measured parameter were further separated using Fisher's least significance difference (LSD) to determine levels of significance.

RESULTS AND DISCUSSION

Fusarium oxysporum was isolated and identified as one of the organisms causing rot of yam tubers in the study area. This result corroborates the findings of Okoro and Nwankiti (2004) that had earlier on identified this organism in rotten yam tubers at different locations in Nigeria. Colony characteristics growth on PDA was rapid. There was white aerial mycelium colour (figure 1). Microscopic examination and morphological characteristics and identification showed that micro and macro conidia were present, macro conidia slightly sickle-celled with apical cell and foot shaped basal cell, chlamydospores are present, single and some in pairs (figure 1).

T. harzianum assessed in this investigation was able to reduced mycelia growth of F. oxysporum when grown in dual culture irrespective of the time of introduction of the antagonist (figure 2). The results of dual culture indicated that T.harzianum significantly ($P \leq 0.05$) inhibited the growth of F. oxysporum at varying degrees across duration of incubation (table 1).The findings revealed that T. harzianum introduced 2days before inoculation of F. oxysporum has the highest mean percentage growth inhibition (77.99%), followed by that introduced same time with the pathogen (45.69%) and the least mean percentage growth inhibition (13.72%) was observed when the antagonist was introduced 2days after inoculation of the pathogen (table 1). The inoculation of the test antagonists two days before the pathogen was done because there are no biocontrol agents that have enough competitive ability to displace an already established pathogen. The time lapse allows adequate increase in cell concentration and subsequent colonization by antagonist before the arrival of the pathogen (Adebola and Amadi, 2010a).

The results of the dual culture showed that T. harzianum inhibited the growth of the target organisms through its ability to grow much faster than the pathogenic fungi thus competing efficiently for space and nutrients. Starvation was the most common cause of death for F. oxysporum, so that competition for limiting nutrients resulted in biological control of the test pathogen. This finding is in agreement with the work of Siameto et al., (2011). Antagonists may also affect growth of pathogen either through antibiosis or mycoparasitism (Saba Banday et al., 2008). It was observed microscopically that the interaction region between F. oxysporum with T. harzianum showed mycelia of T. harzianum grew on the surface of the pathogen and later penetrated the cell walls directly without formation of appresorium structures (figure 3). It also prevented the formation of both micro and macro conidia of the test fungus. The pathogen mycelia then disintegrated suggesting enzyme action (figure 3). This result agreed with the work done by Mokhtar and Aid (2013) who reported the inhibition of the growth and spore formation of F. acuminatum by 66.66% using T. harzianum in vitro. Siameto et al., (2011) demonstrated possible role of chitinolytic and/or glucanases enzymes in bio-control by Trichoderma. They showed that the enzymes function by breaking down the polysaccharides, chitin, and glucans that are responsible for the rigidity of fungal cell walls, thereby destroying cell wall integrity limiting the growth of the pathogen. Microscopic observation also showed that the antagonist, T. harzianum prevented the formation of spores of the test pathogen. It was observed in the study that a clear zone of interaction was formed in all Trichoderma- F. oxysporum interactions except in the interaction between T.harzianum and F. oxysporum; where T. harzianum was introduced 2days before inoculation of F. oxysporum. The zones of inhibition produced might be due to the production of antifungal metabolites by the test antagonist as reported by Adejumo et al. (1999).

CONCLUSION

The study found out the antagonistic potentials of T. harzianum as good biological control agent of yam tuber rot caused by F. oxysporum. The study also revealed that the best time for the introduction of bio-agent is before the arrival of the pathogen. This is because the introduction of the antagonist 2days before in vitro inoculation of F. oxysporum gave the highest inhibition of the mycelia growth of the pathogen.

Figure 1: Pure culture of F. oxysporum on potato dextrose agar (left), macro conidia of F. oxysporum (middle) and Chlamadospores (right) (× 10)

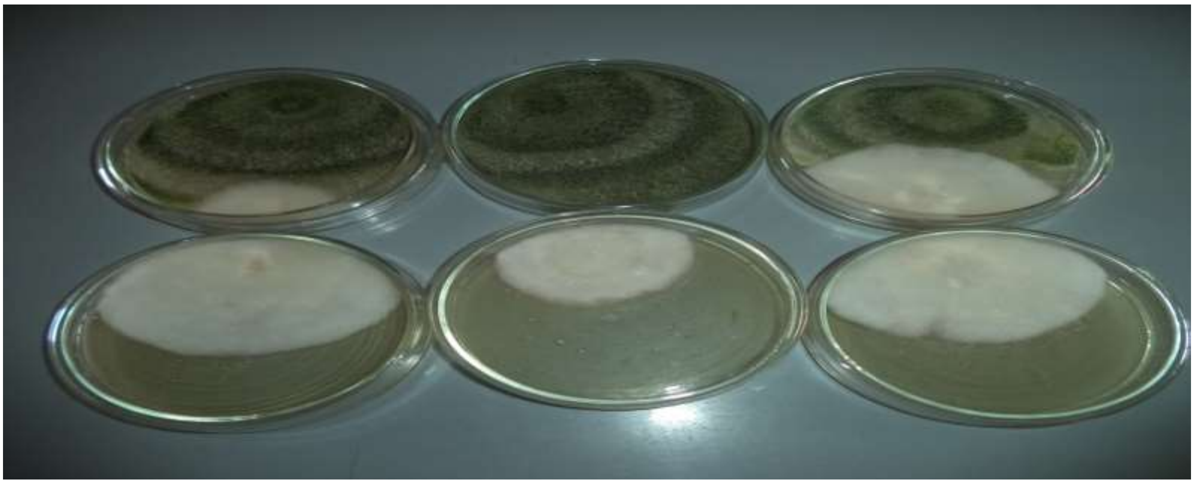

Figure 2: Dual culture of T. harzianum and F. oxysporumon on potato dextrose agar with control; T. harzianum introduced same time with F. oxysporum (top left); T. harzianum introduced 2days before inoculation of F. oxysporum (middle) and T. harzianum introduced 2days after the inoculation of F. oxysporum (right)

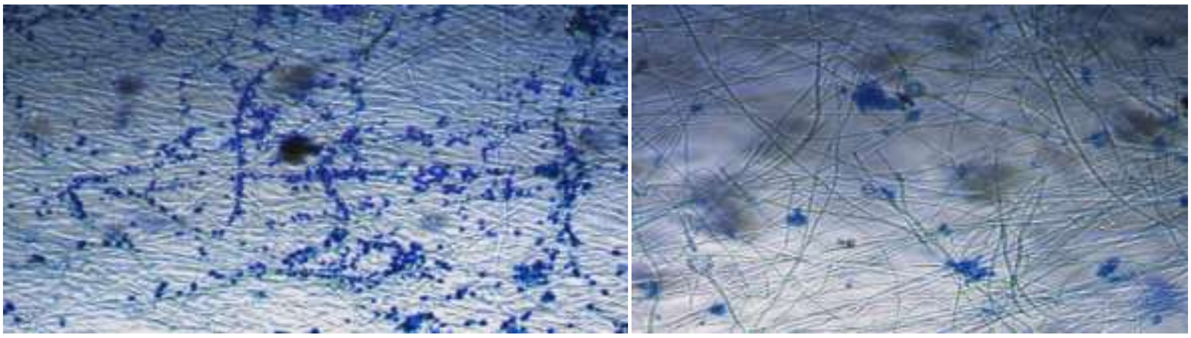

Figure 3: Trichoderma harzianum growing on mycelia of F.oxysporum and subsequently preventing the formation of conidia by F. oxysporum

Table 1: In vitro Percentage Growth Inhibitions (PGI) of F. oxysporum by time of Introduction of T. harzianum

Duration of Incubation	Time of Introduction of T.harzianum		
	ThXPath	**Th2dbiPath**	**Th2daiPath**
72 Hrs	22.25±6.03[c]	16.70±6.70[b]	2.78±2.78[d]
96 Hrs	33.50±3.49[c]	81.99±2.63[a]	7.06±2.13[d]
120 Hrs	37.65±6.90[bc]	89.63±0.37[a]	7.03±0.78[d]
144 Hrs	52.39±4.19[ab]	91.72±0.88[a]	12.99±0.65[c]
168 Hrs	62.68±3.36[a]	93.47±0.90[a]	21.88±1.13[b]
192 Hrs	65.65±2.85[a]	94.44±0.79[a]	30.05±1.05[a]
LSD	15.47	23.31	4.98
Mean (LSD= 14.11)	**45.69±4.20[b]**	**77.99±7.13[a]**	**13.72±2.36[c]**

Means on the same column with the same superscript are not statistically significant ($P \leq 0.05$)
Means on the same row (for Mean) with the same superscript are not statistically significant ($P \leq 0.05$) by time of introduction of T. harzianum. Th×path = T.harzianum introduced same time with pathogen; Th2dbipath = T.harzianum introduced 2days before inoculation of pathogen; Th2daipath = T. harzianum introduced 2days fter inoculation of pathogen.

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MORPHOLOGICAL CHARACTERIZATION AND CLASSIFICATION OF GROUNDNUT (ARACHIS HYPOGEAE L.) CULTIVARS FROM NORTHERN NIGERIA

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ABSTRACT
Experiment was conducted at the National Cereals Research Institute (NCRI), Badeggi, , Bida, Niger State, Nigeria with the objective for morphological characterization and classification of groundnut (arachis hypogeael.) cultivars from Northern Nigeria. Eleven (11) cultivars comprising of six (6) release varieties and five (5) accessions were obtained from the Gene Bank of the National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria while sixteen (16) other accessions were collected in Niger State by the National Cereals Research Institute (NCRI), Badeggi, Nigeria. The Characterization and classification of the groundnut cultivars were carried out using 18 morphological characteristics based on the IBPGR and ICRISAT Descriptor for Groundnuts and with slight modifications. Pod and seed dimensions were determined by measuring a total of 50 pods or seeds randomly from each sample. The length (L), width (W), and thickness (T) of pods or seeds were measured using a micrometre with accuracy of 0.001 mm. The mass of individual sample was measured using an electronic balance (accuracy of 0.001 mg). The result showed that the traits studied were close to the morphological characteristics from the three countries, indicating that similar postharvest equipment used for groundnut processing in America, China and Egypt may be suitable for Nigerian groundnut cultivars. The relatively small percentage of coefficient of variation (1.25 for AMD) and 10.69 for GMD in this study is an indication of uniformity of groundnut seeds obtained from the northern Nigeria. The close CV is also important in equipment design and selection for improvement during groundnut breeding as it gives some minimal difference in their morphology. The study also classified the groundnut cultivars studied into 7 groups using dendrogram with complete linkage and absolute correlation and found them distinctive
Keywords: groundnut, morphological traits, classification, processing

INTRODUCTION
Groundnut (Arachis hypogeae L.) is one of the world's most important sources of edible vegetable oil and protein (Lusas, 1979). There is great diversity among botanical varieties of groundnut (Ferguson et al., 2006). The genus Arachis for instance consist of 40-70 species which all possess unique quality and morphological characteristics. As a result of the acknowledged diversity in botanical materials, there is need for a common interface for information sharing among breeders and other interest groups in genetic resources management and utilization. This has become more intensive even with the establishment of international foundation for exchange of genetic materials (Kotzamanidis et al., 2006).
The need for national data base on the available varieties and accessions that will facilitate exchange and utilization of the data for the improvement of groundnut value chain including processing techniques and technologies in Nigeria led to the study of some important morphological characteristics of groundnut pods and seeds of the Nigerian groundnut cultivars and to identify cultivars belonging to similar groups. Together with agronomic and grade information, data on seed and pod quality are essential requirements for the release of new groundnut cultivars to ensure acceptability by the entire groundnut value chain actors. Seeds and pods physical attributes like all other agricultural materials are needed to adequately design appropriate equipment and systems for planting, harvesting and post-harvest operations such as cleaning, conveying and storage (Asoegwu et al., 2006). Physical characteristics of cheat, such as dimensions, weight, shape and bulk density were used to establish machine design and operating parameters for roller and hammer mills, selecting the optimum gap between rolls and optimum screen opening size for the hammer mill Hauhouot-O'Hara et al., (1999; 2000). While Vaughan et al., (1980) Asoegwu et al. (2006) and Simonyan et al. (2007) reported that separation of agricultural materials from unwanted materials is based on differences in the physical properties between the crop and foreign materials.
The process of cleaning groundnut pods and seed therefore requires that differences in the physical properties of pods and seeds be known. The surface area (SA) of seeds or pods is useful to estimate the rate of heat transfer and in the design of appropriate heating equipment. It is also required for grading and packaging and in sieve separation and grinding operations (Wilhelm et al., 2004; Singh et al., 2004). In this study, twenty seven (27) cultivars of groundnuts cultivated in the northern region of Nigeria were characterized and classified into groups

as a strategy to provide information for breeders on the available germplasms for improvement and also technical information for production and post-production engineers that will facilitate easy design of machines and processes for the processing of groundnut pods and seeds into intermediate and finished value added products.

MATERIALS AND METHODS

Eleven (11) cultivars comprising of six (6) release varieties and five (5) accessions were obtained from the Gene Bank of the National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria while sixteen (16) other accessions were collected in Niger State by the National Cereals Research Institute (NCRI), Badeggi, Nigeria. All the materials were cultivated during the 2015 cropping season (between May to November, 2015) at the upland research field of NCRI and harvested pods were cleaned manually and stored in a paper bag at room temperature (30±2°C) for about 6 months until required for analysis. Characterization and classification of the groundnut cultivars were carried out using 18 morphological characteristics based on the IBPGR and ICRISAT Descriptor for Groundnuts (1992) as reported by Kotzamanidiset al. (2006) with slight modifications. Pod and seed dimensions were determined by measuring a total of 50 pods or seeds randomly from each sample. The length (L), width (W), and thickness (T) of pods or seeds were measured using a micrometre with accuracy of 0.001 mm. The mass of individual sample was measured using an electronic balance (accuracy of 0.001 mg).

The arithmetic (AMD) and geometric (GMD) mean diameters were calculated from the three axial measurements (L, W and T).

$$AMD = \frac{(L+W+T)}{3} \quad (1)$$

$$GMD = (LWT)^{1/3} \quad (2)$$

The sphericity (S) of each pod and seed were determined by the following equation proposed by Mohsenin, (1970). Sphericity is the ratio of the geometric mean diameter of the three mutually perpendicular dimensions to the longest dimension of a solid triaxial ellipsoid (Cao et al., 2004). The surface area (SA) and volume (V) were determined by equations reported by Jouki and Khazaei (2012)

Statistical analysis

Data generated were subjected to statistical analysis using Minitab 13. The means and standard deviations of all properties were calculated. Means of the experimental data were compared by Duncan's multiple range test (DMRT) at 95% confidence of interval. The correlation coefficients among the properties were calculated.

RESULTS AND DISCUSSION

The results of the descriptive analysis of the morphological characteristics of groundnut pods and seeds are presented in Tables 1 and 2 respectively.The highest pod mass on the average was observed in BDA/ND-2 (2.00g) with BDA/ND-9 having the highest length and length/width ratio. The highest variation coefficients (7.35 and 12.35%) were obtained for pod density and surface area respectively. The low levels of variability of the majority of morphological characteristics are typical of the common groundnut from the natural populations. The pod weight of 0.736-1.995g is within the average mean of 1.06 - 3.60, 1.14 - 3.21 and 0.66 - 3.01g reported for American, Chinese and Egyptian varieties respectively reported by El-Sayed et al.(2001).

The average length, width, length/breadth ration, seed weight, arithmetic and geometric diameter, aspect ratio and density are presented in Table 2. The average length was 13.14g, width 8.16g, and length/width ratio 7.49. The average seed weight was 0.47g, while arithmetic mean diameter and geometric mean diameter were 9.60mm and 9.26mm respectively. Aspect ratio, sphericity and seed density mean were 63.02, 0.74 and 0.14 respectively. The variation coefficients were 2.44, 1.47, 1.05, 4.47, 1.25, 10.69, 2.65, 1.35 and 2.82 respectively for length, width, length/width ratio, seed weight, AMD, GMD, aspect ratio, sphericity and density. According to El-Sayedet al.(2001), Egyptian groundnut variety have the following dimension, length, width, thickness, geometricdiameter and mass 12.60 - 24.85mm, 5.35 -11.25mm,4.40-10.80mm, 7.19-13.77mm, and 0.22-1.17g,respectively. He also reported three varieties of groundnut pod obtained from China, America and Egypt which indicate the following range of geometric diameter 21.05, 20.59, and 20.34mm and 2.21, 2.17 and 2.13g of mass, respectively. The results of this study is close to the morphological characteristics from the three countries, indicating that similar postharvest equipment used for groundnut processing in America, China and Egypt may be suitable for Nigerian groundnut cultivars. The relatively small percentage of coefficient of variation (1.25 for AMD) and 10.69 for GMD in this study is an indication of uniformity of groundnut seeds obtained from the northern Nigeria. The close CV is also important in equipment design and selection for improvement during groundnut breeding as it gives some minimal difference in their morphology.

The groundnut cultivars were classified by considering all the morphological characteristics considered in this study using cluster analysis (Fig. 1).. In this study, we hypothesize that the cluster analysis can be used to classify the groundnut cultivars having similar morphological characteristics into single group. According to Lee et al. (2012), using this approach, characteristics from different cultivars but with similar morphological properties can be assumed as a single commodity for easy identification and selection by breeders and processing industry for specific application purposes. In this study, the groundnut cultivars were classified into 7 groups using dendrogram with complete linkage and absolute correlation. The first group includes SAMNUT21 and SAMNUT23, group 2 (SAMNUT22, SAMNUT25, NGBO1293, BDA/ND-4, BDA/ND-11, BDA/ND-12), group three (SAMNUT24, NGBO187, NGBO1370, BDA/ND-8, BDA/ND-14, BDA/ND-15), group four (SAMNUT26, BDA/ND-6), group five includes NGBO1294, BDA/ND-1, BDA/ND-7, BDA/ND-9, and BDA/ND-16. Cultivars NGBO1369, BDA/ND-2, BDA/ND-3, and BDA/ND-11 were group in cluster 6 and BDA/ND-5 and BDA/ND-10 were in group 7.

CONCLUSION

The result showed that the traits studied were close to the morphological characteristics from the three countries, indicating that similar postharvest equipment used for groundnut processing in America, China and Egypt may be suitable for Nigerian groundnut cultivars. The relatively small percentage of coefficient of variation (1.25 for AMD) and 10.69 for GMD in this study is an indication of uniformity of groundnut seeds obtained from the northern Nigeria. The close CV is also important in equipment design and selection for improvement during groundnut breeding as it gives some minimal difference in their morphology. The study also classified the groundnut cultivars studied into 7 groups using dendrogram with complete linkage and absolute correlation and found them distinctive

Table 1: Pod morphological characterization of groundnut cultivars cultivated in northern Nigeria

Cultivars	L	W	T	PWT	HWT	CONS	PBK	NSD	SAP	SPRP
SAMNUT21	25.10	12.21	11.63	1.341	0.316	2.05	2.70	1.00	0.450	0.65
SAMNUT22	23.89	10.37	9.65	0.860	0.199	3.40	3.15	1.10	0.234	0.62
SAMNUT23	30.40	11.70	10.21	1.247	0.245	4.65	2.75	1.50	0.492	0.58
SAMNUT24	24.85	11.65	10.81	1.001	0.312	2.74	3.42	1.00	0.355	0.64
SAMNUT25	24.33	10.56	9.17	0.900	0.245	3.05	2.67	1.00	**0.110**	0.61
SAMNUT26	25.24	12.31	10.90	1.203	0.336	2.45	1.30	1.00	0.412	0.64
NGBO187	22.72	**10.27**	**8.75**	0.877	0.193	3.25	2.20	1.00	0.154	0.61
NGBO1294	35.84	11.91	9.57	1.029	0.248	3.55	2.80	1.00	0.625	0.54
NGBO1369	26.01	12.23	10.59	1.377	0.349	3.05	3.30	1.00	0.405	0.63
NGBO1370	26.45	12.65	10.73	1.310	0.325	3.50	3.65	2.50	0.468	0.63
NGBO1293	**36.43**	11.85	9.66	1.399	0.301	5.65	**4.50**	1.00	0.642	**0.53**
BDA/ND-1	25.11	11.20	9.15	1.009	0.225	4.75	3.90	1.10	0.244	0.60
BDA/ND-2	33.81	15.10	12.38	**1.995**	**0.571**	**6.25**	3.95	1.00	0.150	0.61
BDA/ND-3	23.44	10.76	10.44	0.857	0.208	4.80	3.20	1.00	0.255	0.64
BDA/ND-4	23.23	10.76	10.52	0.925	0.214	4.00	3.55	1.01	0.654	0.64
BDA/ND-5	26.28	12.95	12.54	1.379	0.400	4.40	3.45	1.00	0.974	0.65
BDA/ND-6	28.69	13.61	13.47	1.500	0.450	5.80	4.10	1.00	0.100	0.66
BDA/ND-7	30.27	13.67	12.95	0.948	0.440	4.45	3.30	1.00	0.180	0.65
BDA/ND-8	28.42	18.97	12.52	1.185	0.436	4.50	3.75	1.50	0.710	0.62
BDA/ND-9	31.14	**31.94**	**14.31**	1.134	0.434	4.85	3.35	1.00	0.375	0.70
BDA/ND-10	23.96	11.66	11.56	0.942	0.248	1.80	1.05	1.00	**0.999**	**0.82**
BDA/ND-11	28.77	13.68	13.54	1.465	0.467	4.10	3.80	1.10	0.321	0.66
BDA/ND-12	23.23	11.47	11.43	0.948	0.235	2.40	1.20	**2.80**	0.910	0.65
BDA/ND-13	33.65	12.53	12.66	1.373	0.437	3.50	2.00	1.00	0.804	0.58
BDA/ND-14	**22.13**	10.48	10.33	**0.736**	**0.178**	2.35	1.65	1.00	0.119	0.65
BDA/ND-15	26.25	13.83	10.06	1.022	0.343	**1.35**	**0.60**	1.00	0.143	0.68
BDA/ND-16	32.29	14.09	12.64	1.176	0.512	4.30	3.05	1.00	0.310	0.61
Mean	27.45	13.13	11.19	1.15	0.33	3.74	2.90	1.17	0.43	0.63
CV (%)	2.93	6.40	2.60	5.60	6.36	6.44	6.76	7.35	12.35	1.58

L=length (mm), W=width (mm), T=thickness, PWT=pod weight (g), HWT=hull weight (g), CONS=constriction, PBK=pod beck, NSD=pod specific density (g/cm^2), SAP=pod surface area (mm^2), SPRP=pod sphericity (%)

Table 2: Seed morphological characterization of groundnut cultivars cultivated in northern Nigeria

Cultivars	Seed morphology								
	L	W	T	SWGT	AMD	GMD	Ra	SPR	DST
SAMNUT21	12.24	8.99	8.22	0.56	9.81	9.65	73.45	0.81	0.14
SAMNUT22	11.53	7.76	7.16	0.37	8.81	8.60	67.30	0.77	0.14
SAMNUT23	15.28	8.29	7.23	0.45	10.43	9.69	54.25	0.69	0.13
SAMNUT24	12.44	7.93	7.50	0.42	9.29	9.02	63.75	0.75	0.15
SAMNUT25	12.85	7.81	7.15	0.43	9.27	8.93	60.78	0.73	0.15
SAMNUT26	12.77	8.86	7.72	0.51	9.78	9.54	69.38	0.77	0.13
NGBO187	11.19	7.72	7.15	0.38	8.68	8.50	68.99	0.78	0.15
NGBO1294	13.63	8.00	7.79	0.45	9.81	9.45	58.69	0.72	0.14
NGBO1369	12.75	8.85	8.12	0.59	9.91	9.69	69.41	0.78	0.15
NGBO1370	12.64	8.87	8.22	0.56	9.91	9.71	70.17	0.79	0.15
NGBO1293	15.34	8.01	7.28	0.51	10.21	9.61	52.22	0.67	0.11
BDA/ND-1	12.68	7.88	7.45	0.45	9.34	9.04	62.15	0.74	0.15
BDA/ND-2	17.94	7.97	7.25	0.84	11.05	10.10	44.43	0.62	0.22
BDA/ND-3	11.54	8.01	7.38	0.41	8.98	8.78	69.41	0.78	0.14
BDA/ND-4	11.47	8.01	7.38	0.43	8.95	8.77	69.83	0.78	0.15
BDA/ND-5	13.28	9.06	7.75	0.58	10.03	9.75	68.22	0.76	0.15
BDA/ND-6	13.53	9.43	8.37	0.62	10.44	10.20	69.70	0.77	0.13
BDA/ND-7	12.03	7.01	6.71	0.33	8.58	8.25	58.27	0.72	0.16
BDA/ND-8	14.51	7.85	7.34	0.44	9.90	9.40	54.10	0.68	0.15
BDA/ND-9	14.59	7.53	7.35	0.40	9.82	9.29	51.61	0.68	0.14
BDA/ND-10	11.78	9.40	8.01	0.62	9.73	9.59	79.80	0.83	0.13
BDA/ND-11	13.62	8.04	7.36	0.40	9.67	9.29	59.03	0.72	0.12
BDA/ND-12	11.71	8.04	7.36	0.40	9.03	8.83	68.66	0.77	0.13
BDA/ND-13	12.30	7.38	6.90	0.39	8.86	8.54	60.00	0.72	0.16
BDA/ND-14	11.03	8.02	7.48	0.34	8.84	8.70	72.71	0.81	0.12
BDA/ND-15	13.88	8.02	7.48	0.42	9.79	9.39	57.78	0.71	0.13
BDA/ND-16	16.19	7.68	7.25	0.47	10.37	9.64	47.44	0.64	0.14
Mean	13.14	8.16	7.49	0.47	9.60	9.26	63.02	0.74	0.14
(CV) %	2.44	1.47	1.05	4.47	1.25	10.69	2.65	1.35	2.82

L=seed length (mm), W=seed width (mm), T=thickness, SWT= seed weight (g), ARM=arithmetic mean diameter, GMD=geometric mean diameter, Ra=aspect ratio, SPR=seed sphericity, DST=seed densit

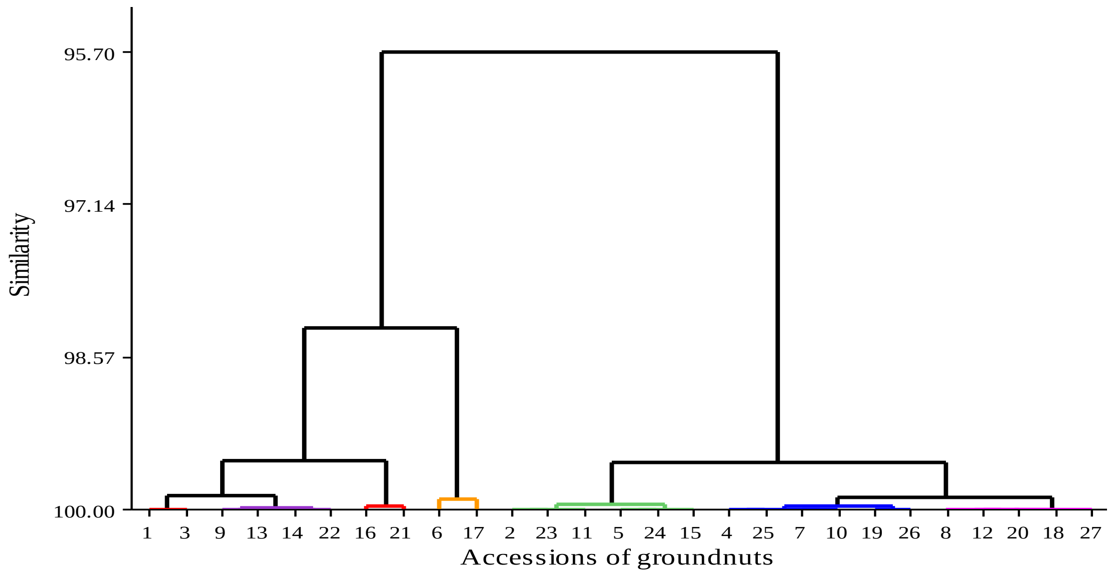

Fig.1: Classification of groundnut cultivars using dendrogram with complete linkage and absolute correlation

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EFFECTS OF DROUGHT STRESS ON AGRONOMIC TRAITS OF RUBBER (HEVEA BRASILIENSIS) SEEDLINGS

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ABSTRACT
In order to meet the ever rising global demand for natural rubber cultivation, cultivation of natural rubber seedlings is been extended to green house where extreme climatic conditions like drought and high temperature negatively influence the crop performance. To ensure maximum productivity, identification of drought tolerant clones of Hevea which can cope with water stress and give better crop yield is essential. Ten genotypes of Hevea clones were screen for tolerance to 26 days of drought stress in the green house. The aim was to select tolerant clones for development of new promising genotypes of natural rubber. Rubber seedlings were transplanted (4 seedlings per poly bag filled with top rich soil) from the pre nursery field to the green house at one month old. After subjection to 26 days of drought stress each clone was evaluated for five juvenile characters. Phenotypic, genotypic and environmental variances as well as heritability estimate were obtained through analysis of variance. Results obtained showed that variations existed in the level of drought tolerance among the genotypes. GT1 recorded the highest plant height, number of leaves, percentage plant survival and leaf area followed by Nig 804 and PR107.

Keywords: Hevea brasiliensis, Rubber seedlings, drought stress, juvenile traits.

INTRODUCTION

The Hevea genus belongs to the Euphorbiaceae family and comprises 11 species native to the Amazon region (Pires et al., 2002). Hevea brasiliensis (Willd. ex Adr. de Juss. Muell-Arg.) is the only cultivated species and the main source of natural rubber. The rubber tree is a perennial and deciduous crop with an economics life span of 25-30 years. The plant is quick growing, erect, with a straight trunk and surfaces. It is the tallest species of the genus, Hevea. It is a tropical crop that survives between 15^0N and 10^0S of the equator, where the climax vegetation is lowland tropical forest and where the climate is hot and humid with temperature range of 25-30^0c with a well distributed rainfall of 1800-2000mm per year. The crop does not perform well if there is a long dry season. It also does badly if the climate is excessively humid, as this encourages leaf diseases. Rubber tree can tolerate a wide range of soil conditions from sandy to loamy soils provided the soils are deep, fertile, well drained and slightly acidic with a soil pH of 4-8 or 4-6.

As global demand for natural rubber increases a major challenge for cultivation of rubber plants is their inability to withstand unfavorable environmental conditions in the context of global climate change (Nair et al., 2010). Drought remains one of the ecologically limiting factors among all environmental constraints. Drought is an extended period of dry weather characterized by shortage of water supply to plants (Acquaah, 2007). Drought begins when the readily available soil water in the root zone is exhausted (Taiz and Zeiger, 2006). Drought stress can occur at any stage of the growing process, and cause complete loss of crops or serious damage to yield. In Nigeria, natural rubber production comes mostly from a single popular clone RRIN 800 series and it occupies most of the area under rubber cultivation. Although it is the highest yielding clone in Nigeria, it does not exhibit good drought tolerance capacity. The present study aimed to identify tolerant genotypes for development of new clones of natural rubber.

MATERIALS AND METHODS

Ten genotypes of Hevea clones were screened at the green house of the National Root Crops Research Institute (NRCRI), Umudike, Abia State, for tolerance to 26 days of drought stress using five juvenile characters. The ten seedling clones were five RRIN developed clones (NIG 800 to NIG 804) and five exotic clones (RRIM 600, RRIM 628, GT1, PR107 and PB5/51 from Malaysia. Sprouted seedlings were transplanted from the pre nursery to the poly bags filled with rich top soil at one month old on October 10, 2013 in a Complete Randomized Design (CRD) with three replication. Each poly bag contains 4 seedlings and the seedlings were watered twice daily (morning and evening) to enhance establishment before imposing 26 days of drought on them. Data were collected on the following five juvenile characters: (plant height, number of leaves, plant girth (circumference), percentage plant survival and leaf area) at 26 days of drought stress.

Plant height was measured from the ground level to the tallest leaf using meter rule at 26 days of drought stress. Number of leaves per plant was obtained by counting the number of leaves of each plant after which their mean was calculated and recorded.

Plant girth was obtained by measuring the diameter of the plants using slide calipers to measure the girth of plants.
Percentage plant survival was calculated by counting the number of seedlings that survived over the total number transplanted from field to the poly bags according to (Samarappuli et al., 1996).
Data on leaf area (cm^2) at 26 days of drought was measured and calculated. Leaf Area (cm^2) = L x W x K, where L is leaf length, W is maximum width of the leaf and K is a correction factor of 0.654.
All the data collected were subjected to Analysis of Variance (ANOVA) using the SAS package (SAS, 1998) to determine if variability existed among the genotypes for various traits. Genetic parameters such as variance components (genotypic, phenotypic and error variances) and heritability in the broad sense was calculated according to Allard (1987) as follows:
$Vg = \{MSG\text{-}MSE/r\}$, $Vp = \{MSG/r\}$, $Ve = \{MSE/r\}$
where MSG, MSE, Ve and r are the Mean Squares of genotypes, Mean Squares of error, Environmental variance and number of replication respectively.

RESULTS AND DISCUSSION

The mean effects of drought stress on plant height, number of leaves, percentage plant survival, plant girth and leaf area of rubber seedlings are presented in Table 1. Plant height varied from 21.8cm in RRIM 600 to 34.98cm in GT1. GT1 recorded the highest plant height of 34.98cm followed by NIG 804 with plant height of 33.04cm. RRIM 600 recorded the least plant height of 21.8cm. The genotype RRIM 600 was reported to be drought tolerant in the field by Korieocha et al., (2015) but cannot withstand 26 days of drought in the green house. This may be due to the fact that the taproots penetrated deep inside the soil and absorbed water that helped them to survive up to 40 days of drought while in the green house root penetration was restricted in the poly bags. This is in line with the findings of (Samarappuli et al., 1996) who reported that root growth in relation to density may have had greater effect in the performance of rubber plants in the green house. Young plants are less likely to survive in the soils with inadequate supply of moisture at the surface; this is particularly so during the dry periods. Well developed and more efficient root system would enable the young plant to tap on a larger reservoir of moisture beneath the surface, thereby increasing the soil water and nutrient absorption efficiency of the plant.
Number of leaves varied from 5.33 in RRIM 600 to19.11 in GT1 after 26 days of exposure to drought stress (Table 1). As a result, GT1 had the highest number of leaves 19.11 after 26 days of drought followed by PR107 with 18.53 while RRIM 600 exhibited the least number of leaves (5.33) at 26 days of exposure to drought stress. There were influences of drought on all the genotypes but the effects of drought stress were more pronounced in RRIM 600 and PB5/51.
The percentage plant survival per genotype ranged from 25% in RRIM 600 to 66.6% in GT1 after subjection to 26 days of drought stress (Table 1). Percentage plant survival of the genotypes was generally high after establishment, before exposing them to 26 days drought, except for RRIM 600 that had 50% survival after establishment. Generally, there was much influence of drought stress on the genotypes after 26 days of drought stress but GT1 recorded the highest plant survival rate of 66 6% while RRIM 600 and PB5/51 recorded the least plant survival rate of (25%) followed by NIG 800 and RRIM 628 with 30.67% and 30.33% respectively. Meanwhile GT1 was the only genotype that can tolerate drought periods of 26 days or even more in the green house and field. The remaining genotypes showed little or no drought tolerance in the green house experiment when compared with field experiment as reported by (Korieocha et al., 2015).
The leaf area varied from 84.48cm^2 in RRIM 600 to 513.87cm^2 in GT1 after subjection to 26 days of drought stress. GT1 produced the highest leaf area of 513.87cm^2 at 26 days after exposure to drought stress, followed by PR 107 with 431.01cm^2 and RRIM 600 produced the least leaf area of 84.48cm^2 at 26 days of drought (Table 1). There was variation among the genotypes during the drought stress period but low leaf area was recorded across the ten genotypes especially in RRIM 600. This result indicated that drought had influence on the genotypes. Since there was limited supply of water and the crops were not exposed to direct sun shine, photosynthetic process was inhibited and the leaves did not grow elaborately well. The significant clonal variations for the five juvenile traits will permit selection among the clones for tolerance to drought stress.

In 2013 all the traits had higher phenotypic variances than genotypic and environmental variances. Also, the environmental variances were more than genotypic variances. Consequent upon this, the broad sense heritability ($h^2_{b\ \%}$) estimates were generally low, except for leaf area and plant girth where moderate heritability (h^2_b) estimates were obtained. Percentage plant survival had the highest phenotypic variance (403.55); lower genotypic variance (7.72) compared to high environmental variance (395.83), and had a lower heritability estimate of 0.02. Leaf area had phenotypic variance of 70.64 and genotypic variance estimates of 30.10, and consequently a moderate heritability estimate of 0.43 (Table 2). The lower genotypic variances recorded, compared to environmental and phenotypic variances, suggest greater influence of the non- heritable components over and above heritable (genetic) components on the total phenotype observed. Genetic gain under this scenario will be very slow, and will take considerable time. Similar results of higher environmental (error) variance than genotypic variance for characters were reported by (Adebisi et al., 2001) for soybean and (Adebisi et al., 2001) for kola. Heritability is a measure of observed phenotype that is accounted for by genetic effects.

CONCLUSION

From the result in the green house experiment, it was observed that only GT1 withstood 26 days exposure to drought. The result also showed that rubber seedlings cannot withstand drought stress at nursery stage for a long period especially in the green house. The lower genotypic variances recorded, compared to environmental and phenotypic variances, suggest greater influence of the non- heritable components over and above heritable (genetic) components on the total phenotype observed. These also further explain that selection under this scenario will be very slow and will involve a lot of recurrent selection.

Table 1: Mean effects of 26 day of drought stress on 10 genotypes of rubber seedlings evaluated in the green house.

Genotypes	Plant height (cm)	Number of leaves	Percentage plant survival (%)	Leaf area (cm^2)	Plant girth (cm)
GT1	34.98	19.11	66.67	513.87	1.20
NIG 800	27.78	10.66	30.67	162.78	0.11
NIG 801	31.33	13.25	50.00	305.81	0.88
NIG 802	26.89	13.08	33.33	293.12	0.99
NIG 803	30.17	12.00	40.00	253.80	0.92
NIG 804	33.04	16.38	41.67	389.03	1.81
PB 5/51	26.20	6.17	25.33	73.299	0.12
PR 107	31.63	18.53	41.67	431.01	1.12
RRIM 600	21.80	5.33	30.33	84.48	0.41
RIMM 628	28.22	8.67	25.00	147.39	0.55
Means	29.20	12.32	38.47	265.46	0.81
F-LSD$_{(0.05)}$	10.11	4.587	32.83	50.51	0.301

Table 2: Phenotypic, genotypic, environmental variances and heritability estimates of five juvenile traits of ten genotypes of rubber seedlings evaluated in the green house in 2013.

Traits	Vp	Vg	Ve	H^2_b%	$\bar{x}$
Plant Height	46.332	8.7937	37.538	0.1898	30.372
Number of Leaves	8.9106	1.1825	7.7281	0.1327	8.8122
Percentage Plant Survival	403.56	7.7160	395.83	0.0191	60.00
Leave Area	70.641	30.104	40.536	0.4262	26.04
Plant girth	0.5105	0.1605	0.3500	0.3144	2.283

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MORPHOLOGICAL TRAITS AND YIELD EVALUATION OF HUNGRY RICE (DIGITARIA IBURUA KIPPIS STAPF) ACCESSIONS AT BADEGGI SOUTHERN GUINEA SAVANNAH OF NIGERIA

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ABSTRACT:
The field experiments were carried out to evaluate the yield and selected morphological traits of twelve (12) hungry rice (D. iburua) accessions in 2014 and 2015 cropping seasons at the National Cereals Research Institute, Badeggi. The experimental design was a Randomized Complete Block Design with three replications,. Traits such as number of tillers, leaf area, plant height, panicle length, number of spikes, length of spikes and grain yield (kg ha^{-1}) were assessed. The analysis of variance showed significant differences among the accessions for all the traits evaluated. The overall mean grain yield of the accessions in the study was 1,883.51kgha^{-1}. Jipel accession produced the highest grain yield of 992.33kgha^{-1}, followed by Nibang accession in 2014. While in 2015, Nashelleng accession out yielded the rest of the accessions, while Jipel and Pelking accession produced the lowest grain yields in both years of the study.
Keywords: Rice, morphological traits, yield evaluation, accessions

INTRODUCTION:
Hungry rice (D. iburua) also known as fonio, findo, fundi, pom, kabuga or acha in different West African countries is a cereal crop in the Savannah Zone of West Africa. It is the oldest indigenous crop with cultivation record dating back to 7000 B.C. (Cruz, 2004). It is relatively unimproved and is characterized by a number of poor traits such as fragile stems, small seed size and weight, photoperiod sensitive, low seed set, low yielding capacity among others. In Nigeria, hungry rice (D. iburua) is produced on 160,000ha with an annual yield of 85,000t and 500 kg ha^{-1} (FAO, 2011). It is a crop that demands low input for its production and can give appreciable yield on poor or marginal soils and will tolerate a wide range of soils such as sandy, loamy, rocky or shallow soils. However, soils with very high clay content are not suitable for the crop (Philip and Itodo, 2006). In Nigeria agricultural productivity per hectare is characterized by low yield, small holdings and rudimentary farming system, which is also attributed to poor soil conditions and insufficient use of resources. Nevertheless, increases in agricultural productivity for availability of food for the populace must involve the cultivation of minor crops such as hungry rice (D. iburua), finger millet (Eleucine coracana L.), and foxtail millet among others that have high nutritional qualities useful to human health.
Hungry rice (D. iburua) can be utilized in similar ways like major cereals such as maize (Zea mays L.), rice (Oryza sativa L.) and sorghum, (Sorghum bicolor) (Dachi, 2014). Hungry rice (D. iburua) contains two important sulphur amino acids (cysteine and methionine) that are lacking in major cereals. These amino acids are useful to human health particularly for people with diet challenges. Also, in the medical field, hungry rice (D. iburua) starch has been compared with maize starch as a binder at various concentrations and was found to be as good as maize starch in the formulation of paracetamol tablets (Musa et al, 2008, Iwuaguwu et al, 2001). Also, the breakthrough in the processing of this crop which has been a setback to its production has enhanced hungry rice (D. iburua) production to meet local and international demand. This might be responsible for the increase in its production in areas where it is grown in recent years. Hungry rice (D. iburua) can be used in the preparation of porridge, local beverages, couscous or ground and mixed with other cereals for consumption (Purseglove, 1975; Hag and Ogbe, 1995; Anon., 1995). The demand for hungry rice (D. iburua) is on the increase as a result of its nutritional qualities, organoleptic properties and health benefits among other uses of the crop (Dachi, 2014). There is need to intensify the production of this crop to satisfy local and international demands, hence further evaluation of these accessions for yield and adaptability to local conditions is way forward to its availability. The revitalization of hungry rice (D. iburua) production will enhance the diversification of the economy and food security in the country. Thus, this study was aimed at evaluating the performance of some promising hungry rice (D. iburua) accessions in the Southern Guinea Savannah of Nigeria

MATERIALS AND METHOD
The experiments were conducted at the National Cereals Research Institute, Badeggi in 2013 (Lat. 9^0 45N' and Long. 6^0 07'E) in Niger State located in the Southern Guinea Savanna ecological zone of Nigeria in 2014 and 2015. The textural class of the soil of the experimental site was sandy loam with pH of 5.78 in water, low in organic carbon (4.40), organic matter (0.57), low in residual phosphorus (12.45kgha^{-1}) and low in residual nitrogen (0.48). The treatments consisted of twelve hungry rice (D. iburua) accessions selected from the germplasm. The experiment was laid out in a Randomized Complete Block Design with three replications. Plot

size was 3.0m x 4.0m. Seeds were sown by drilling at 30cm inter-row spacing and at 30kgha^{-1} seeding rate in the third week of June in all the seasons. At five weeks after sowing, NPK 15:15:15 fertilizer was applied at the rate of 30kg Nha^{-1}, 30 kg ha^{-1} P_20_5 and 30 kg K_20 ha^{-1} in all the plots.

Weeds were removed manually by hand pulling at 4, 8 and 12 week after sowing (WAS). The crops were harvested at maturity using sickles in the fourth week of October in both seasons and threshed by beating with sticks to remove the seeds from the chaff and winnowed to obtain clean seeds. The data collected included number of tillers, leaf area, plant height at harvest, panicle length, number of spikes, length of spikes and grain yield (kg ha^{-1}). The data collected were subjected to analysis of variance and treatment effects were compared using least significant difference (LSD) at 0.05% level where significant.

RESULTS AND DISCUSSION

There were significant differences among the accessions in terms of all the traits studied. This could be due to the genetic variability among the accessions in terms of the character assessed. Similar result was also obtained among evaluated wheat genotypes by Peyman et al, (2014). The range of number of tillers among the accessions studied varied from 5.60 for Pelking accession to 71.87 for Jarab accession in 2014 (Table 1) and from 5.67 for Pelking accession to 16.60 for Jepel accession in 2015 (Table 2). Sunpiya accounted for the highest leaf area of 29.59 in 2014 while in 2015 the highest leaf area of 42.16 was produced by the accession Jipel (Table 2). Suhn and Gotip accessions had the least leaf area of 24.79 and 24.86 respectively. Plant height was observed to differ significantly among the hungry rice (D. iburua) accessions. Suhn and Sunpiya accessions were significantly taller up to 124.71 and 125.14cm respectively, while Nashelleng and Pelking accessions recorded the shortest heights in both years with heights of 113.92 and 107.53cm respectively. The maximum panicle length was produced by Jipel (59.57cm) and Suhn accession (56.83cm) and the minimum was recorded by Sunpiya and Dinat accessions with 51.14 and 49.19cm (Tables 1 and 2).

In both years of experimentation, Nashelleng accession gave the highest number of spikes per plant and pelking accession produced fewer numbers of spikes per plant among all the accessions. Length of spikes per plant was observed to be significantly longer in Napiya and Suhn accessions, while Pelking and Nibang accessions produced the shortest length of spikes (Tables 1 and 2).

Statistical analysis of the data showed that there was significant difference among the 12 hungry rice (D. Iburua) accessions in terms of grain yield. In 2014, Jipel accession produced significantly higher grain yield, followed by Nibang accession (Table 1), while in 2015, Nashelleng accession gave the higher grain yield, followed by Jipel and Sunpiya accessions (Table 2). Generally, the differences observed among the 12 hungry rice (D. iburua) accessions in respect to yield and yield components assessed could be due to their varied genetic compositions and adaptation to the soil and climatic conditions under which the studies were conducted. The yields obtained from these hungry rice (D. iburua) accessions ranged from 550.10 to 1,500.01kgha^{-1}. The implication of the results is that farmers have a wide range of choice to make for high yielding hungry rice (D. iburua) accessions in and around the study area. Breeders can also select for more desirable traits for improvement.

CONCLUSION:

The variability in the accessions can be exploited by plant breeders for further improvement.

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Table 1: Yield and growth performance of some selected hungry rice (D. iburua) Accessions at Badeggi in 2014

Treatment/ Accession Name(Local)	No. of tillers per pant	Leaf Area (cm^2) per plant	Plant height (cm).	Panicle Length (cm)	No. of Spikes/ Plant	Length of spike (cm).	Grain Yield ($Kgha^{-1}$)
Dampep	13.22	27.76	111.53	54.95	7.00	15.84	783.33
Dinat	12.24	28.09	115.83	59.07	7.12	15.77	850.01
Gotip	12.57	24.75	109.93	55.01	6.61	13.16	950.05
Jakalak	10.30	21.80	111.91	56.03	6.03	16.08	966.67
Jarab	71.87	29.25	110.51	53.93	6.23	13.91	900.50
Jipel	14.57	25.18	115.98	59.57	7.62	16.13	992.33
Napiya	11.81	25.49	112.68	56.31	7.01	16.91	833.33
Nashelleng	11.03	27.49	107.53	58.94	7.14	14.55	633.33
Nibang	13.01	26.46	113.57	57.47	6.77	15.59	983.33
Pelking	5.60	28.84	114.44	53.21	5.95	1.02	550.10
Suhn	10.73	24.79	124.71	59.05	6.21	14.88	833.33
Sunpiya	10.33	29.59	116.23	51.14	6.22	15.39	916.67
LSD (0.05%)	8.75	4.41	3.39	6.10	8.62	1.90	0.27
CV (%)	16.61	8.95	5.01	6.40	14.96	7.40	19.50

Table 2: **Yield and growth performance of some selected hungry rice (D. iburua) accessions at Badeggi in 2015**

Treatment/ Accession Name(Local)	**No. of tillers per pant**	**Leaf Area (cm^2) per plant**	**Plant Height. (cm)**	**Panicle Length (cm)**	**No. of Spikes/ Plant**	**Length of spike (cm)**	**Grain Yield ($Kgha^{-1}$)**
Dampep	14.73	21.61	122.81	52.37	7.20	16.99	871.67
Dinat	14.93	30.87	124.75	49.19	7.10	16.17	868.33
Gotip	11.67	24.86	114.82	54.27	6.60	17.05	1,033.33
Jakalak	12.40	31.59	120.65	54.33	6.47	15.16	1,000.00
Jarab	11.87	30.28	120.61	51.85	6.27	16.28	968.33
Jipel	16.60	42.16	121.57	52.15	7.73	18.35	1,366.67
Napiya	12.53	22.53	122.40	52.96	7.00	16.57	816.76
Nashelleng	12.53	26.71	118.43	52.72	7.13	16.33	1,500.01
Nibang	15.63	24.17	125.60	54.06	6.80	14.31	866.67
Pelking	5.67	25.54	113.92	51.17	5.93	17.62	633.33
Suhn	10.01	23.97	122.95	56.83	6.07	17.83	1,118.33
Sunpiya	11.93	32.71	125.14	52.50	6.07	15.16	1,365.60
LSD (0.05%)	1.94	7.21	2.23	10.06	8.56	6.32	79.57
CV (%)	29.70	16.01	10.8	9.01	10.34	9.10	15.31

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AGRONOMIC AND MORPHOLOGICAL VARIABILITY IN TUBERS OF WHITE YAM (DIOSCOREA ROTUNDATA) GENOTYPES DEVELOPED THROUGH CLONAL SELECTION OF OPEN POLLINATED SEEDLING POPULATION

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ABSTRACT
The objective of the study was to to select high yam yielding genotypes with distinctive desirable characteristics that will enhance the tubers' market potential. The materials used for the study were tubers weighing between 10 to 25g half-sibs developed from open pollination of Amola, Obiaoturugo, Hembakwasi and Faketsa in 2014. Each tuber is a genotype and was planted on a plot size of 4x5m² at a planting distance of 100 x 45 cm. Results indicated that tubers from clones with planted tuber weight of less than 25g and 25g that produced tubers weighing above 500 to 1000g indicated high yield potential. The variability in the morphological features of the tubers of the clones was an indication that variability existed in the clones and the genetic variability of the clones could be enhance to add value to their marketability, breeding and farming systems.
Keywords: Yield, Morphology, clone, open pollinated and marketability.

INTRODUCTION
Yam is one of the most popular tuber crops in Nigeria and abroad because of its yield potential and high calorific value. It is mainly cultivated almost in all the tropical countries. It is heterozygous cross-pollinated and vegetative propagated tuber (modified stem) crop in which many of the traits show continuous variation. It is the king of all roots and tuber crops. It contains raw protein in fresh storage roots which ranges from maximum 49 to minimum 2.24 per cent on wet basis (Ezeocha et al., 2015) . The starch content in raw tuber varies from 33-73 per cent on dry basis (Ezeocha et al., 2015). In addition to protein and starch some of the yam varieties such as yellow yam provide 1-12 mg carotene per 100 gm of tuber making the tubers more nutritious (Ezeocha et al., 2015). According to Grafuis (2009) increasing total yield would be made easier by selecting for components because the components are more simply inherited than the total yield itself. Thus studies on correlation enable the breeder to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic improvement. The objective of this study was to select high yam yielding genotypes with distinctive desirable characteristics that will enhance the tubers' market potential.

MATERIALS AND METHODS
The study was conducted at western experimental field of National Root Crops Research Institute Umudike. The materials used for the study were tubers weighing between 10 to 25g half-sibs developed from open pollination of Amola, Obiaoturugo, Hembakwasi and faketsa in 2014.. The 53 tubers generated as clones were planted in a unreplicated plots. Each tuber is a genotype and was planted on a plot size of 4x5m² at a planting distance of 100 x 45 cm. The following data were collected: number of plants with .tubers weighing less than 25g, The number of plants with tubers weighing between 25 <500g, number of plants with tubers weighing between >500 <1000g, and number of plants with tubers weighing > 1000g. Data was also collected on tuber morphological characteristics such as smooth surface, hairy, spiny, slender and lengthy tubers and round/ rotund shape tubers.

RESULTS AND DISCUSSION
Percentage of Clone plants with various tuber weight: The weight of tubers from various clone plants and morphological features of the open pollinated hybrid clone of white yam genotypes are presented in Table 1. The result on Table 1 indicated the varying weight of the tubers of the clones. The result classified the clones developed from open pollinated seedlings into 4 various weight populations. The result classified 17 clones with tubers weighing less than 25g representing 29.3% as micro-tubers. Twenty-nine clones with tubers weighing between 25 to less than 500g representing 50% as Mini-tubers while 20 clones weighing more than 500g but less than 1000g representing 34.5% as Seed yams. Nine clones produced tubers with weight above 1000g representing 16.0% classified as Ware tubers. The weight of the clones indicated their yield potentials. Tubers from clones with planted tuber weight of less than 25g and 25g that produced tubers weighing above 500 to 1000g indicated high yield potential, these genotypes multiplies both in plant population and in yield when subjected to minisett techniques (Ezulike et al., 2006), while those weighing between 25 to less than 500g may be regarded as medium yielding genotypes while those with weight less than 25g that produced microtubers are low yielding genotypes with low multiplication ratio..
Morphological features of the tubers: The morphological features of the tubers indicated that thirty-nine clones representing 67.2% have smooth surface texture as distinguishing trait, 13 clones representing 22.4% of the

clones evaluated have hairy surface body while 6 clones which was 10.3% of the total clones tested have tubers with spiny surface texture..

Tuber Shape; Also the tuber lengths and width were used to discriminate against the clones. Fourteen clones representing 24.1% have long slender tubers that are prone to damage during harvest while 44 clones representing 75.9% have rounded body shape that may be regarded as rotund. Genotypes with rotund shape could be further developed since they will be amenable to mechanical harvesting and good candidates for rocky soils or areas with hardpan or impediment less than 30cm soil depth.

CONCLUSION

The variability in the morphological features of the tubers of the clones was an indication that variability existed in the clones developed from open pollinated yam seedling population. Tubers from clones with planted tuber weight of less than 25g and 25g that produced tubers weighing above 500 to 1000g indicated high yield potential. The genetic variability of the clones could be utilized in various food forms, breeding, farming systems and to add value to their marketability.

Table 1: Weight of tubers from clone plants and Morphological features of the open pollinated hybrid clone of white yam genotypes

s/no.	Clone name	Micro-tubers (<25g)	Mini-tubers (>25g <500g)	Seed yams (>500 <1000)	Ware yam {>1kg)	Total tuber number	Smooth skin texture	Hairy surface texture	Spiny surface texture	Slender and Lengthy of tuber	Rotund tuber
1	Cl/001		1			1	1				1
2	Cl/002		1			1	1				1
3	Cl/003		1			1			1		1
4	Cl/004		1			1	1				1
5	Cl/005		1			1				1	
6	Cl/006		2			2		1			1
7	Cl/007		1			1			1		1
8	Cl008		1			1	1				1
9	Cl009		2			2	1				1
10	Cl0010		1			1	1				1
11	Cl/0011		1			1		1			1
12	Cl/00i2	1				1	1				1
13	Cl/0013			1		1	1				1
14	Cl/0014	1				1	1				1
15	Cl/0015			1		1	1			1	
16	Cl/0016	1				1	1			1	
17	Cl/0017				1	1		1			1
18	Cl0018			1		1	1				1
19	Cl0019	1				1	1				1
20	Cl0020				1	1	1				1
21	Cl/021			2		2	1				1
22	Cl/022		2	1		3			1	1	
23	Cl/023				1	1					1
24	Cl/024	1	2			3		1			1
25	Cl/025	1		1		2		1			1
26	Cl/026			2		2	1				1
27	Cl/027	1	1			2	1				1
28	15Cl028	1				1	1			1	
29	Cl029	1				1		1			1
30	Cl030		1		1	2	1				1

Table 1 Contd: Morphological features of the Open pollinated hybrid clone of white yam genotypes

s/no.	Clone name	Micro-tubers (<25g)	Mini-tubers (>25g <500g)	Seed yams (>500 <1000)	Ware yam {>1kg)	Total tuber number	Smooth skin texture	Hairy surface texture	Spiny surface texture	Slender and Lengthof tuber	Round/ Rotund tuber
31	Cl/031			1		1	1				1
32	Cl/032		2			2	1				1
33	Cl/033		2			2	1				1
34	Cl/034			1		1		1			1
35	Cl/035		1			1			1	1	
36	Cl/036			1		1		1			1
37	Cl/037				1	1	1				1
38	Cl038	1				1	1				1
39	Cl039	1				1	1				1
40	Cl040	3				3		1		1	
41	Cl/041			1		1		1			1
42	Cl/042		1			1	1				1
43	Cl/043				1	1			1	1	
44	Cl/044			2		2		1			1
45	Cl/045	1				1	1				1
46	Cl/046		2			2	1			1	
47	Cl/047		1			1	1				1
48	Cl048				1	1	1				1
49	Cl049				1	1	1			1	
50	Cl050			1		1	1				1
51	Cl/051		1			1		1			1
52	Cl/052			2		2				1	
53	Cl/053			1		1			1	1	
54	Cl/054		2			2	1				1
55	Cl/055			1		1	1			1	
56	Cl/056	2				2		1		1	
57	Cl/057		2			2	1				1
58	Cl058				1	1	1				1
	Total	**17**	**29**	**20**	**9**	**81**	**39**	**13**	**6**	**14**	**44**

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FFICACY OF PRE-SOWING SOAKING TREATMENT OF AFRICAN MAHOGANY (AFZELIA AFRICANA SM.) SEEDS ON ENHANCED GERMINATION

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ABSTRACT
Afzelia africana is a multipurpose indigenous leguminous tree of sub-Saharan Africa origin. Nursery trials were conducted to determine effectiveness of pre-sowing soaking of seeds in water, solutions of potassium nitrate (KNO_3) and hydrogen peroxide (H_2O_2) for varying durations as methods of breaking seed dormancy and enhancing germination. Results showed that seeds treated with pre-sowing soaking in H_2O_2 for four hours and 0.1% KNO_3 treatment for three hours had earliest mean day to first germination of 3 days after sowing (DAS) and 5 DAS respectively, as against non-soaked seeds (7.5 DAS) and cool water treatment for 12 hours (7 DAS). Days to 50% germination was markedly reduced to 8 DAS in seeds treated with 0.1% KNO_3 for six hours soaking. Pre-treated seeds in 0.1% KNO_3 solution for 6 hours and in 0.2% KNO_3 solution for 3 hours produced best results of 100% total germination percent by 15 DAS as well as reduced number of days taken to reach total germination. It was concluded therefore that pre-sowing treatment with 0.1% KNO_3 solution for six hours or 0.2% KNO_3 solution for three hours enhances uniform and massive germination of A. africana seeds within earliest possible time of 15 DAS.
Key words: Afzelia africana, germination, propagation, seed dormancy, seed treatment

INTRODUCTION

The African mahogany (Afzelia africana Sm.) is an important multipurpose leguminous tree of sub-Saharan African origin where it is naturally distributed. A. africana belongs to Caesalpinioideae sub-group of the Fabaceae family (Keay, 1989). The species is a large tree, commonly reaching up to 15 m height, but sometimes in more humid localities can grow up to 30 m. Its bole girth spans to 3 m, buttressed and seldom over 16 m long (Burkill, 1994). It is occasionally grown in other tropical countries as ornamental shade tree since the species possesses fragrant white flowers often characterized by purple markings. The tree, as a multipurpose species, holds great potentials in traditional agroforestry systems practice in the humid forest ecological zone of west and central Africa sub-regions. Its habitat is semi-humid savannah, frying forest, Guinea forest and wooded grassland on deep sandy and alluvial soils. Seedlings are sensitive to fine browsing and drought, and therefore need to be protected from these factors until they have fully established (Owonubi and Otegbeye, 2004). A. africana usefulness is versatile. It is known to produce high quality timber, which is termite free but relatively difficult to work. The wood is used for construction, furniture, cooking utensils, canoes and African talking drum, and also for firewood and charcoal. The plant is used in local medicine for general pain relief, digestive problems e.g. constipation and vomiting, and for treating internal bleeding (haemorrhage). Its seeds ('Akparata') are used by the Igbo of southern Nigeria as spices in the preparation of their local soups (Okeke et al., 2009).

Although it is a wide spread species as earlier indicated, it has declined in population. In 1998 it was re-assessed and classified as vulnerable on the IUCN red list of threatened species due to the threat of over exploitation for a number of international market commodity (Owonubi and Otegbeye, 2004; IUCN Red list, 2015). Often times, most of the species produce harvests are from wild stands and protected volunteer stands in farm lands. A. africana is propagated by seed as evidenced by its high natural regeneration capacity; although natural regeneration is not usually abundance because the seeds predation by animal is high. Besides, the species is not fire-resistance and exhibits recalcitrant behaviour in storage. Delayed and irregular germination due to inherent seed dormancy posed serious challenge to the large scale propagation of the species. In the bid to tackle the afore-mentioned constraints, seed pre-sowing treatments have been practiced and recommended in order to achieve high viability of seeds, bring about massive and uniform early germination, as well as improve early seedling vigour and establishment (Alamgir and Hossian, 2008; Asiedu et al., 2012). In this regard, pre-treatment of seeds in solutions of potassium nitrate (KNO_3) and hydrogen peroxide (H_2O_2) were applied to promote dormancy release and increase germination of the seeds. Some gardeners and plant nursery experts choose KNO_3 and H_2O_2 among other options to break seed dormancy and boost seedling vigour, due to its relative affordability and less toxicity in handling in contrast to acid scarification and plant growth regulator gibberellins (Giri and Tamta, 2012; Rouhi et al., 2012]. The present study was conducted to examine the effect of pre-sowing treatment with KNO_3 and H_2O_2 on seed germination parameters (percent, speed and uniformity of germination) of A. africana.

MATERIALS AND METHODS

This experiment was carried out at Tree nursery section in the Department of Horticulture and Landscape Technology, Federal College of Agriculture Ishiagu Ebony State. Coordinates of experimental location showed that the place lies along $05^0 55^0$.096'N latitude; $007^0 33^0$.567'E longitude and elevation of 59m above sea level with average annual rainfall of about 1735.7m and average annual temperature of about 29.4^0C and relative humidity of about 69% during dry season (FCA Agromet, 2015). The experiment was laid out in Completely Randomized Design (CRD) format. There were fifteen treatments replicated three times. The treatments used in this experiment consist of: no soaking (i.e. the control), soaking in cool tap water at ambient room temperature for 6, 12, 24 hours; soaking in 0.1% and 0.2% concentration of potassium nitrate (KNO_3) solutions separately for 3, 6, 12 hours; and soaking in hydrogen peroxide for one to five hours separately. The treated seeds were sown in perforated polyethylene bags (of 40cm x 50cm dimension) filled with sterilized mixture of river sand and saw dust (at ratio 1:1 by volume). Daily germination count was taken every evening for 20 days after sowing (DAS). The following data were generated from the daily germination count for assessment of treatment effects in the experiment: cumulative germination percent across 20 DAS, days to first germination after sowing (DAS), days to fifty percent germination (DAS) and total germination percent at 20 DAS across the various treatments. Data collected were analysed by use of analysis of variance (ANOVA) and cumulative germination frequency, while mean separation was performed, where applicable using least significant difference (LSD) at $p<0.05$.

RESULTS AND DISCUSSION

Daily germination count showed that the pre-sowing treatments had varying impacts on the germination parameters of the Afzelia africana seed. From the cumulative germination percent result, seeds generally commenced germination after 5 DAS, with exception of pre-sowing soaking in hydrogen peroxide for four and five hours that germinated a little earlier (3 DAS), although this exceptional record did not translate into massive germination ultimately (Table 1). Hydrogen peroxide solution might have been used to enhance germination and seedling emergence in certain plants, e.g. wheat (Triticum aestivum) under stress growth conditions (Hung et al., 2005; He et al., 2009), its application in this study seemed to be relatively less effective in releasing seed dormancy, boosting germination and ensuring mass uniform seedling establishment of A. africana. Other treatments that had early germination records at 5 DAS included the seeds soaked in 0.1% KNO_3 for three hours, as well as those soaked in 0.2% KNO_3 for 12 hours and those soaked in hydrogen peroxide for three hours.
Concerning days to fifty percent germination (D50%G), potassium nitrate solutions treated seeds, across the two concentration levels (0.1% and 0.2%) and varying durations of soaking, had the least number of days (9.5 DAS) to attain 50% germination among the different treatments, while seeds pre-soaked in water across the various durations of soaking had most prolonged mean of 13 DAS to 50% germination in relation to other pre-sowing treatments investigated (Table 2). This result agreed with (Akinsoji and Nwana, 2005) as per the ineffectiveness of pre-germination soaking in cool water for enhancing germination in many tree species seeds. Seed dormancy can be overcome by immersing the seed in boiling water and then allowing it to soak for 24 hours as the water cools. This technique, which can be effective in enhancing imbibition and improving germination rates, is not useful for most tree species. Soaking seeds however, in tap water at ambient room temperature is generally ineffective in breaking dormancy (Kattimani et al., 1999; Akinsoji and Nwana, 2005).
Total germination results at 20 DAS showed that most of the seeds in all the treatments had relatively high percent total germination, ranging from 50 to 100% (Table 2). A greater number of seeds pre-soaked in potassium nitrate solutions reached up to 100% germination, with the exception of pre-sowing soaking in 0.1% KNO_3 for 3 hours and 0.2% KNO_3 for 12 hours which gave 93.3% germination at 20 DAS. Comparatively, pre-treated seeds of A. africana in 0.1% KNO_3 solution for 6 and 12 hours and in 0.2% KNO_3 solution for 3 and 6 hours proved to give best results in total germination percent as well as reduced the number of days taken to reach total germination (Table 2). This impressive high germination percent obtained from potassium nitrate treated seeds agreed with similar reports by Giri and Tamta (2012) and Rouhi et al.(2012) who researched on Hedychium spicatum (family: Zingiberaceae) and Tulipa kaufmanniana (family: Liliaceae) respectively.
Akinsoji and Nwana (2005) reported in their work that Albizia lebbeck (family: Fabaceae) seeds pre-treated with sodium nitrate solution at low concentration of 10ppm promoted germination, while higher concentrations suppressed it. In a similar report, Kattimani et al. (1999) showed that pre-sowing seed treatments of Withania somnifera (family: Solanaceae) with nitrates of sodium and potassium at 1.0% concentration for 24 hours were found to significantly increase total germination percent, as well as hasten speed of germination. Moreover, it had been reported that many nitrogen-containing compounds, including NO gas, nitrite (NO_2^-), nitrate (NO_3^-), nitrogen dioxide, ammonium, azide and cyanide enhance dormancy release and subsequent germination in many species, possibly as a means of sensing soil nitrogen availability (Rouhi et al., 2012). Seeds pre-soaked in water for the various durations had recorded between 60% and 85% total germination. Remarkably, an inverse relation

was observed between duration of pre-sowing soaking in water and the germination parameters of day to first germination, day to fifty per cent germination and total germination percent at 20 DAS.

CONCLUSION

Comparison of the total germination percent, mean days to fifty percent germination (i.e. germination speed) and mean days to first germination in relation to the various pre-sowing seed treatments showed very remarkable differences of relevance to seedling multiplication Afzelia africana. A greater number of seeds pre-soaked in potassium nitrate solutions reached up to 100% germination by 20 DAS; however pre-treated seeds of A. africana in 0.1% KNO_3 solution for 6 hours and in 0.2% KNO_3 solution for 3 hours proved to give best results in terms of total germination percent as well as reduced number of days taken to reach total germination of the seed lot. It was therefore concluded from the results that pre-sowing treatment with KNO_3 solutions at the given concentration in either duration of soaking had proved to enhance uniform and massive germination performance of A. africana seeds within earliest possible time of 15 DAS.

Table 1: Cumulative percent germination of Afzelia africana seeds under control, water, potassium nitrate (KNO_3) solution and hydrogen peroxide (H_2O_2) pre-soaked seed treatments.

DAS	Control	Water			KNO_3 0.1%			KNO_3 0.2%			H_2O_2				
	0hr	6hr	12hr	24hr	3hr	6hr	12hr	3hr	6hr	12hr	1hr	2hr	3hr	4hr	5hr
0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
5	0	0	0	0	20	0	0	0	0	13	0	0	10	25	15
10	53	51	48	45	53	80	33	73	67	93	40	45	45	45	60
15	93	85	73	60	93	100	100	100	100	93	50	50	50	50	65
20	93	85	73	60	93	100	100	100	100	93	50	50	50	50	65

DAS = Day after sowing; hr = hour

Table 2: Afzelia africana germination parameters responses to various pre-sowing treatments

	Control	Water			KNO_3 0.1%			KNO_3 0.2%			H_2O_2				
Parameter	0hr	6hr	12hr	24hr	3hr	6hr	12hr	3hr	6hr	12hr	1hr	2hr	3hr	4hr	5hr
DFG	7.4	7.2	7.7	8.3	5.3	8	10.7	8	7.3	6.7	8	7	5.8	5	5.5
D50%G	10	9.5	18.5	11	9	8	12	10	10	8	15	12	12	13	8
TG%	93	85	73	60	93	100	100	100	100	93	50	50	50	50	65

DFG = Day to first germination sowing; D50%G = Day to 50% germination; TG% = Total germination at twenty days after sowing; hr = hour

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STUDIES ON THE INCIDENCE OF MELOIDOGYNE INCOGNITA INFECTION AND YIELD OF SOME VARIETIES OF YAM

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ABSTRACT
Field experiment was carried out in the Teaching and Research Farm of College of Agronomy, University of Agriculture, Makurdi to evaluate five rotundata varieties (TDr 95/18531, TDr 96/01168, TDr 96/01799, TDr 96/01395 and TDr 98/01164) for yield and determine their response to the root-knot nematode attack. Results showed that the five rotundata varieties were significantly different in percentage emergence and crop vigour (growth parameters). However, agronomic characteristics (tuber shape, texture, etc) and yield attributes (number of stands at harvest, number of seed and ware tubers/plot, total fresh tuber yield/plot) were not significantly different for the varieties. The mean values for yield parameters showed that TDr 96/01395 gave the highest yield both in ware tubers and total fresh tuber yield while TDr 96/01799 gave the lowest yield. There was variation in the degree of galling which was observed as the symptoms of the root-knot nematode attack on the tubers. It varied from gall to lesions and excessive root branching. The five varieties showed evidence of susceptibility to the root-knot nematode – Meloidogyne spp. Results of these studies showed that, yam plots could be treated before planting, or susceptible yam varieties be treated, or resistant yam varieties planted for adequate protection against Meloidogyne spp.
Keywords: yam varieties, yield, meloidogyne incogmita, infection

INTRODUCTION
Root-knot nematodes, Meloidogyne spp. (Kofoid and white) are important pest of edible yams, Dioscorea spp, wherever they are grown (Bridge, 1982; Nwauzor and Fawole, 1982). If preplant populations of root-knot nematodes are high enough, plant growth and tuber yield are severely affected. Infected tubers are galled and flaky and may develop abnormal rootlets, especially after a period of storage (Jenkins and Birds, 1962). The deformity and consequent unattractive appearance of infected tubers reduce their market value. More important, however, root-knot nematode-infected tubers in storage lose weight rapidly and are highly prone to secondary infection by fungi such as Aspergillus niger van Teigh and Penicillium selerotigenum Yamomoto. This results in a considerable reduction in the edible portion of the tubers or, in severe cases, the total loss of the stored tubers. Infected tubers also contain fewer pharmaceutically useful steroids such as diosgenin. Jenkins and Bird (1962) reported the formation of "stone cells" in infected storage tubers which were composed of a mature female and egg mass enclosed in wound periderm. Root-knot nematodes complete their life cycle in the yam tuber and egg remains viable even after a 3 – 4 month storage period (Nwauzor and Fawole, 1982).
Yam (Dioscorea spp. L) constitutes one of the most important food crops in the tropics and a most important group of staple foods in West Africa (Coursey, 1967). There are between 300 and 600 species of Dioscorea, of which only a few are edible. The four most commonly cultivated are water yam (D. alata L.) yellow yam (D. cayenensis Lam.), Chinese yam (D. esculenta [Lour.] Burk.) and white yam (D. rotundata poir). D. cayenensis and D. rotundata are indigenous to West Africa; D. alata and D. esculenta are native to Asia. D. rotundata is the most important species of yams in Africa, followed by D. cayenensis. Yams are grown as annual crop. The underground stem tuber is the economically important part of the plant and also the planting material. Yams are adapted to fairly high rainfall areas with distinct dry seasons of not more than 5 months. Nematodes damage yam tissues by their feeding activities and also create micro-wounds through which secondary pathogens (fungi and bacteria) can enter and cause complete yam decay during storage (Bridge, 1972). Such post-harvest losses account for a reduction of about 26% in world yam production (Coursey and Booth, 1972). Root-knot nematodes are the most serious nematode pests of numerous food crops in the tropics. It was in recognition of the involvement of the root-knot nematodes in world food production that the international Meloidogyne project was founded in 1976 with the sole objective of establishing the role of root-knot nematodes in food production, and more importantly, finding ways of reducing crop loss due to these pests.
There is currently reduction in the quality and quantity of yam tubers due to attack by the yam nematodes, and in particular the root-knot nematode. In Nigeria, M. incognita is the major specie that attack yams. Losses of more than 80% within a storage period of 16 weeks have been reported. Also, no matter the degree of the infection by the root-knot nematode, market value is lost because the body of the tuber is disfigured. The objective of this study therefore, was to evaluate rotundata varieties for yield and susceptibility to the root-knot nematode (M. spp), with the intent to research into possible control options should these varieties be susceptible.

MATERIALS AND METHODS

Experiments were conducted in the field to investigate the yield and incidence of the root-knot nematode (Meloidogyne incognita). The crops used for the study were TDr 95/18531, TDr 96/01168, TDr 96/01799, TDr 96/01395 and TDr 98/01164.

Infected field served as source of inoculum. M. incognita was extracted from the soil using the modified Baermann funnel extraction method (Whitehead and Hemmings, 1965) of supporting the material to be extracted on a plastic sieve of about 6 to 8cm diameter and 2cm deep. Paper tissues were then place on the sieves and the chopped yam peel or finely crumbled soil samples put in them. The sieves with the materials to be extracted were placed in water in extraction trays. Overnight, the sieves were gently remove and the content of the dishes examined for nematodes. The dishes can be reimmersed in fresh water for further extraction. This is necessary only when extracting from tubers.

Yams in the field were artificially infested using infected soils for which the nematode content had been estimated. The field trial was carried out during the months of May – December, 2015 in the Teaching and Research Farm of the College of Agronomy, University of Agriculture, Makurdi. The trial involved observing of yam varieties for yield and reaction to the root-knot nematode attack. The plot was cleared and ridges and mounds were made ready for planting. The experiment was a Randomized Complete Block Design with the treatments replicated three times.. One seed tuber per stand was planted. Plant population per plot was 20 (60 for 3 replicates). Mean weight of sett was 200g. Plots were hand-weeded to control weeds. NPK fertilizer application was done at the rate of 30g per mounds (300Kg/ha) eight weeks after planting where more than 60% of stands have emerged. Preplanting soil samples from the inocula field were taken and accessed for nematode occurrence and abundance by the modified Baermann technique as described before. Approximately 500 to 550m M. incognita adult and juvenile were sampled per plot. At harvest, matured tubers upon visual, qualitative inspection were rated for severity of disease symptoms (degree of galling) on a 0 – 5 scale according to the method described by Taylor and Sasser (1978).

R.G. Index	% Damage
0 -	No damage (immune)
1 -	0 – 5% (highly resistant)
2 -	6-25% (fairly resistant)
3 -	26 – 50% (fairly susceptible)
4 -	51 – 75% (susceptible)
5 -	76 – 100% (highly susceptible)

Infected tubers were characterized by gallings or swellings on the tubers. At harvest, agronomic and yield parameters – establishment count at 4WAP, 8WAP, crop vigour at 8WAP, 12WAP; number of stands at harvest, number of seed tubers harvested per plot, number of ware tubers harvested per plot, tuber shape, tuber surface texture, thorniness of tuber, yield of ware tubers (above 1kg) in kg/plot, number of rotten tubers per plot and total fresh tuber yield (kg/plot) were recorded. Data obtained from the field were analyzed using Generalized Linear Model procedure and the means were separated by Duncan's Multiple Range Test (DMRT). Analysis of variance (ANOVA) was used to test the hypothesis that there was no difference in yield, visible symptoms of infection and level of infestation by the nematode on the tubers.

RESULTS AND DISCUSSION

The five rotundata varieties showed significant differences in emergence at 4 weeks after planting (4WAP) and 8 weeks after planting (8WAP). TDr 95/18531 variety gave the highest percentage emergence of 67.33 at 4WAP while TDr 96/01168 variety gave the highest percentage emergence of 96.67 at 8WAP. The lowest percentage emergence at 4WAP was produced by TDr 98/01164 with 52.67% while at 8WAP TDr 96/01799 gave the lowest percentage as 76.00% (Table 1). TDr 95/18531 and TDr 96/01395 showed no difference in crop vigour both at 8 WAP and 12 WAP as shown in the Table 1 with vigor indices 3.00a and 5.00a respectively. Vigour score 3 and 5 indicates moderate to high vigor for the two varieties. Yam varieties TDr 96/01168, TDr 96/01799 and TDr 98/01164 had crop vigour 2.00b and 4.00b at 8 and 12 WAP were respectively, indicating low to high vigor (Table 1).

Attributes like tuber shape, tuber surface texture and thorniness of tuber had the same mean values of 1.00 hence, no significant differences were recorded among the varieties (Table 2). The mean score 1.00 for the three attributes suggests that all the yam varieties evaluated had very good shape, good tuber surface and had no thorns. No rotten tubers were observed among the five varieties, which suggests that the varieties might possess some resistance against rot pathogens. The yam varieties had nematode root gall index of 3-4 range. This indicates that all the varieties were either fairly susceptible or susceptible to nematode infestation (Table 2). The disease symptoms observed on the plots were galls and lesions on the tubers, and excessive root branching at varying degrees. The characteristics multiple heavy galls observed all over the tuber of infected varieties conform with the symptoms of Meloidogyne incognita infection.

TDr 95/18531 and TDr 96/01395 had the highest number of stands at harvest of 92.67 and 91.00 respectively. These were significantly higher than the number of stands at harvest of TDr 96/01168 (77.67), TDr 96/01799 (79.33)and TDr 98/01164 (77.67) (Table 3). The five varieties were not significantly different in number of seed and ware tubers/plot and yield of ware tubers/plot. Number of seed tubers/plot however ranged between 22.00 and 30.33, while number of ware tubers/plot and yield of ware tubers/plot also ranged between 9.00 and 14.33, and 15.67 and 25.67, respectively (Table 3). The observed lack of variation among the five rotundata varieties for the three yield components could be as a result of the fact that all the five varieties must have been developed for high yield Breeding for high yield through improving yield components is a primary objective of yam breeders. As for total fresh tuber yield (kg/plot), only TDr 96/01799 with yield of 25.07 kg/plot had significantly lower yield compared to others. The yield of the remaining four varieties ranged between 26.43 and 34.70 kg/plot. The variation in percentage emergence shows that there is great variation in rate of sprouting among cultivars and consequently their potentials differ for seed yam production. This disparity observed agreed with Bridge (1972). The characteristic multiple galls observed in this study agrees with work of Nwauzor and Fawole (1982) who estimated the possibility of 100% crop loss resulting from M. incognita infestation in field situations. In study by Sasser (1977) to evaluate seven varieties of hybrid yams, varietal differences were observed in tuber yields and susceptibility to the root–knot nematode (Meloidogyne spp). In a similar experiment on screening of new yam clones (D. alata and D. rotundata) in nematode prone ecology, significant higher values were observed for meloidogyne spp occurrence on the tubers of D. rotundata than D. alata in every year of experimentation. Meanwhile, no significant difference was observed for the occurrence of S. bradys in both groups of yam.

CONCLUSION

Result of this trial shows that more yam varieties especially D. rotundata are joining the class of "nematode susceptible". It is therefore necessary to speed up research in control strategies or management to guard against yield and quality loss.

Table 1: Growth parameters of five rotundata varieties evaluated in Makurdi in 2015.

Varieties	% Emergence		Plant Vigour	
	4WAP	8WAP	8WAP	12WAP
1. TDr 95/18531	67.33a	94.33b	3.00a	5.00a
2. TDr 96/01168	60.67b	96.67a	2.00b	4.00b
3. TDr 96/01799	59.33c	76.00e	2.00b	4.00b
4. TDr 96/01395	57.00d	91.67c	3.00a	5.00a
5. TDr 98/01164	52.67e	82.33d	2.00b	4.00b

- Means with the same letter in a column are not significantly different.

WAP = Weeks After Planting

Plant Vigour (1= weak, 5 = very vigorous).

Table 2: Agronomic characteristics of five rotundata varieties evaluated in Makurdi in 2015.

Varieties	Tuber shape	Tuber surface texture	Thorniness of tuber	No. of Rotten tubers	Root-Gall Index
1. TDr 95/18531	1.00a	1.00a	1.00a	0.00a	3.00a
2. TDr 96/01168	1.00a	1.00a	1.00a	0.00a	4.00a
3. TDr 96/01799	1.00a	1.00a	1.00a	0.00a	3.67a
4. TDr 96/01395	1.00a	1.00a	1.00a	0.00a	3.67a
5. TDr 98/01164	1.00a	1.00a	1.00a	0.00a	4.00a

- Means with the same letter in a column are not significantly different.

Tuber shape (1 = very good; 2 = very poor)

Tuber surface texture (1 = smooth, 2 = rough)

Thorniness of tubers (1 = absent, 2 = present)

Table 3: Yield of five rotundata varieties evaluated in Makurdi in 2015.

Cultivars	% Stand at harvest	No. of seed tubers/plot	No. of ware tubers/plot	Yield of ware tubers (kg/plot)	Total fresh tuber yield (kg/plot)
TDr 95/18531	92.67a	25.67a	14.33a	22.77a	30.43a
TDr 96/01168	77.67b	22.00a	11.33a	19.67a	27.57a
TDr 96/01799	79.33b	30.33a	9.00a	15.67a	25.07b
TDr 96/01395	91.00a	26.00a	14.33a	25.67a	34.70a
TDr 98/01164	77.67b	28.00a	10.33a	18.33a	26.13a

- Means with the same letter are not significantly different.

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EFFECT OF INBREEDING DEPRESSION ON AGRONOMIC TRAITS IN SEEDLING AND CLONAL STAGES OF CASSAVA

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ABSTRACT
A study to assess the performance of S_1 progenies of five African cassava varieties (TMS 30572, TME 419, TMS 98/0505, TMS 01/1371 and TMS 98/0002) for agronomic traits was conducted in seedling evaluation and clonal evaluation trial stages. The average ID obtained in both stages indicated that harvest index, dry matter content and vigour were not severely affected in performance. The average trait value for plant height in the S_1 was not reduced implying no inbreeding depression for this trait. The effects of ID were highest in fresh root yield and fresh foliage yield which are relatively much more complex traits than others. Reduced heterozygosity associated with selfing (S_1) appeared to have strong effects on both traits thus underscoring the relative importance of non-additive genetic effects in their inheritance. For each trait, results identified individual S_1 genotypes that substantially outperformed the non-inbred parents likely representing transgressive segregants for favorable allele combinations. This was observed mainly for plant height, dry matter content and vigour where ID values were lower. These genotypes were therefore used further to generate an S_2 population.
Keywords: Inbreeding depression, conal stages, selfed cassava, traits

INTRODUCTION
Cassava (Manihot esculenta Crantz) is among the most important sources of energy in the diet of most tropical countries of the world. It is also becoming an important source of raw material for different industries. Therefore, it is vital to develop information about the genetic structure and the inheritance of relevant traits. Inbreeding is the reproduction from the mating of two genetically related parents, which can increase the chances of offspring being affected by recessive or deleterious traits. This generally leads to a decreased fitness of a population, which is called inbreeding depression. Cassava, as a typical cross-pollinated species, shows severe inbreeding depression (Rojas et al., 2009). Nonetheless, it is encouraging to observe that interest in cassava inbreeding is beginning to gain momentum (Ceballos et al., 2004, 2007; Rojas et al., 2009). Certainly, it would be prudent in cassava to tap into the benefits of inbreeding as witnessed in maize. Inbreeding provides an opportunity to exploit both additive and non-additive effects (Rojas et al., 2009). It is envisaged that inbreeding in cassava will provide several advantages including: reduction of genetic load which limits attainment of sustainable genetic progress, increased probability of increasing the expression of useful recessive traits, facilitation of the implementation of mutation breeding and allows implementation of backcross scheme (Ceballos et al., 2004). We report results obtained from quantifying inbreeding depression in cassava.

MATERIALS AND METHODS
Seed production
Five of the African cassava varieties (TMS 30572, TME 419, TMS 98/0505, TMS 01/1371 and TMS 98/0002) were obtained from the germplasm of International Institute of Tropical Agriculture, (IITA) Ibadan. These five african cassava varieties were used as progenitors (S_o) to generate S_1 progenies

Establishment of the seedling evaluation trial
After two months in the nursery, S_1 seedlings were transplanted to a well-prepared field where they were grown and evaluated. Harvesting was done at 12 months after planting, after which they were cloned to generate at least 10 stem cuttings per seedling for clonal evaluation trial.

Establishment of the clonal evaluation trial
In the clonal evaluation trial, each S_1 genotype was represented by ten plants, which were established in the field for evaluation. All progeny belonging to the same family, together with the parents, were established in the same block. Each row represented a clone and spacing within rows was 1 m, with between row spacing of 1.5 m to minimise inter-plot interference. The parental clones served as checks or controls. Evaluation was conducted in a single location, using augmented experimental design (AED) Federer (1956).

Data collections
During the growth period, the plants were evaluated for vigour at 1, 3, 6, 9 and 12 Months After Planting (MAP). Vigour was scored based on the scale of 1-5; where 1= very weak (plants somewhat stunted with very thin stems), 2= weak (thin stem), 3= intermediate (moderately growing), 4 = vigorous (fast growing and no bending), 5= extra vigourous (very fast growing, strong and no bending) (IITA, 1990).

At harvest (12 months after planting), plant height (cm) was measured from the soil level to the highest apical point of the plant at harvest time; eight innermost plants per clone were uprooted and used for phenotypic assessments. Roots were separated from the vegetative harvestable biomass (leaves, stems and original planting stake) and independently weighed with a weighing balance. Fresh root yield and fresh foliage yield (kg $plant^{-1}$) were computed. Harvest index (root biomass as proportion of total biomass) was computed for each clone following the procedure outlined by Kawano (1990). Estimation of Dry Matter Content (DMC) (measured as a percentage) in the root samples, were determined by the specific gravity method as suggested by Kawano et al., (1987).

$$Specific\ gravity = \frac{Weight\ in\ air}{Weight\ in\ air - Weight\ in\ water}$$

$$DMC = 158.3\ specific\ gravity - 142.0 \text{ (IITA, 1990)}$$

Inbreeding depression (ID) was estimated for plant height, vigour, fresh root yield, fresh foliage yield, harvest index and dry matter content as a percentage of the S_1 average. The ID was obtained following the equation suggested by (Rojas et al., 2009)

$$ID = \frac{S_0\ mean - S_1\ mean}{S_0\ mean} \times 100$$

Inbreeding depression was also measured at the family level. Therefore, the lower the ID value, the lower the depression, which implies that the performance of the S_1 progenies is close to that of the S_0 progenitor.

RESULTS AND DISCUSSION

Phenotypic measurements for key breeding traits were made at the seedling and clonal evaluation trial stages. Results of phenotypic assessment of the families revealed some superior S_1 clones which were found to substantially outperform their S_0 progenitors. This was particularly observed for the following traits: plant height, dry matter content (DMC) and vigour. The result indicates that breeders can explore inbreeding for these traits at early stages of the selfing cycle in the breeding scheme. By implication it shows that genetic progress can be achieved through inbreeding for these traits. The results demonstrated that inbreeding can be strategically explored in breeding to increase genetic gain and identify recessive traits.

Considerable variations in ID were observed among S_1 progenies for morphological/ architectural traits with highest ID ranging from 0.56% in plant height to 46.47% for vigor. Agronomic traits result revealed high ID with for fresh root yield being the highest (53.05%) (Table 1). ID observed for other agronomic traits were 38% for fresh foliage yield and 22% for harvest index (Table 1). The effects of ID tended to be relatively higher for the much more complex traits given their polygenic character. Reduced heterozygousity associated with selfing (S_1) appeared to have strong effects on fresh root yield and foliage yield thus underscoring the relative importance of non-additive genetic effects in their inheritance. Some transgressive segregants were observed in the population at S_1. This was observed mainly for plant height, dry matter content and vigour where ID values were lower.

Generally, inbreeding depression was higher in seedling nursery compared to the clonal evaluation trial (CET) stage for fresh root yield, fresh foliage yield, harvest index and dry matter content. In the seedling stage, cassava is raised from seeds while stem cuttings were used as planting materials at the CET. Seeds typically produce plants with fewer and smaller tubers than those raised from the stem cuttings (clonal stage) (Department of Agriculture, Forestry and Fisheries, 2010) (Table 1).

CONCLUSION

Inbreeding was not severe in the S_1 for morphological and architectural traits. The occurrence of some transgressive segregants in the population for key strategic traits of the crop is indicative of favorable allele combinations at S_1. The results therefore demonstrate that inbreeding can be strategically explored in breeding for these traits to increase genetic gain and possibly identify recessive traits. Inbreeding depression for plant height in this study was much lower than for fresh root yield. For cassava, fresh root yield involve many genes, it is the result of the activity of the whole genome while plant height is a characteristic controlled by fewer genes.

Table 1: Inbreeding Depression values (ID), as a percentage of the performance from the S_0 generation measured in five S_1 Cassava Families based on the yield data from two stages

Family	Plant height (cm)	FRY	FFY	HI	DMC	Vigour
Seedling Nursery Stage						
TME 419	-78.53	91.84	63.73	40.70	11.41	27.50
TMS 01/1371	-4.98	74.38	42.50	26.46	4.81	-3.03

TMS 30572	-6.67	89.31	73.17	28.86	20.28	44.44
TMS 98/0002	-41.30	88.31	61.85	35.32	18.24	15.00
TMS 98/0505	4.00	88.89	90.63	-4.63	16.85	20.25
Average	**-25.49**	**86.55**	**66.38**	**25.34**	**14.32**	**20.83**
Clonal Evaluation Stage						
TME 419	-5.76	69.89	7.56	34.24	10.03	30.76
TMS 01/1371	-4.10	31.00	38.72	19.29	-2.75	1.71
TMS 30572	-15.15	60.76	67.44	10.42	9.52	46.47
TMS 98/0002	-8.04	60.98	32.19	34.34	6.80	28.95
TMS 98/0505	0.56	42.61	44.20	11.30	-3.18	33.20
Average	**-6.50**	**53.05**	**38.02**	**21.92**	**4.08**	**28.22**

FRY = Fresh Root Yield (Kg pl^{1}); FFY = Fresh Foliage Yield (Kg pl^{1}); HI= Harvest Index; DMC = Dry Matter Content (%)

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EFFECT OF WEEDING REGIME ON GROWTH AND YIELD OF SWEET MAIZE (Zea mays L. sub spp. Saccharata) IN GANYE, ADAMAWA STATE, NIGERIA

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ABSTRACT

Field experiment was conducted at the Teaching and Research Farm of Adamawa State College of Agriculture Ganye, to evaluate the growth and yield performance of sweet corn under different weeding regimes during the 2012 and 2013 raining seasons. The weeding regime consisted of one weeding at 3 weeks after sowing (WAS) only, two weedings at 3 and 6 WAS, three weedings at 3, 6 and 9 WAS and unweeded check as control. The experiment was fitted in a randomized complete block design (RCBD) and replicated four times. Results indicated that weed dry weight, plant height, leaf area and number of leaves per plant were not significantly influenced at sampling period of 3 WAS in both seasons. At 6 and 9 WAS however, increased weeding regime from control significantly reduced weed dry weight and increased plant height, leaf area and number of leaves per plant in both seasons. Similarly, number of days to 50% tasseling and silking reduced significantly with increased weeding regime in both years, but increased number of grains per cob and 1000-grain weight in both seasons and the combined analysis. Increasing weeding regime to three in 2012 season significantly increased grain yield of 1562kgha^{-1}. In the 2013 season and the combined analyses however, two weedings at 3 and 6 WAS produced grain yield of 1439.0kgha^{-1} in 2013 and 1464.0kgha^{-1} in the combined analysis respectively, which out-yielded other treatments except three weeding regime and could therefore be the recommended weeding regime from this study.

Keywords: weeding regime, growth, yield, sweet corn, Ganye.

INTRODUCTION

Maize (*Zea Mays L.*), also known as corn belongs to Poaceae family and ranks third after wheat and rice in world production and popularity (Dugje et al, 2010). Maize production is also generally gaining popularity in Nigeria as its cultivation transforms from mere subsistence to commercial. However, sweet corn (spp. saccharata) is mostly produced for fresh consumption with its sweet, tender and immature pericarp (Hardenbug et al., 1986).

Weeds by their nature are plants, naturally adapted to certain local environment which tends to interfere with crop performances through competition for space, nutrient, water and light in order to thrive at the expenses of our defined edible crops (Zeenshan, 2003). It has been reported that small, slow growing plants (seedlings) are more likely to suffer from weed interference than the larger and more vigorous ones, thus early weed-crop competition tend to have more adverse effect on crop growth and yield (Akobundu, 1987). Lambart and Anaso (1980) also reported that weed infestation reduce maize nutrient quality by about 63-84%.

Although the consequences of weed-crop field competition has always been reported and documented, the approach that integrates weed frequency and critical stage of crop development together to achieve optimum crop performance is still poorly understood in most weeding schedule, thus the need to undertake this experiment.

MATERIALS AND METHODS

The experiment was conducted during 2012 and 2013 rainy seasons at the Teaching and Research Farm of the Department of Agricultural Technology, Adamawa State College of Agriculture, Ganye. This study area forms part of northern Guinea Savanna agro ecological zone in Nigeria, with soil textural classes of clay-loam in both seasons and total annual rainfall of 877.3 mm and 1363.3 mm during 2012 and 2013 cropping seasons respectively.

The treatments consisted of four weeding regimes (3 WAS, 3 and 6 WAS, 3, 6 and 9 WAS and unweeded check), arranged in a randomized compete block design (RCBD) and replicated four times. Two to three seeds from locally sourced variety of sweet corn ("Bataji") were hand-sown on 2nd and 4th June, 2012 and 2013 rainy seasons respectively at the spacing of 75cm x 25cm on well prepared seed beds measuring 4.0x4.0m each over-seeded holes were later thinned to two per hole at first weeding.

Data on weed dry weight, plant height, leaf of area and number of leaves per plant respectively were taken at 3, 6 and 9 WAS before weeding schedules, and days to 50% tasseling and silking were taken when 50% of plant population in each plot attained tasseling and silking. However, number of grains per cob, 1000-grain weight and grain yield per hectare were evaluated at harvest. Data was subjected to statistical analysis of variance (ANOVA) to determine the level of significance between treatment means as described by Little and Hills

(1978), and the difference between treatment means were evaluated using Duncan's multiple Range Test Duncan, 1955).

RESULTS AND DISCUSSION

Results from the experiment generally indicated that weed dry weight, plant height, leaf of area and number of leaves per plant were not all significantly influenced at 3 WAS in both seasons. From Table 1 however, weed dry weight was higher at unweeded check (control), which reduced significantly with increased weeding regime from control experiment in both seasons, as plant heights increased with increasing weeding regimes at 6 and 9 WAS in both years.

Table 2 indicated similar increase in leaf area and number of leaves per plant respectively, as weeding regime increased to three (3, 6 and 9 WAS). However, difference in number of leaves per plant among all weeding regimes were not statistically significant in both seasons except at 9 WAS in 2012 season. Similarly difference in leaf area per plant among second weeding (3 and 6 WAS) and third weeding were not significant during the sampling of 6 WAS in 2012 season.

Table 3 however, indicated significant reduction in number of days to 50% tasseling and silking as weeding regime increased in both seasons. In days to 50% silking, all weeding regime except the unweeded check (control) recorded statistically similar reduction in both seasons. Number of grains per cob however increased as weeding regime increased to two, after which there was no significant increased in both seasons and the combined analysis (Table 3).

Results from Table 4 also indicated that at three weeding regime of 3, 6 and 9 WAS, 1000-grain weight was highest and out-weighed other weeding regimes and control experiment in 2012. Same trend was observed in the combined analysis. Similarly, three weeding regime treatment produced statistically higher yield per hectare which out-yielded all other treatments and control experiments in 2012 season. In 2013 season and combined analyses however, two weeding regime 3 and 6 WAS produced statistically similarly grain yield per hectare with three weeding regime of 3, 6 and 9 WAS, which out-yielded one weeding regime at 3 WAS only and the unweeded check.

However, improved performance of growth parameters at later sampling periods of 6 and 9 WAS was due to increased weed-free condition which conserved more soil moisture, nutrients and oxygen for crop use and increased photosynthesis ability. Similarly, increased performance of yield and yield parameters and early 50% tasseling and silking were all attributed to reduced weed interference (Zeenshan, 2003), through increased weeding schedule.

It is also more likely that the most critical phase for growth and physiological development that will improve yield performance in maize coincided with weed free condition, provided by two weeding scheduled at 3 and 6 WAS only in this experiment. Thus 1000-grain weight, number of seeds per cob and grain yield per hectare improved significantly as reported by Mahdi et al, (2010) and Mustapha and Bayo (2010).

CONCLUSION

Weeding regime has significant influence on many important agronomic attributes of sweet maize. While increasing weeding regime significantly reduced weed dry weight, 2-3 weeding regimes significantly increased grain yield. Weeding sweet maize field 2- times will be a good recommended practice for sweet maize production provided labour cost is low.

Table 1: Effects of weeding regime on weed dry weight and plant height of sweet maize at different sampling periods in Ganye during 2012 and 2013 rainy seasons.

Treatment	Weed dry weight (g)						Plant height (cm)					
	2012			2013			2012			2013		
Weeding regime	**3**	**6**	**9 (WAS³)**	**3**	**6**	**9 (WAS³)**	**3**	**6**	**9 (WAS³)**	**3**	**6**	**9 (WAS³)**
No weeding	12.2	30.2a	32.6a	14.5	32.4a	52.6a	13.2	29.7b	129.3c	49.8	37.6b	113.0c
3 WAS only	12.0	28.6b	32.5a	14.2	27.2b	44.1b	13.8	31.1a	134.8b	29.4	44.1a	118.5b
3 and 6 WAS	11.2	24.9c	31.0b	14.4	26.9b	34.1c	13.9	31.1a	134.8b	30.9	44.1a	123.6a
3, 6 and 9 WAS	12.1	21.6b	27.5c	14.3	24.8c	32.2c	14.1	31.7a	138.6a	33.0	48.2a	126.4a
S±	NS	1.3	2.1	NS	1.3	24.6	NS	2.1	6.8	NS	24.6	22.4

1 = Means followed by the same letter(s) in the same column are not significantly different at 5% level of probability using DMRT.

2 = Not significant at 5%

3 = Weeks after sowing

Table 2: Effects of weeding regime on leave area per plant and number of leaves per plant of sweet maize at different sampling periods in Ganye during 2012 and 2013 rainy seasons.

Treatment	Leaf area per plant (cm^2)						Number of leaves per Plant					
	2012			2013			2012			2013		
Weeding regime	**3**	**6**	**9 (WAS³)**	**3**	**6**	**9 (WAS³)**	**3**	**6**	**9 (WAS³**	**3**	**6**	**9 (WAS³)**
No weeding	89.2	168.9b	180.7d	74.4	64.4d	170.5d	3.9	6.3b	8.6c	4.7	9.3b	9.2b
3 WAS only	89.5	170.1b	182.9c	80.2	165.8c	176.7c	4.2	6.6b	11.2b	4.9	10.6a	11.0a
3 and 6 WAS	89.0	174.4a	185.9b	83,5	177.6b	192.6b	4.3	6.8b	12.2b	5.2	10.4a	11.0a
3, 6 and 9 WAS	89.6	175.3a	187.8a	83.1	182.8a	197.5a	3.8	7.5a	12.8a	5.2	10.8a	11.4a
S±	NS	3.0	3.9	NS	3.0	3.9	NS	1.1	0.9	NS	1.2	1.4

1 = Means followed by the same letter(s) in the same column are not significantly different at 5% level of probability using DMRT.
2 = Not significant at 5%
3 = Weeks after sowing

Table 3: Effects of weeding regime on number of days to 50% tasseling, days to 50% silking and number of grains per cob of sweet maize at Ganye, 2012 and 2013 seasons.

Treatment	Days to 50% tasseling		Days to 50% silking		Number of grains per cob		
Weeding regime	2012	2013	2012	2013	2012	2013	Combine
No weeding	58.8a	65.9a	66.3a	76.2a	226.7c	220.1c	223.4b
3 WAS only	58.7a	64.9ab	64.8b	75.6a	228.3b	226.7b	227.b
3 and 6 WAS	58.1ab	64.7a	64.3b	73.5b	231.6a	259.7a	245.7a
3, 6 and 9 WAS	57.5b	64.3b	63.8b	72.3b	230.9a	255.1a	243.0a
S±	0.9	1.8	2.0	4.1	25.9	32.8	17.7

1 = Means followed by the same letter(s) in the same column are not significantly different at 5% level of probability using DMRT.

2 = Weeks after sowing

Table 4: Effects of weeding regime on 1000-grain weight and grain yield per hectare of sweet maize at Ganye 2012 and 2013 seasons.

Treatment	1000-grain weight			grain yield per hectare		
Weeding regime	2012	2013	Combine	2012	2013	Combine
No weeding	121.1b[1]	130.2b	125.7b	1312.0c	1237.0b	1275.0c
3 WAS only	124.8b	154.3a	135.5a	1414.0b	1279.0b	1346.0b
3 and 6 WAS	129.3b	155.3a	142.3a	1488.0b	1439.0a	1464.0a
3, 6 and 9 WAS	132.7a	156.8a	144.7a	1562.0a	1455.0a	1509.0a
S±	17.3	83.6	15.9	735.6	292.4	139.8

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EFFECT OF COLCHICINES ON FLOWERING, FRUITING AND BOTANICAL SEED PRODUCTION IN CASSAVA

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ABSTRACT
Five high yielding cassava varieties with good agronomic and disease resistance characters were induced to improve their productivity using colchicine. The experimental materials were evaluated under both green house and field situations in a randomized complete block design replicated three times. Data collected were statistically analyzed. The results from the field showed that cassava varieties treated with colchicines at Level 4 significantly affected most of the physiological characters such as the leaf area index, number of seeds and the girth. While Level 2 of the treatment gave the highest number of leaves, other parameters were not significantly affected. Cassava mosaic disease the most common and yielding reducing disease was not affected by the treatment

Keyword: induction, mutagen, potentials, botanical seeds

INTRODUCTION
Cassava has a great potential of becoming a sustainable food, industrial and a renewable sources of energy crop in SSA Scott et al (2000) and Cock 1985. Most of these potential are locked up and remained untapped as a result of irregular, low flowering and low seed production habit, common in root and tuber crops. Large population size of botanical seeds is required to increase the variables in cassava to harness the great potentials or development the key traits of impotence Olusami et al., (2014). To be able to generate wide range of variables for diverse uses and usefulness in cassava, there is need to overcome the bottle neck of conventional breeding and create room for the development of those traits that naturally do not exist or have been lost through genetic erosion Ceballo (2004), Kasky (2013). Some researchers have used growth hormones such as gibbrellic acid and colchicine to induce flowering in Dioscoerea and aroids Amanze et al., (2010) and Mbanaso et al., 2006) For this reason an initiatives was undertaken to investigate the use of the hormone colchine to manipulate the morphology, flowering and seed production of cassava to develop large population size of botanical seeds as to create large gene diversities needed for diverse purposes.

MATERIAL AND METHODOLOGY
The experiment was conducted in May during the 2013 growing season at National Root Crops Research Institute (NRCRI), Umudike research farm, which lies within the humid rainforest agro-ecology of Nigeria (Njoku et al., 2015). Five high yielding cassava varieties with good agronomic and disease resistance characters: TMS98/0505, TMS94/4479, TMS98/1632, TMS92/0057, TMS98/0581 were treated with manipulating hormone-"colchicines" at two levels: 2%, 4% and0% as control at 100/50cl ppm (parts per million) and established in the field to maturity. Twenty pieces of stem cuttings of about 25cm each of the cassava varieties were cut from the mature plants raised from the treated materials and planted in a well harrowed and ridged field in a 4x5 randomized block design, at a spacing of 1m x1m intra and inter-row replicated three times. Post and pre- mergence herbicides were applied immediately after planting and all the other agronomic practices were applied. Data were collected on the physiological parameters such as: number of leaves, number of branches, plant height and girth, number of plants flowered and no of seed produced, weight and tuber yield.

RESULTS AND DISCUSSION
Table 1 Shows that the concentration of hormone affected the physiological parameters of the cassava varieties treated. Level 4 of the treatment significantly affected the leaf area index, number of seeds and the stem girth. While Level 2 of the treatment gave the highest number of leaves, other parameters were not significantly affected. This result is in agreement with Hahn et al., 1991.It also simply implies that the hormone really induced seed production components well as seed yield.

Table 2 shows that concentration of hormone applied did not significantly affect the cassava mosaic disease of the parent materials. This is a positive result showing that the hormone does not have adverse effect on the materials. However it increased CBB and CAD at ($P<0.05$) but they are not serious cassava disease.

Table 3 shows the effect of variety on the seed yield components and yield of botanical seed. LAI, No of leaves and no of branches produced are significantly effect by varieties. Variety 47791 and 1632 had higher leaf area than the other varieties. Variety 4779 also had the highest number of leaves, followed by variety 0581, but 0505 had the highest number of branches, number of seeds and heaver seed weight than the other varieties, in contrast to positive correction of high root yield with high photosynthetic area as reported by Okeke (1981) and others. This result is in conformity with the ability of cassava cultivars to flower and set seed is variety specific but has been reduced (Jennings, 1962).While the application of mutagens will trigger and enhance it.

CONCLUSION

Though variety is a key factor in flowering and seed production, application of colchicine mutagen enhanced yield component of cassava, enhance seed production of flowering and triggered seed production in dormant ones.

Table 1: Effect of Concentration on Physiological Characters

LEVEL OF CONCENTRATION (PPM)					
Parameter	**0**	**2**	**4**	**P-Value**	**Remark**
LAI	3.62 ± 0.25**	3.59 ± 0.20*	4.56 ± 0.92***	p<0.05	Sig
No of leaves	59.82 ± 8.41	90.80 ± 15.43	67.44 ± 13.504	P<0.05	Sig
Girth	1.24 ± 0.28	1.41 ± 0.08	1.33 ± 0.81	p<0.05	Sig
No of Branch	2.93 ± 0.97	3.03 ± 0.90	3.95 ± 1.37	P>0.05	N.S
No of seed	1.06 ± 45.82	1.41 ± 69.07	98.7 ± 53.35***	P>0.05	sig
No of that flower	4.50 ± 2.05	6.80 ± 2.79	3.7 ± 1.67	p>0.005	N.S
Wt of seed	9.51 ± 4.29	12.99 ± 6.37	9.43 ± 4.71	P>0.05	N.S

NS -Not Significant Sig-significant *-level one conc**level two***level three

Table 2: Effect of Concentration on Disease

DISEASE SCORE					
Parameter	**0**	**2**	**4**	**P Value**	**Remark**
CBB	1.32 ± 0.49	1.52 ± 0.64	1.08 ± 0.44	P<0.05	Sig
CAD	2.0 ± 0.00	2.10 ± 0.10	2.04 ± 0.34	p<0.05	Sig
CMD	0.70 ± 0.26	0.70 ± 0.260	0.90 ± 0.23	p>0.050.141	N.S

NS-Not Significant Sig-significant =*-level one, =level two**,***level three

Table 3: Effect of variety on the yield component and yield of botanical seed

	VARIETY						
Parameter	**47791**	**0505**	**0581**	**1632**	**0057**	**P-value**	**Remark**
LAI	4.86 ± 1.57	2.98 ± 0.19	4.30 ± 0.18	4.03 ± 0.13	3.47+_0.18	P<0.05	Sig
No of leaves	93.1 ± 14.62	76.9 ± 20.59	83.4 ± 20.1	44.76 ± 8.54	65.2 ± 16.1	P<0.05	Sig
Girth	1.31 ± 0.12	1.37 ± 0.29	1.39 ± 0.11	1.23 ± 0.12	1.33 ± 0.500	P>0.05	NS
No of Branch	4.150 ± 058	6.68 ± 1.30	1.33 ± 0.23	1.03 ± 0.21	3.3 ± 2.17	P<0.05	Sig
No of seed	0.00 ± 0.00	3.72 ± 37.32		2.05 ± 73.19	-	P>0.05	NS
Wt of seed	-	33.0 ± 3.39	-	20.22 ± 7.01	-	P>0.05	Sig
No that flower	-	12.67 ± 2.26	-	12.33 ± 1.86	-	P>0.05	Sig

NS-Not Significant Sig-significant =*-level one , =level two**,***level three

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STABILITY ANALYSIS FOR GRAIN YIELD IN SESAME (*Sesamum Indicum L.*)

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ABSTRACT
Thirteen sesame genotypes were evaluated under rain fed conditions in 2013 and 2014 at the research fields of the National Cereals Research Institute located at Badeggi, Mokwa and Yandev stations to identify high yielding and stable genotypes. Randomized complete block designs with three replications were used in each location. Results obtained suggest that high yielding genotypes were less stable across all the environments Highly insensitive (stable) genotype GEN10 and GEN8 gave the lowest grain yield compared to GEN1, GEN4 and GEN12 that had higher grain yield but highly sensitive to the environment (less stable). The partitioning of GGE through GGE biplot analysis showed that PCA 1 and PCA 2 accounted for 86.0% and 7.3% of GGE sum of squares respectively for grain yield, explaining a total of 93.3% variation. The GGE biplot revealed the best genotypes under different environments and accurately identified genotype G1 as the best genotype with respect to site E1, E2, E4, and E5 while genotype G4 was revealed as the best for site E3 and E6. Genotype G1 gave the highest average yield (largest PCA 1 scores), but was unstable over the environments.
Keywords: G x E, Sesame, grain yield, stability,

INTRODUCTION

Sesame (Sesamum indicum L.), a member of the order Tubiflorae, family Pedaliaceae is perhaps the oldest oil seed known and used by human beings (Weiss, 1983). It is an important annual crop in the tropics and warm subtropics, where it is usually grown in small plots (Bedigian and Harlan, 1986). Sesame is an erect herbaceous annual plant that has two growth characteristics indeterminate and determinate, with the plant height of up to two meters. Most varieties show an indeterminate growth habit, which is showing as a continuous production of new leaves, flowers and capsules as long as the environment remains suitable for growth (Carlson et al.2008). The crop originated from tropical Africa and was taken at an early stage to India where it was domesticated and became a crop of the New World (Ashri, 1995). The crop is grown in both tropical and sub-tropical regions of Africa, Asia and Latin America. In Nigeria, sesame crop is widely cultivated in northern and central Nigeria between latitudes 7 – 14°N and an annual rainfall of about 1000 – 1500 mm (Iwo, et al., 2005). It is cultivated mainly for its seeds that contain approximately 50% oil and 25% protein. It has been regarded as a crop of insignificant importance compared to other oil seed crops like groundnut and soybeans probably due to its lower yield in Nigeria.

Breeding programmes are intended to develop new varieties with superior agronomic performance compared to those in current production by farmers. Prior to release of the new varieties, they are evaluated in yield trials at several locations for two or more seasons in multi-environmental trials (METs). The varietal trials provide important information that enables identification and recommendation of superior crop cultivars for commercial purposes, (Yan and Tinker, 2006). Assessing any genotype performance without including its interaction with the environment is incomplete and limits the accuracy of measured parameter estimates. Studies of the causal factors of the Genotype x Environment (G x E) effect and quantifying unexplained variation are of prime importance for selection and recommendation of environmentally stable varieties [Signor et al., 2001]. A significant G x E interaction for a quantitative trial such as grain yield can seriously limit progress in selection. The study of the G x E interaction may assist understanding of stability concept. Therefore, the objective of this study is to determine the yield stability of promising genotypes, and identify high yielding genotypes.

MATERIALS AND METHOD

Thirteen sesame genotypes were evaluated under rain fed conditions in 2013 and 2014 at the research fields of the National Cereals Research Institute located at Badeggi, Mokwa and Yandev stations. Field were plough, harrowed and row marked out into 13 plots each measuring 3 m x 5 m in a randomized complete block design (RCBD) with three replications in each location. Sowing of sesame seeds were done by hand-drilling after mixing with soil from the field site to ensure even distribution of the seeds within the plot. Each genotype was sowed in a seven-row of 0.5 m inter row spacing, five plants were tagged in the middle rows and data were collected from the five middle rows to avoid border effect. Recommended crop management practices were followed to raise the crop at all sites. Plots were kept weed, pest and disease free until harvest. Grain yield data were recorded.

RESULTS AND DISCUSSION

Table 1, shows genotypes sensitivity to environments using Finlay and Wilkinson regression analysis (1963) which revealed a high positive linear relationship between the regression coefficient and the average yield of the genotypes, indicating that high yielding genotypes were less stable across all the environments' highly insensitive (stable) genotype GEN10 and GEN8 gave the lowest grain yield compared to GEN1, GEN4 and GEN12 that had higher grain yield but highly sensitive to the environment (less stable). GEN1 recorded the highest mean grain yield of 811.1kg/ha, followed by GEN4 with 786.6 kg/ha while GEN10 recorded the lowest value of 310.4 kg/ha. High variability observed among genotypes as indicated by the range of their mean performance, indicated the presence of sufficient genetic variability for grain yield, with GEN1 having the highest grain yield across the locations while GEN10 recorded the least yield. This result was inconformity with the results reported by Osman, et al. (1974), Parameshwarappa, et al. (2009).

The analysis of stability and Superiority were performed for grain yield based on the Finlay and Wilkinson (1963) stability Model Table 2. Stability of the genotypes on grain yield across the six environments revealed that GEN8 gave a stable yield across locations (Static stability) followed by GEN10 and all other genotypes were less stable across environment (dynamic stability) Genotype GEN1 gave the lowest stability value. This result is in conformity with the finding of Vijendra (2007) that stability evaluated by static concept, is associated with poor yield. He further reveals that a stable genotype is supposed to possess unchanging performance regardless of any variation in the environmental condition. The superiority values of genotypes on grain yield showed that GEN4 and GEN1 had the superiority value of 3848 and 6398 respectively and are more superior in contrast to G8 and G10 that recorded the highest superiority values of 162743 and 165674 respectively having the least mean grain yield. Lin and Binns (1994) proposed a model called superiority analysis, and made known that highest yielding genotypes can be compared with the other entries in a location by using a superiority statistic called **Pi,** that the smaller the Pi value of a cultivar the better adapted. However since Pi is to be measured over all locations it represents superiority in respect of general adaptability and therefore a cultivar that has a large Pi value (poor in general adaptability) may be good in a specific region.

The partitioning of GGE through GGE biplot analysis showed that PCA 1 and PCA 2 accounted for 86.0% and 7.3% of GGE sum of squares respectively for grain yield, explaining a total of 93.3% variation as shown in Figure 1. The GGE biplot revealed the best genotypes under different environments and accurately identified genotype G1 as the best genotype with respect to site E1, E2, E4, and E5 while genotype G4 was revealed as the best for site E3 and E6. Genotype G1 gave the highest average yield (largest PCA 1 scores), but was unstable over the environments, due to its high absolute PCA 2 scores. In contrast, G8 yielded poorly in all environments, as indicated by its small PCA 1 scores (low yielding) and relatively small PCA 2 scores (relatively stable).

The partitioning of GGE through GGE biplot analysis showed that PCA 1 and PCA 2 accounted for 86.0% and 7.3% of GGE sum of squares respectively for grain yield, explaining a total of 93.3% variation as shown in Figure 1. The GGE biplot revealed the best genotypes under different environments and accurately identified genotype G1 as the best genotype with respect to site E1, E2, E4, and E5 while genotype G4 was revealed as the best for site E3 and E6. Genotype G1 gave the highest average yield (largest PCA 1 scores), but was unstable over the environments, due to its high absolute PCA 2 scores. In contrast, G8 yielded poorly in all environments, as indicated by its small PCA 1 scores (low yielding) and relatively small PCA 2 scores (relatively stable). Generally, genotypes show wide fluctuations in their yielding abilities when grown over varied environments or agro-climatic zones (Fan et al., 2007). Based on GGE biplot analysis, in assessing an 'ideal' environment and genotypes, a polygon is first drawn on genotypes that are located away from the biplot origin so that all other genotypes are contained in the polygon. Perpendicular lines are then drawn, starting from the biplot origin, to each side of the polygon (Figure 1). These perpendicular lines divide the biplot into sectors, and the wining genotype for each sector is the one located on the respective vertex. This revealed that GEN1 was the winning genotype in E2, E1, E4, E5 and GEN4 in E6 and E3 were the winners in the rest of the environments. This indicates that sesame genotypes responded to G × E interaction over the environments differently and to varying seasons. The GGE biplot enabled visual comparison of the locations and genotypes studied and their inter-relationship.

CONCLUSION

G X E interactions is significant to plant breeders in the identification and selection of promising genotypes that perform better in terms of yield potential to specific environmental situations or specific locations. The stability analysis provides meaningful information regarding stability and consistency of sesame performance across different environments.

Abbreviations

E: Environment (E1 = Badeggi13, E2 = Mokwa13, E3 = Yandev13, E4 = Badeggi14, E5 = Mokwa14, E6 = Yandev14)

G: Genotype (G1=Ex-Sudan, G2=Nicaragua-Blanc**o, G3=**SN603, G4=Kenana4, G5=NCRIBEN 01M, G6=NCRIBEN 02M, G7=NCRIBEN 03L, G8=ICEASE 0001, G= ICEASE 00013, G10=ICEASE 00018, G11=ICEASE 00020, G12=E 8 G9=13=Bogoro local)

G x E: Genotype **×** environment interaction

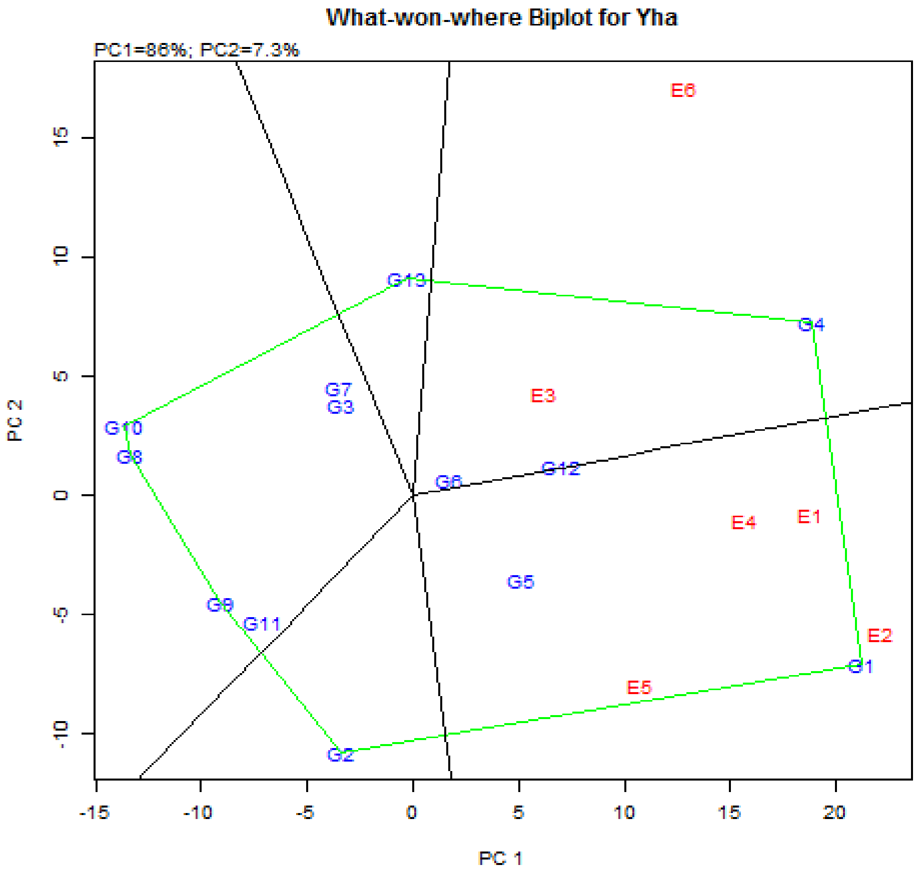
METs: Multi environment trials
PCA: Principal component analysis

Table 1: Genotypes sensitivity for grain yield based on the Finlay and Wilkinson (1963) stability model

S/N	Genotype	Sensitivity	Mean grain yield (kg/ha)	Mean standard deviation
1	GEN8	0.5125	325.1	5032
2	GEN10	0.6778	310.4	5009
3	GEN11	0.7530	401.9	4808
4	GEN7	0.7691	463.8	3176
5	GEN9	0.8332	375.8	6370
6	GEN13	0.8646	516.9	13598
7	GEN3	0.8834	460.3	3497
8	GEN6	0.9599	538.1	2591
9	GEN12	1.1632	612.2	3647
10	GEN2	1.2048	446.6	11137
11	GEN5	1.2501	583.7	8383
12	GEN4	1.3482	786.6	12632
13	GEN1	1.7436	811.1	6569

Table 2: Stability and Superiority for grain yield based on the Finlay and Wilkinson (1963) stability Model

Genotype	Stability Value	Genotype	Superiority Value
GEN8	12101	GEN4	3848
GEN10	18510	GEN1	6398
GEN7	20361	GEN12	34655
GEN11	20915	GEN5	45637
GEN3	26095	GEN6	58269
GEN9	26979	GEN13	72246
GEN6	29056	GEN3	87530
GEN13	36408	GEN7	88275
GEN12	44179	GEN2	96796
GEN2	54200	GEN11	117425
GEN5	55103	GEN9	131332
GEN4	67426	GEN8	162743
GEN1	99882	GEN10	165674



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ORGANIC HORTICULTURAL FOOD CROP PRODUCTION AND ITS HEALTH BENEFITS TO SOCIETY

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ABSTRACT
Human welfare, health and safety are the principal component of sustainability as the social and economic welfare of farm workers and their community greatly depends upon it. Organic farming is a system of employing agricultural practices that avoid the use of synthetic chemicals in favour of naturally occurring fertilizers and pesticides. It involves a number of activities ranging from acquisition of suitable land, land preparation, right varieties of seeds, pre-planting and post planting operations. The adoption of organic farming increases soil fertility, balance insect populations and at the same time reduce environmental pollution of air, soil and water. The world agriculture is faced with three challenges of improve food security, rural livelihood income and the protection of natural resources. Organic horticultural food crops produced through practices that achieve an optimal balance between economic, social and environmental goals were reviewed. They provide adequate household income, food security and safety to producers while the farmers must adhere to safe working procedures with acceptable working inputs.
Keywords: Organic foods, horticulture, crop production, health

INTRODUCTION

Agricultural productions involve a number of activities which include among others, acquisition of suitable lands for each crops, tilling, use of right varieties of seeds, spectrum of other agronomic practices such as weeding, pest control & management, fertilizer applications, storage and marketing down to the final consumers. These processes are applicable to both crops and livestock with the aim of achieving an effective food security system in the society (Okunade, 2014). Until recently, increase food production had generally been achieved by extending crop land, but population pressure increased competition between crop and livestock farming and declining soil fertility, thus forcing farmers to ramp up investments in pesticides. For food crop production to succeed, certain inputs must be put in place such as fertilizers, (to increase output) pesticides (to control various forms of pests and pathogens) and good agronomical practices. The inputs are obtained from two major sources namely the living matters and the non- living matters otherwise referred to as organic and inorganic materials. The inorganic materials (synthetic) which has been adjudged to be very good and effective has been subjected to abuse by most illiterate poor resource farmers in Nigeria and other developing countries of the world occasioned by the dramatic results achieved in food production. And this has results into loss of life which had given room for total ban or severely restricted use in most countries of the world.

Nigeria is rated as one of the leading producers of tropical horticultural fruits and vegetables in the world, but it is not a major horticultural fresh produce exporting country due largely to poor quality produce, codes and procedures to eliminate fruits that can lead to food borne illnesses resulting from crop contaminated with pathogenic microorganisms, chemical poisons arising from poor handling practices at various stages of production.

It is against this background that organic food production with safe, cheaper, readily available , effective and short life span of degradable and easy to apply inputs are suggested in our farming systems.

Objectives

This work is set out to:

1. review the concept of Good Agricultural Practices (GAP) that has evolved in the context of a rapidly expanding food economy based on food production & security, food safety and quality,
2. raise awareness and upgrade the technical knowledge of fresh horticultural produce and enlighten farmers on the growing concern driven by spread of microbiological hazards and chemical food Contaminants,
3. ensure production of high quality fresh horticulture products for local and international market with the goal of improving rural living standards, increase income and minimize health risks from farm to fork as well as sustainable food safety.

METHODOLOGY

The work is a general review of the state of technical knowledge of fresh horticultural produce and strategy set out in the process for organic food safety and quality, voluntary standards on organic agriculture and sustainability assessment scheme. From the production perspective, farmers inherently apply practices that aim to achieve economic viability while conserving their own natural resource base and maintaining their cultural values. On the demand perspective, consumers can have concern both about the safety and quality of the agricultural products and also the process – including good agricultural practices that are used to produce them. Because GAP is currently being driven by demand – side sectors, with a number of possible implications that must be address for further development and application of GAP approach.

DISCUSSION

The concept of good agricultural practices (GAP)

Since the 1990s, due to frequent outbreaks of animal and plant epidemic diseases and Genetically Modified (GMO) products abuse, the European countries have formulated various agricultural safety management standards to prevent the safety threats of agricultural products. In 1997, the Euro-Retailer Produce Working Group began drafting Good Agricultural Practice (EUREPGAP) which composed of Hazard Analysis and Critical Control Point (HACCP) and Good Agricultural Practices (GAP) specifying the safety management regulations for all aspects in agricultural cultivation, processing and retail supply chain.

With the globalization of economy and product purchasing, a growing number of countries over the world have adopted EUREPGAP by equation or by equivalent, to specify the safety management of domestic agricultural cultivation, processing, marketing and export. EUREPGAP changed its name to GLOBALG.A.P.at the end of 2007 in accordance with its implementation (FAO, GAP WEBSITE).

Broadly defined, a GAP approach aims at applying available knowledge to addressing environmental, economic and social sustainability dimensions for on-farm production and post-production processes, resulting in safe and quality food and non-food agricultural products. Based on generic sustainability principles, it aims at supporting locally developed optimal practices for a given production system based on a desired outcome, taking into account market demands and farmers constraints and incentives to apply practices (FAO, 2003).

World agriculture in the twenty-first century is faced with three main challenges: 1) to improve food security, rural livelihoods and income; 2) to satisfy the increasing and diversified demands for safe food and other products; and, 3) to conserve and protect natural resources, an approach that improves environmental, economic and social sustainability of on-farm production and results in safe and quality food and non-food agricultural products. A GAP approach can contribute concretely to implementing sustainable agriculture and rural development while addressing the demand-side priorities of consumers and retailers, the supply-side priorities of producers and labourers, and those institutions and services that are bridging supply and demand. The development of a GAP approach by FAO emerges against an expanding backdrop of codes, standards and schemes relating to agricultural practices and products. It is also formally recognized in international regulatory framework and associated codes of practice to minimize or prevent the contamination of foods.

Awareness and upgrade of the technical knowledge of organic fresh horticultural produce

In the production of organic horticultural food crops, a number of activities are involved ranging from the acquisition of suitable land, land preparation, right varieties of seeds, pre-planting and post planting operations. Organic farming which is a system of employing agricultural practices that avoid the use of synthetic chemicals in favour of naturally occurring fertilizers and pesticides is adopted for increased soil fertility, balance insect populations and also reduced environmental pollution. The organic farming approach is the systematic sustainable agriculture where by manure from animals are used to fertilize horticulture farms that will in turn serve as sources of animal feeds.

The concern in organic farming was passed into law in some countries like America, where it is known as National Organic Program (NOP) with the essential component of the prohibition on Genetically Modified Organisms (ingredient) and irradiation to decontaminated food products, the prohibition of sewage sludge as fertilizers in the production of horticultural food crops that will be marketed. Among other things, organic products in USA must contain at least 95% organic ingredients while those products with minimum of 75% organic ingredients are referred to as 'made with organic ingredients' (Okunade, 2014).

The application of fertilizer in organic farming is absolutely necessary since it is the addition of substances used for enriching soil in order to promote plant growth. Organic fertilizers are therefore obtained from plants, animals, mineral products and also from processed house waste. The use of manure and guano (dried excrement usually of sea birds, and animals) containing nitrogen are some examples of organic fertilizers used in some horticultural food crop production. Others are bones, wood ash, and leguminous crops. Advantages of the use of organic fertilizers in horticulture crops are; enhances the life span, slowly absorbed by the crops but over a long time for lasting action and also improves soil texture and erosion prevention. Other merits of organic fertilizers are that they are readily available and cheap with no adverse effect on non-target organisms. In the production

of organic horticultural food crops, single organic fertilizer could contain the entire nutrient required for a growth cycle of the crops.
The need to embark on the use of organic pesticides in horticultural food crops arises due to the perceived problems possessed by synthetic pesticides in the developing nations of the world, such as being very costly, application abuse and misuse, high mammalian toxicity, development of resistance, residual effects and drift to non- targeted areas.

Production of High Quality Fresh Horticulture Products (organic) for Improving Rural Living Standards, Increase Income and Minimize Health Risks
Organic horticultural food crops are highly nutritious, free from Genetically Modified Organisms (GMO) and are free from the dangers of withholding period (time between pesticides application and when consumption ought to take place).The selection of suitable varieties before land clearing and preparation will minimize the attraction of pest and weed infestations, while ensuring that all rodent holes are completely blocked with stone and trashes around the farm areas. In the production of high quality fresh horticulture products (organic), adequate supply of water on the crop land should be advocated since little water may cause plant stress, loss of plant vigour that could attract pests on the farm. Adequate soil nutrient encourages plant ability in fighting pest invasion and timely harvest of matured / ripped produce will increase food availability.
In an area that is endemic to pests' infestation, the use of crop rotation and resistance varieties followed by intercropping practicing with a view to interrupt the movement of disease causing organisms within the farm site. This is visible by establishing trap crops (plants that are more attractive to a particular pest than the target crop) and plant attractant (plants that serve as feed or shelter to beneficial insects. This is recommended since many insects and fungi feed on one type of crop and also the planting of crops that beneficial insects like ladybugs and lacewings. These insects will naturally feed on other insects that could be harmful to the crop.
Good Agricultural Practices are used to prevent pest and disease problems as they encourage good health and crop resistance to pests. This is achievable by growing crops in appropriate climate, in appropriate season and constant good sanitation in production. The very moment pest and disease incidence tends towards Economic Injury Level (EIL) of 5% damage, intervention measures such as the utilization of other living organisms predators, parasitoids or pathogens of the pest to control pest population. This is done by either direct introduction of the organisms into the ecosystem or indirectly by altering conditions in the affected areas and it is very effective because the development of resistance by pest is rare. Cultural intervention is achieved by making crop environment unsuitable for pests to the extent of avoidance or displacing the crop plant in time or space thus making it not available for pests during the period of need.
The tropical horticultural crop sector in addition to providing nutrient for health could be a new source of generating income, employment, and savings on foreign exchange. Therefore, every effort towards efficiency of production, stemming post-harvest losses and use of organic materials with enhancement of extension services delivery will position organic food crop production in the right directions of high nutrition and good health. Nigeria's tropical climate can support the production of various types of indigenous, exotic and tropical crops, but land and access road constraints with high cost of improved planting materials as well as lack of skilled manpower in harnessing the potentials of our food crops are impediments.
Nikki, (2012) reported that horticultural food crops boast a long list of healing powers and pack powerful nutritional punch for a relatively low calorie, and are also packed with substances that help in fighting inflammation and cancer. This report had shown that most horticultural food crops inhibit the growth of tumors and even cause cancer cells to die without damaging healthy cells. As a result of the unique blend of phyto-nutrients, vitamins and minerals found in horticultural crops, they help to protect against heart diseases, stroke, cancer and respiratory diseases. Most ailments caused by the intake of un-natural foods can be successfully treated with some horticultural fruits, vegetables and spices and as such not only a good food but also good medicine. Natural health benefits of organic products of horticultural crops ranges from hydrating effects to alkalizing mineralizing, laxative and tonic actions (Dazzle, 2012).

CONCLUSION
The adoption of Global Good Agricultural Practices (GAP) and management of organic farm products in horticultural food crops is of immense importance in areas of food safety, cost effectiveness and improved nutrition. Organic food products and production is a new area that is gradually being recognized world – wide and should be actively considered by both private and public organization for better awareness. It remains a major step towards the attainment of food security in the developed, developing and under – developed countries of the world.

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A BASELINE SURVEY ON SORGHUM (*Sorghum Bicolor L.)* PRODUCTION IN TARABA STATE, NIGERIA

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ABSTRACT
A baseline survey was carryout to assess the experience in years of sorghum production, cropping system, hectarages cultivated and identifying most important weed species infesting sorghum in Taraba state. The study aimed at gathering information on the production status of sorghum in the state. A questionnaire was administered to 300 farmers in their local language spread across 5 wards each from 5 Local Government Area (LGA) (Wukari, Takum, Donga, Ussa and Ibi), major sorghum producing area of the State. The surveyed shows that most of the farmers cultivate between 2-3 ha of sorghum more than ten years ago. The cropping system has been intercrop mostly with maize and to a lesser extends with groundnut and millet. Very few of the farmers cultivate sorghum sole. Also 60% of the farmers interviewed identified striga hermontheca to be the most important weed in sorghum. In conclusion, more research effort to finding solution to the challenge of striga hermontheca in sorghum is strongly advocated in this part of the country. This will encourage the farmers to cultivate more hectarages of sorghum considering many years of experience they have in producing the crop. Also there is need to sensitise the farmers on the practice of sorghum-legumes intercrop, instead of the usual cereal-cereal intercrop system, to increase sorghum production for food security in Nigeria.
Key word: Experience, Hectarage, Intercrop, Weed and Sorghum

INTRODUCTION
Sorghum (Sorghum bicolor (L) Moench) is the fifth, fourth and third major cereal in terms of production and acreage in the World, India and Nigeria respectively (ICRISAT, World sorghum). It is a staple food in the drier part of Africa, china and India (Zalkuwi et al., 2013). In Africa, Nigeria and Sudan contribute nearly half of the sorghum production (Robert et al., 2013). Sorghum is used as human food, where it is a staple food for millions of people; as animal feed and industrial raw material (Agrama et al., 2003; Mamoudou et al., 2006). Industrially, the grain is used to manufacture wax, starch, syrup, alcohol, dextrose agar, edible oils and gluten feed (Mamoudou et al., 2006, Rainford, 2005). As food, the grain is used in making fermented and non fermented porridge. The grain has high levels of iron (>70 ppm) and zinc (> 50 ppm), hence may be used to reduce micronutrient malnutrition. There is high demand for sorghum mainly in brewing industry in Nigeria, yet the amount produced by farmers is too low to satisfy the market demand. One of the major constraints in sorghum production in Nigeria is the challenge of Striga hermontheca which have decreased the overall production of the crop in the country.
Understanding the years of experience of farmer, amount of hectarages cultivated, cropping systems as well as identifying the most challenging weed species in sorghum could be important in improving sorghum production in Taraba state Nigeria. Therefore, the study aimed at gathering information on the production status of the sorghum in Taraba state.

METHODOLOGY
Description of study area
Taraba State is located at the north eastern part of Nigeria. It lies between latitude 6° 30' and 8° 30' north of the equator and between longitude 9° 00' and 12° 00'east of the Greenwich meridian. The state shares boundaries with Bauchi and Gombe states in the north, Adamawa state in the east, and the Cameroon Republic in the south. The state is bounded along its western side by Plateau, Nassarawa and Benue states. The state has a land area of 60,291km^2. It is divided into sixteen Local Government Areas (LGAs) and three senatorial districts (Taraba north, central and south). Major cereals produced in the state include maize, rice, sorghum and millet.
Data Collection
Focus group discussions were held with average of 12 farmer groups per five wards each from five LGAs (Wukari, Takum, Donga, Ussa and Ibi), predominantly a sorghum producing areas in the state. The discussion helped to determine the years of farmers experience in sorghum production, hectarages cultivated, major cropping system, important weeds spp. A semi-structured questionnaire was administered to 300 farmers in their local language spread across the wards to supplement findings from the group discussions. The data were summarised into averages and percentages.

RESULTS AND DISCUSSION

Table 1 highlights the years of farmers experience in sorghum production. Among the farmers interviewed in the wards of Wukari LGA, 45% have been cultivating sorghum over 10 years ago, 29% between 7- 9 years, 22% between 4-6 years and 4% between 1-3 years. In Takum LGA, 51% of the farmers have been cultivating sorghum more than 10 years ago, 33% between 7-9 years, 11% between 4-6years and only 5% have been cultivating sorghum for 1-3 years. At Donga LGA, among the farmers interviewed, 46% have been cultivating sorghum, 32% between 7-9 years, 16% between 4-9 years and 6% between 1-3 years. In Ussa LGA, 40 % of the farmers have been cultivating sorghum, 32% between 7-9 years, 16% between 4-6 years and 12% between 1-3 years. Also in Ibi LGA area of the State, 36% of the farmers have been cultivating sorghum for more than 10 years, 33% between 7-9 years, 17% between 4-6 years and 14% between 1-3 years. This implies that farmers in Taraba State have been cultivating sorghum many years ago. This support Oruonye (2014) who reported sorghum among major cereals produced in Taraba state.

Table 2 below presents the hectarages of sorghum cultivated in Taraba state. 60% of the respondents cultivate up to 1-2 ha of sorghum, 35% uses between 3-5 ha, 3% uses between 6-9 ha and only 2% more than 10 ha. In Takum, 65% of the farmers have been cultivating 1-2 ha of sorghum, 32% uses between 3-5 ha, 2% produced between 6-9 ha and only 1% cultivate more than 10 ha of sorghum. Among the farmers interviewed at Donga LGA, 68% have been cultivating sorghum at 1-2 ha, 30% uses between 3-5 ha, 2% uses between 6-9 ha and none cultivate sorghum beyond 10ha. In Ussa LGA, 50 % of the farmers cultivate sorghum about 1-2ha, 43% cultivate between 3-5ha, 5% cultivate between 6-9ha and 2% cultivate between above 10 ha. Also in Ibi LGA, 48% of the farmers cultivate 1-2 ha of sorghum, 38% cultivate between 3-5 ha, 14% cultivate between 6-9 ha of sorghum and none cultivate more than 10ha of sorghum. This means that most the farmers in this part of the country cultivate sorghum majorly within 1-2 ha of land.

Table 3 presents sorghum cropping system in Taraba state. Among the farmers interviewed in Wukari LGA of the State, 45% of the sorghum farmers intercrop with maize. 43% intercrop sorghum with groundnut. 8% intercrop sorghum with millet, 2% grow sorghum sole. In Takum, 32% of the farmers intercrop sorghum with maize. 27% of the farmers intercrop sorghum with millet and 22% intercrop with groundnut. 19% cultivate sorghum sole. In Donga, 35% practiced sorghum/millet intercrop, 30% intercrop maize with sorghum and 22% intercrop groundnut with sorghum. 13% cultivate sorghum sole. In Ussa, 35% practiced sorghum/maize intercrop, 25% intercrop sorghum with millet and 23% intercrop sorghum with groundnut. 17% cultivate sorghum sole. In Ibi, 45% intercrop sorghum with maize, 32% intercrop sorghum with millet, 15% practiced sorghum/millet and 8% cultivate sorghum sole. This implies that most farmers in Taraba State rarely cultivate sorghum sole but intercrop sorghum with other crop particularly maize, groundnut and millet . This agrees with Olukosi et al. (1991) who reported that mixed farming and mixed cropping had been traditionally practiced and were still very common in Nigeria.

Table 4 shows the important weed species infesting sorghum field during production in Taraba state. Among farmers interviewed, 60% perceived that Striga hermontheca dominated sorghum fields. This was followed by 23% Rottboellia cochinchinensis, 6% Imperata cylindrica, 5% Digitaria horizontalis, 4% Commelina benghalensis and 2% Pennisetum pedicellatum. This shows that, farmers in the state are face with the challenge of parasitic striga spp infestation during sorghum production followed by Rottboellia cochinchinensis. This agreed with Ejeta and Gressel (2007) who reported that Striga has long been recognized as the greatest biological constraint to maize, sorghum, pearl millet (Pennisetum glaucum), upland rice, and cowpeas (Vigna unguiculata) production in Africa savanna.

CONCLUSION

More research effort to finding solution to the challenge of parasitic striga in sorghum is strongly advocated in this part of the country as this will encourage the farmers to cultivate more hectarages of sorghum since they have many years of experienced in the production of the crop. Also farmers need sensitising on the practice of sorghum-legumes intercrop, instead of the cereal-cereal intercrop system, to increase sorghum production for food security in Nigeria.

Table 1: Farmers Experience in Sorghum Production in Taraba State, 2015

	Local Government Areas				
Years	Wukari	Takum	Donga	Ussa	Ibi
1-3	4.0	5.0	6.0	12.0	14.0
4-6	22.0	11.0	16.0	16.0	17.0
7-9	29.0	33.0	32.0	32.0	33.0
10 above	45.0	51.0	46.0	40.0	36.0

Table 2: Sorghum Hectarages Cultivated in Taraba State, 2015

	Local Government Areas				
Hectarages (ha)	Wukari	Takum	Donga	Ussa	Ibi
1-2	50.0	65.0	68.0	50.0	48.0
3-5	45.0	32.0	30.0	43.0	38.0
6-9	3.0	2.0	2.0	5.0	14.0
>10	2.0	1.0	0.0	2.0	0.0

Table 3: Percentage Sorghum Intercropped System in Taraba State, 2015

	Local Government Areas				
Cropping System	Wukari	Takum	Donga	Ussa	Ibi
Sole	2.0	19.0	13.0	17.0	8.0
Sorghum / Ground nut	33.0	22.0	22.0	23.0	32.0
Sorghum /Maize	43.0	32.0	30.0	35.0	45.0
Sorghum /Millet	10.0	27.0	35.0	25.0	5.0

Table 4: Important Weed Species in Sorghum Field in Taraba State in 2015 Cropping Season

Weed Species	Common Name	Family	Growth Habit	% Respondents
Rottboellia cochinchinensis	Itchgrass	Poaceae	AG	23.0
Imperata cylindrica	Spear grass	Poaceae	PG	6.0
Pennisetum pedicellatum	-	Poaceae	AG	2.0
Commelina benghalensis	Tropical spiderwort	Commelinaceae	PSp	4.0
Digitaria horizontalis	Crabgrass	Poaceae	PG	5.0
Striga hermontheca	Purple Witch weed	Srophulariaceae	ABL	60.0

PG = Perennial Grass, AG = Annual Grass, PSp = Perennial Spiderwort, ABL = Annual Broadleaf, PS = =Perennial Sedge. - = Not Available

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FARMERS' PERCEPTION OF LEAF SPOTS AND CONTROL PRACTICES IN RAINFED GROUNDNUT CROPPING SYSTEMS IN TARABA, NIGERIA

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ABSTRACT
Groundnut (Arachis hypogaea L.) is one of the most important oil seed crop in Nigeria. It contains 48-50% oil, 26-28% protein and 11-27 % carbohydrate, minerals and vitamin. Groundnut pod yields from farmers' field are low, averaging about 800 kg ha-1, less than one-third the potential yield of 3000 kg ha-1. Early and late leaf spots, caused respectively by Cercospora arachidicola and Phaeoisariopsis personata, are the most common and serious diseases of groundnut, worldwide with over 50% yield loss. There had not been preliminary information on status of groundnut production in Taraba State. Questionnaires were administered among farmers in a participatory manner. Data were collected on cropping systems, cultural practices, yield levels, constraints to production and utilization. Responses obtained from farmers were analyzed using non-parametric or descriptive statistics. The data was summarized into averages, percentages or ranges. Results identified major production practices, importance and constraints to groundnut production in Taraba State. The second experiment was to determine the extent of leaf spots by random sampling of four farmers' fields per each of the 5 wards in each Local Governments of namely Wukari, Takum, Donga, Ussa and Ibi surveyed. The result revealed that early leaf spot disease was prevalent in all the areas surveyed, and percentage leaf area damaged, infection frequency, lesion diameter and sporulation index were more in Takum and Ussa than other locations. The findings provide important guides to formulate good farmer consumer oriented researches that will help to address these constraints and to improve the livelihoods of farmers in their rural communities.

Key word: Survey, farmers' perception, leaf spots, groundnut, cropping systems

INTRODUCTION
Groundnut (Arachis hypogaea L.) is the 6th most important oil seed crop in the world. It contains 48-50% oil, 26-28% protein and 11-27 % carbohydrate, minerals and vitamin (Mukhtar, 2009). Nigeria was the third highest producer of groundnut in the world after China and India. In Nigeria, the crop is presently grown throughout the country with the exception of the riverine and swampy areas. Groundnut is either cultivated sole or in mixtures with other crops like maize, sorghum, millet or cassava. Fifty five percent of the groundnuts produced in Nigeria are in mixtures (Anonymous, 2004)). In Nigeria, the leading producing states include Niger, Kano, Jigawa, Zamfara, Kebbi, Sokoto, Katsina, Kaduna, Adamawa, Yobe, Borno, Taraba, Plateau, Nasarawa, Bauchi, and Gombe States (NAERL, 2011). Groundnut pod yields from farmers' field are low, averaging about 800 kg ha-1, less than one-third the potential yield of 3000 kg ha-1. This is due to several factors, including low access to high yielding cultivars for a particular ecology, poor soil fertility, unreliable rains with recurrent droughts, inappropriate crop management practices, pests and diseases (Ahmed et al., 2010). In Nigeria leaf spots and rosette virus are the most serious damaging diseases of groundnut (Muhammad and Bdliya, 2011). Early and late leaf spots, caused respectively by Cercospora arachidicola and Phaeoisariopsis personata (until recently known as Cercosporidium personaiurn), are the most common and serious diseases of groundnut, worldwide. Singly or together they can cause losses in pod yield of over 50%**;** in areas where rust disease is also present a combined attack of foliar diseases can cause yield losses in excess of 70% (Macdonald, et al., 1985).
There had not been documented evidence of preliminary information on status of groundnut production in Taraba State. This paper reports the results of a study on farmers' perception of field pests, weeds and pest control practices. It further helped to determine incidence and distribution of leaf spots in Wukari, Takum, Donga, Ussa and Ibi LGAs of Taraba State, Nigeria.

MATERIALS AND METHODS
Taraba State is located at the north eastern part of Nigeria. It lies between latitude 6˚ 30' and 8˚ 30' north of the equator and between longitude 9˚ 00' and 12˚ 00 ' east of the Greenwich meridian. The state shares boundaries with Bauchi and Gombe states in the north, Adamawa state in the east, and the Cameroon Republic in the south. The state is bounded along its western side by Plateau, Nassarawa and Benue states. The state has a land area of 60,291km2 with a population of 2006. Taraba State is regarded as Nature's Gift to the Nation because of its abundant natural resource endowment. The state is blessed with climate and vegetation types that cut across the country, ranging from a more humid climate and forest vegetation in the south to a more seasonal wet and dry climate and savanna vegetation in the north.

This study carried out in 2015 involved interviewing a total of three hundred farmers in five wards each in five local government areas namely Wukari (Babtaji, Tsukundi, Jibu, Avyi, Rafinkada), Takum [Manya, Dutse Gawhetun, Tikari, Chanchanji), Donga (Gayama, Mararraba, Nyita, Kumbo, Asibiti), Ussa (Jenuwagida, Lumbu, Kpakya, Tutuwa in Kwesati LIssam I, Lissam II) and Ibi (Rimi uku I, Nwonyo I, Sarkinkudu, Rimiuku II, Nwonyo II). To minimize bias, the questions were interactive and open – ended, rather than asking the farmer to select an answer among fixed choices. The survey was conducted with twelve individual farmers per ward. After covering basic information on education, farming experience, farmers' age, type of crop grown and cropping systems, the questions focused on crop constraints, pests, weeds and pest control methods. The interview was concluded in each ward with random sampling of four farmers' fields to determine the prevalent of early and late leaf spots. The five wards in each local government served as replicates; while the five local governments are the treatments. Data on prevalent of leaf spots were collected on the following: a) Infection frequency - final number of lesions per cm2 of leaf obtained by counting lesions on each leaflets of five randomly selected main stems and finding average per leaflet. Leaf area was estimated using a leaf area meter. b) Percentage leaf area damage**.** It was estimated for each leaf on the five randomly selected main stems and averaging per main stem in comparison to the diagram depicting the known percentage of the area affected and a scale of 1 to 9 (Subrahmanyam et al., 1995). c) Lesion diameter. The diameters of 10 randomly selected lesions were measured on the leaves of the main stem using millimeter scale. d) Sporulation. Five leaflets were taken from each main stem and incubated on moist filter paper in petri dishes at 25°C under continuous illumination in a plant growth chamber for 5 days. On the 6th day, the lesions were examined under a stereoscopic-microscope (x70) to score the degree of sporulation on a 5-point scale.as follows: Rating description (5-point scale). 1 = No sporulation; 2 = Very few spores; 3 = Moderate sporulation; 4 = More sporulation than score 3; 5 = Extensive sporulation. Responses obtained from farmers were analyzed using non-parametric or descriptive statistics. The data were summarized into averages, percentages or ranges. The data obtained from leaf spots disease prevalence were subjected to analysis of variance (ANOVA) for RCBD using the generalized linear model (GLM) procedure of SAS Version 9 (SAS, 2005).

RESULTS AND DISCUSSION

Farmers listed a total of 17 production constraints of which 7 were insects, 3 diseases, 2 weeds (non-parasitic category), 1 birds, 5 abiotic constraints such as drought or low soil fertility (Table 1). Leaf spots were reported as the most important diseases (55 – 92 %) across the 5 local governments (LG) follow by Rosette virus disease, while the least was Rust disease. This confirms report by Muhammad and Bdliya (2011) that leaf spots and rosette virus were the most serious damaging diseases of groundnut in Nigeria. It was further revealed that termites and aphids were considered very prominent in all the LGs visited. Dominant weed species in most groundnut farms as reported by most farmers was itch weed or Rotboellia (Table 1). The results on production practices showed that farmers employed a range of practices in groundnut production namely: early planting, use of improved varieties, intercropping, pesticide application, use of herbicides, crop rotation, burning of crop residues, fallowing among others (Table 2). Among the recommended management practices, early sowing was the management common and was being practiced by 89 % of the farmers. Pesticide application and fertilizer application were the least employed with 5.7 % and 9.8 % of farmers interviewed implementing them respectively. 46 % of the farmers practiced crop rotation, while 31.4 % reported that they adopt fallows for exhausted fields. Also 8.3 % burned crop debris after harvest. 58 % farmers weeded their farms twice during the growing season, while 39 % weeded only once during the season. Control of leaf spot diseases in Nigeria has depended on some cultural practices and on multiple applications of fungicides, though fungicidal treatment was not reported by farmers as one of the management practices. Effective and long-term control of leaf spot disease can be achieved by applying recommended fungicides at the recommended time intervals. Combination of several control strategies is recommended (Kucharek, 2004). Reduction of initial inoculum is achieved through cultural measures such as crop rotation, removal of volunteer plants, and burial of groundnut residue (Shokes and Culbreath 1997). In addition, low to moderate resistance is present in some released cultivars and much effort has been directed at developing cultivars with high levels of leaf spot resistance.

There were no statistically significant differences in percentage leaf area damaged, infection frequency, lesion diameter and sporulation index across the surveyed locations (Table 3). The result revealed that early leaf spot disease was prevalent in all the areas surveyed. This was supported by the works that both early and late leaf spots diseases are widely distributed and occur in epidemic proportions in all groundnut growing regions of the world (Nutsugah et al., 2007). It was further noted that percentage leaf area damaged, infection frequency, lesion diameter and sporulation index were more in Takum and Ussa with scores of 18.5, 2.6, 2.5, and 4.7 respectively than other locations. Leaf spot can increase rapidly under favorable conditions as several secondary cycles may occur per season. The first appearance of leaf spot and its continuous progress throughout the growing season are heavily dependent upon weather conditions. Environmental conditions required for both types of leaf spot are warm temperatures and long periods of high humidity or leaf wetness. When adequate moisture is present, leaf spot infections may occur in a relatively short period when temperatures are warm (Butler, 1990).

CONCLUSION

In conclusion, results of this survey identified production practices, production constraints, farmers' preferences and important reasons for growing groundnut. The result also revealed that early leaf spot disease was prevalent in all the areas surveyed. The results are important guides to formulate good farmer consumer oriented researches that are geared towards addressing some of these constraints and findings to improve the livelihoods of farmers in their rural communities.

Table 1: Percentage (%) farmers' responses to groundnut production constraints in Taraba State, Nigeria

		Percentage farmers' responses				
S/N	**Constraints**	**Wukari**	**Takum**	**Donga**	**Ussa**	**Ibi**
1.	**Diseases**					
	Early and late leaf spots	55	72	86	92	69
	Rust	15	18	5	2	10
	Rosette virus	30	10	9	6	21
2.	**Arthropods**					
	Millipedes / Insects	22	13	26	19	26
	Pod sucking bugs	6	-	-	3	-
	Caterpillars	8	-	-	16	-
	Aphids	35	27	37	29	36
	Beetles	13	2	8	5	-
	Grasshoppers	14	5	11	2	8
	Termites	14	53	44	35	56
3.	**Weeds**					
	Rotboellia	87	92	87	97	89
	Spear grass	13	8	13	3	11
4.	**Abiotic constraints**					
	Drought	35	28	19	14	23
	Poor germination	20	14	15	25	15
	Poor yield	39	27	25	32	19
	Lack of manure or fertilizers	4	7	18	15	23
	Poor soil fertility	2	24	23	13	20

Table 2: Mean Percentage (%) farmers using different groundnut management practices in Taraba State, Nigeria

S/N	Management practices		No of practicing farmers	% farmers responses
1.	Varieties planted	Improved	111	37
		Local	189	63
2.	Weeding regime	Once	117	39
		Twice	174	58
		Thrice	9	3
3.	Inter copping	Yes	219	73
		No	81	27
4.	Pesticide application	Yes	17.1	5.7
		No	282.9	94.3
5.	Fertilizer application	Yes	294	9.8
		No	270.2	90.2
6.	Crop rotation	Yes	138	46
		No	162	54
7.	Burning of crop residues after harvest	Yes	111	37
		No	189	63
8.	Fallowing fields	Yes	112.5	37.5
		No	187.5	62.5
9.	Planting date	Early planting	267	89
		Late planting	33	11
10.	Herbicide	Yes	225	75
		No	75	25

Table 3: Mean groundnut leaf spot disease scores in the surveyed areas of State during 2015 wet season

S/N	Location	% leaf area damage	Infection frequency (lesion per cm^2)	Lesion diameter	Sporulation index
1.	Wukari	15.0	2.4	2.3	4.5
2.	Takum	18.5	2.6	2.5	4.7
3.	Donga	17.3	2.4	2.2	4.5
4.	Ussa	16.5	2.6	2.5	4.6
5.	Ibi	12.2	2.4	2.1	4.5
	Mean	15.9	2.48	2.32	4.56
	SE	0.96	0.053	0.067	0.46

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ASSESSMENT OF COWPEA PRODUCTION PRACTICES IN WUKARI, TARABA STATE, NIGERIA

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ABSTRACT
Cowpea is an important grain legume. Production of cowpea has reduced in Taraba State due to constraints such as insect pests, diseases, Alectra infestation and lack of improved varieties. Generally, lack of knowledge of good agronomic practices worsens the limitations to cowpea production. In order to ascertain the extent of these problems and determine the needs of farmers, a baseline survey was conducted among cowpea production wards in Wukari Local Government Area of the state in 2015 cropping season. Questionnaires were administered among 125 farmers in 10 wards of the LGA. Data were collected on cropping systems, hectarages, pests constraints to production and utilization. Responses obtained from farmers were analysed using non-parametric or descriptive statistics. The data was summarised into averages, percentages or ranges. Results identified mostly 1-2 hectarages cultivated and sole cropping and a few of maize, sorghum intercrop. Insect pests, diseases and Alectra infestation were identified as major constraints to production. The results obtained will be useful in drawing a pathway for improve cowpea production in the state
Key words: Cowpea, cropping system, hectarage, constraints

INTRODUCTION
Cowpea {Vigna unguiculata (L.) Walp}, is an important grain legume. It is consumed by relatively rural and periurban people of less developed countries. Rural families derive food protein (Bressani, 1985), animal feed (Tarawali et al., 1997; Singh, 1999) and cash from the production of this crop (Quin, 1997). In addition, the crop fixes 80% nitrogen for its growth demand from the atmosphere (Asiwe et al., 2009), thereby reducing nitrogen fertilizer demand and cost for the crop. It is also an important companion crop in most cereal-legume cropping systems because of the benefit from the residual nitrogen originating from the decay of its leaf litter, roots and root nodules (Okereke et al., 2006).
Production of cowpea has reduced in Taraba State due to constraints such as insect pests, diseases, Alectra infestation, and lack of improved varieties. Generally, lack of knowledge of good agronomic practices worsens the limitations to cowpea production. In order to ascertain the extent of these problems and determine the needs of farmers, a baseline survey was conducted among cowpea production wards in Wukari Local Government Area of the state in 2015 cropping season.

METHODOLOGY
Wukari is one of the LG of Taraba State with the largest population created in 1977. It is located at the Southern senatorial districts of the State. It lies between latitude 7° 50' N and 8° 30' N and between longitude 9° 68'E and 9° 89' E. A focus groups discussion was held with average of 1 farmer groups per five wards each from five wards in Wukari. The discussion helped to determine the major cropping system, hectarages cultivated, pests constraints to cowpea production and utilization. A semi-structured questionnaire was administered to 125 farmers in their local language spread across the wards to supplement findings from the group discussions. The data collected was computed based on percentages.

RESULTS AND DISCUSSION
Table 1 presents cowpea cropping system in Wukari L G area of Taraba State. Among the farmers interviewed, 45% intercrop cowpea with maize, 32% intercrop with sorghum, 23% practiced sole cowpea production. None of the farmers practiced cowpea/millet intercrop. The results on cropping systems suggest that intercropping were predominant and that cowpea is intercropped with maize and sorghum. This practice of intercropping cowpea with cereals is in conformity with those practices in other parts of sub Saharan Africa. This explains the importance of cowpea as a companion crop in cereal-legume cropping systems which are common practices adopted by farmers in sub Saharan Africa to avert risk, crop failure and distribution of farm labour (Singh et al., 1997; IITA, 1998; Olufajo and Singh, 2002). This also points to the need to develop varieties suitable for intercrop systems as well as crop livestock integration.
Table 2 below presents the hectarages of cowpea cultivated in Wukari area of Taraba state. 50% cultivate up to 1-2 ha of cowpea, 45% uses between 3-5 ha, 3% uses between 6-9 years and only 2% more than 10 ha. Acreage cultivated per farmer was small because grain yield was also very low. In West Africa, hectarages of cowpea are small with low grain yields (Van Ek et al., 1997; Singh et al., 1997). Farmers are likely to cultivate more land if crop yield is made higher through the introduction of improved varieties as well as cultural practices (Singh and Ajeigbe, 2001, 2002). The results suggest that

cowpea production is still at subsistence level and needs a lot of improvement in terms of yield and constraints to its production.

Table 3 present major and important insect pests, diseases and weeds infesting cowpea in Wukari LGA of Taraba state. They are aphids, thrips, pod-sucking bugs and cowpea weevil (bruchids). Among the diseases (fungal, bacterial and viral), virus diseases ranked first as the most common disease attacking cowpea in both provinces (Table 3). Grasses were the most common weeds (Table 3) than the broad leaves. However, only a few respondents mentioned Striga and Alectra as important weeds in their cowpea fields. The survey revealed that insect pests, diseases (virus), common and parasitic weeds pose major constraints to cowpea production in the LG. Development of Striga/Alectra resistant varieties, use of zero tillage in conjunction with suitable herbicide application would reduce the problems posed by weeds. These findings confirm the report of (Mathews, 2005; Asiwe, 2007, 2009) that insects especially aphids and viral diseases constitute a major constraint to cowpea production. These indicate the need to breed cowpea varieties resistant to these important insect pests, drought and diseases in order to increase yield and sustain cowpea productivity. The results also confirm the reports of previous workers on the importance of these biotic factors to cowpea production (Emechebe and Soyinka, 1985; Jackai and Daoust, 1986; Singh et al., 1990; Singh et al., 1992; Asiwe et al., 2005).

CONCLUSION

In conclusion, results of this survey identified production practices, production constraints, farmers' preferences and important reasons for growing cowpea. The results are important guides to formulate good farmer consumer oriented breeding objectives. The information will be helpful to breeders and agronomists starting a new cowpea improvement programmes. Some of the breeding objectives and on-going activities in the cowpea breeding programme at ARC-Grain Crops Institute, Potchefstroom, were formulated based on the results of this survey, and are already addressing some of these constraints and findings to improve the livelihoods of farmers in their rural communities.

Table 1: Percentage Cowpea Intercropped System in Wukari LGA of Taraba State, 2015

Cropping System	Wukari
Sole	23.0
Cowpea / Maize	45.0
Cowpea /Sorghum	32.0
Cowpea /Millet	0.0

Table 2: Cowpea Hectarages Cultivated in Wukari LGA of Taraba State, 2015

Hectarages (ha)	Wukari
1-2	50.0
3-5	45.0
6-9	3.0
>10	2.0

Table 3: Pests incidence reported by farmers in Wukari LGA of Taraba State, 2015

Insect Pest	% Respondents
Aphids	30.0
Thrips	20.2
Maruca pod borer	1.0
Pod-sucking bugs	19.0
Weevils	3.0
Rodents (Meercat)	20.0
Diseases	
Viruses	18.0
Bacterial diseases	1.0
Fungal (root/stem rot	3.0
Weeds	
Alectra	1.0
Striga	6.0
Grasses	38.0
Broadleaf	8.0

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EFFECT OF ORGANIC MULCH TYPES ON THE PRODUCTIVITY OF GROUNDNUT/MAIZE IN OWERRI SOUTHEASTERN NIGERIA

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ABSTRACT

The field experiment was conducted at the Teaching and Research farm of Federal University of Technology Owerri located at latitude 5^0, 27' N and longitude 7^0, 02' E, 89% relative humidity and annual rainfall of 2300-2700mm during the 2011 cropping season. The objective of this experiment was to evaluate the effect of organic mulch types on the productivity of groundnut/maize in Owerri Southeastern Nigeria. The experiment was laid out using the Randomized Complete Block Design with five treatments and four replications. The treatments were: 31.25 ton/ha of multiple species of weeds; 31.25 ton/ha of sawdust; 31.25 ton/ha of wood shavings; 31.25 ton/ha of palm bunch refuse and 0 ton/ha that is no mulch as control. Data on various growth and yield parameters were collected and were subjected to analysis of variance (ANOVA). Means were separated using Duncan multiple range test. Results indicated that palm bunch refuse and multiple species of weed gave the highest yield for groundnut and maize. Also, palm bunch refuse and wood shaving proved most effective in reducing weed density during the experiment. In general, the observations showed that the application of organic mulch as a soil cover was effective in improving maize and groundnut crop yield, reducing weed incidence and improving soil chemical properties.

Keywords: Intercrop, palm bunch refuse, Arachis hypogea, Zea mays, soil fertility

INTRODUCTION

Declining soil fertility due to heavy rains, run-offs and leaching is a major problem facing agriculture in the tropics. In an effort to tackle this menace, it is generally necessary to adopt agronomic practices which conserve soil and water. Run-off is naturally reduced by protecting the soil with cover crops or other vegetation or with mulch, which breaks the impact of raindrops and slows down the movement of water over soil surface (Webster, 1985). Organic mulching of fields help to maintain healthy landscape of plants and soil fertility by enhancing soil nutrients and organic matter content. It also promotes increased soil micro and macro organism's activities, soil aeration and water infiltration.

Groundnut (Arachis hypogea) is one of the widely cultivated and produced legumes in Nigeria. It is cultivated for its fruits which are seeds or kernels in shell (Robbelen, et al, 1984). The seeds are widely eaten in different forms, as they can be eaten raw, roasted, sweetened or boiled with salt (Woodroof, 1984). It has high nutritional value, rich in proteins, vitamins, calcium, iron, magnesium, zinc, carbohydrate, and fat (Robinson, 1984). Groundnut is also of value as a rotational crop, being a legume with root noodles; it can synthesize atmospheric nitrogen and therefore improve soil fertility (Lanrinde, 1999). Maize (Zea mays) is a cereal crop cultivated in all parts of Nigeria. The grains are rich in vitamins A, C, and E, carbohydrates and essential minerals and contain 9% protein. They are also rich in dietary fibre and calories which are a good source of energy (Oladipo et al, 1993). Maize is also processed into pap which is part of breakfast for many families in Nigeria and can be used in the production of livestock feed (Obi, 1991).

Groundnut/Maize intercrop is important in Nigeria's agricultural system. It is therefore important to examine the effect of different organic mulches on the productivity of groundnut/maize intercrop in Southeastern Nigeria, to ensure optimum growth and yield of these crops. The objectives of this research were to: assess the field response of groundnut/maize to the different organic mulch treatments; evaluate the efficacy of the different mulches on weed control in groundnut/maize intercrop; and determine the residual soil fertility in groundnut/maize plots with different organic mulch treatments.

MATERIALS AND METHODS

The field experiment was conducted at the Research farm of the School of Agriculture and Agricultural Technology, Federal University of Technology Owerri, Imo State between March and August 2011. The farm is situated at latitude 5^0, 27' N and longitude 7^0, 02' E, in Southeastern Nigeria about 56.6m above sea level with annual rainfall, temperature and relative humidity ranging from about 2300-2700mm, 21-32 ^{0}C, and 89% respectively (Ibeawuchi, 2004). The area was manual prepared and plots made into beds each measuring 1.2x4m. The experiment was laid out using the randomized complete block design (RCBD) with 5 treatments and 4 replications. The treatments used were: Palm bunch refuse (PBR); Sawdust (SD); Multiple species of weeds (MSW) got from the packed trash after clearing; Wood shavings (WS) and Bare soil as control (C). The groundnut cultivar used was the erect, alternately branching type, whereas the maize was the variety 096EP6 NARZO-18(FARZ-23) with yellow grains. Groundnut was planted at a spacing of 50cmx50cm, whereas maize was planted at a spacing of 100cmx100cm. The various organic mulch treatments were applied on the plots immediately after planting at the rate of 15kg per plot (31.25ton/ha). Chemical analysis of organic mulches and Soil physiochemical analysis before and after the experiment were carried out.

The following growth and yield parameters were measured: plant height and number of leaves at 2, 5, and 8 weeks after planting (WAP); total fresh fruit (cobs and pods) weight at harvest and weed weight.

The data from the experiment were subjected to analysis of variance and differences between means were separated using Duncan multiple range test as described by Obi, (2002).

RESULTS AND DISCUSSION

The chemical and physical analysis of the soil prior to planting shows that the soil is slightly acidic (5.61 in H_2O and 4.62 in KCl). The organic matter content is also low (6.45%), with low nitrogen content (0.32%) and low cation exchange capacity (5.05 cmol.kg). This confirms reports that soils in southeastern Nigeria are characterized by low pH, low organic matter content and low exchangeable cation (Ohiri, 1992).

The post-harvest soil analysis from table 2 shows that there was increase in the nutrient contents of the soil. The total available phosphorus concentration of the soil was increased from 7.36 ppm to 8.35 ppm in soil with MSW treatment. This is in line with the data of Saroa and Lal, (2004) which showed that organic mulching increased total phosphorus concentration in the soil after 4 years of mulching from 601-658 mg/kg. Sinkerviciene et al, (2009) also confirms that grass mulch had the most influence on increased available phosphorus in the soil. From tables 1 and 2 it is evident that soil had higher amount of organic matter than all different mulches non-the-less, organic matter content of the soil increased after the experiment (Table 2).

The response of plant heights of groundnut and maize to organic mulches is presented in tables 3. For groundnut at 2 and 5 WAP, plants mulched with PBR and MSW were significantly taller ($p \leq 0.05$) than those that received other treatments but at 8WAP these differences were no longer evident. The response of maize plant height to organic mulches was inconsistent. This is in agreement with the report by Singh et al, (2007).

Different organic mulch treatments did increase number of leaves of maize compared to the control at most sampling periods (Table 4). The effect of the different organic mulches on weed weight is highlighted by table 5. Visually, the plots with MSW treatments had the highest occurrence of weeds. This could be because of the germination of weed seeds in those plots. This partially varies from the work of Sinkerviciene et al, (2009) which noted that the influence of grass mulch significantly decreased weed number compared to that of unmulched plots. They however observed that in 2008, weed density in plots mulched with grass was higher than in plots mulched with straw, peat and sawdust due to rapid emergence of Poa annua in the second part of summer when grass mulch has been infected with seeds of Poa annua.

The effect of different organic mulches on fresh weight of maize and groundnut at harvest is presented in table 5. In both crops, treatments with PBR and MSW gave the highest yield. This is because they have the highest nutrient contents

CONCLUSION

Results obtained from this study indicated that multiple species of weeds (MSW) and palm bunch refuse (PBR) applied at the rate of 1.25 ton/ha significantly improved yield of maize and groundnut compared to other organic mulch treatments assessed. The residual soil nutrient was also maintained and sustained with the mulch treatment.

Table 1: Soil physiochemical analysis before planting

Soil physical/ chemical properties	
Horizon	0-20
pH in H_2O	5.61
pH in KCl	4.62
Organic carbon	3.73 cmol/kg
Organic matter	6.45%
Aluminium (Al^{3+})	0.70 cmol/kg
Hydrogen (H^{+})	0.70 cmol/kg
Total exchangeable acidity (TEA)	1.00 cmol/kg
Total available % Nitrogen	0.32%
Calcium (Ca^{2+})	2.20 cmol/kg
Magnesium (Mg^{2+})	1.60 cmol/kg
Potassium (K^{+})	0.90 cmol/kg
Sodium (Na^{+})	0.16 cmol/kg
Cation exchange capacity	5.05 cmol/kg
Percentage base saturation	80.1%
Available phosphorus	7.36 ppm
Sand	76.40%
Silt	6.00%
Clay	17.60%
Soil textural class	Sandy Clay

Table 2: Post-harvest soil chemical analysis

Chemical properties	PBR soil	SD soil	MSW soil	WS
pH in H_2O	5.63	5.88	5.60	5.88
pH in KCl	4.66	5.10	4.30	5.10
Organic matter	7.15	6.00	8.80	6.55
Total exchangeable acidity	1.20	1.01	1.15	1.06
Exchangeable Al^{+}	0.75	0.70	0.72	0.71
Exchangeable H^{+}	0.45	0.31	0.43	0.35
Total available Nitrogen	1.20	1.25	1.50	1.30
Calcium	3.75	3.85	3.78	3.98
Magnesium	2.00	1.70	2.20	1.85
Potassium	1.40	0.70	1.60	1.20
Sodium	0.60	0.49	0.29	0.72
Cation exchange capacity	8.1	7.24	8.02	7.65
Available phosphorus	7.50	7.40	8.35	7.65
Basic saturation %	85.2	86.0	85.6	86.6
	Chemical analysis of organic mulch samples			
pH in water	5.67	6.25	5.61	6.25
pH in KCl	4.73	5.86	4.29	5.86
Sodium (cmol/kg)	0.62	0.75	0.45	0.75
Nitrogen (%)	1.00	1.32	1.86	1.32
Phosphorus (ppm)	0.67	0.74	1.35	0.74
Potassium (cmol/kg)	0.54	0.32	0.73	0.32
Magnesium(cmol/kg)	0.92	0.42	1.21	0.42
Calcium (cmol/kg)	2.40	3.20	2.60	3.20
Organic matter (%)	1.29	1.17	2.56	1.17
pH in water	5.67	6.25	5.61	6.25

Table 3: Effect of different organic mulches on plant height (cm) of groundnut and maize

	Mean groundnut plant height (cm)			Mean maize plant height (cm)		
Treatments	2WAP	5WAP	8WAP	2WAP	5WAP	8WAP
1.25 ton/ha palm bunch refuse	11.75a	29.75a	36.50a	20.25a	81.88a	184.9a
1.25 ton/ha multiple species of weeds	14.85a	30.63a	36.17a	15.10a	67.00a	182.5a
1.25 ton/ha saw dust	11.00b	22.50b	33.00a	15.15a	52.62b	140.6a
Control (zero mulch)	10.93b	23.25b	28.30a	17.83a	60.62a	144.0a
1.25 ton/ha wood shaving	10.25b	21.13b	30.25a	14.65a	43.00b	109.0b
$LSD_{0.05}$	3.44	8.96	8.24	6.28	27.66	65.3

WAP- Weeks after planting.

Table 4: Effect of different organic mulches on number of leaves of maize at 2, 5, and 8 WAP

Treatments	Mean number of leaves		
	2WAP	5WAP	8WAP
1.25 ton/ha palm bunch refuse	5.17a	7.87a	10.00a
1.25 ton/ha multiple species of weeds	4.40a	7.12b	10.30a
1.25 ton/ha saw dust	4.15b	6.13b	9.00a
Control (zero mulch)	4.92a	6.37b	9.05a
1.25 ton/ha wood shaving	4.25a	5.25b	7.25b
$LSD_{0.05}$	0.96	1.40	2.49

WAP- Weeks after planting.

Table 5: Effect of different organic mulches on weed wt. and fresh weight harvest (kg)/ ha of maize and groundnut

Treatments	Mean harvest weight (kg/ha)		Weed weight
	Maize	groundnut	Weight (kg)/ ha
1.25 ton/ha palm bunch refuse	5,666.70a	1,416.60a	20.83a
1.25 ton/ha multiple species of weeds	3,958.00ab	1,364.50a	83.33c
1.25 ton/ha saw dust	3,437.50b	1,137.00b	20.83a
Control (zero mulch)	3,645.80b	1,145.80b	62.50b
1.25 ton/ha wood shaving	3,854.20b	1,147.90b	20.83a
$LSD_{0.05}$	1,729.00	125.00	0.35

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VARIETAL EFFECT AND COMPARATIVE EVALUATION OF ETHANOL PRODUCED FROM CASSAVA FLOURS AND STARCHES

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ABSTRACT
Flours and starches were processed from three cassava varieties namely TMS 98/0505, TMS 419 and NR 8082. The flours and starches were fermented employing Termamyl Type L Novoenzyme (an alpha amylase), glucoamylase from A.niger and dried form of Saccharomyces yeast .The flours and starches were analysed for moisture/dry matter, fibre, amylose and amylopectin contents. Slurries obtained were analysed for glucose contents, pH, total titratable acidity (TTA) and temperature during 72hrs of fermentation. The ethanol yield of the flours and starches were determined. Significant differences (P<0.05) were found among the cassava flours/starches with respect to moisture/dry matter, fibre, amylose and amylopectin contents. The ethanol yield of the flours and starches tended to be dependent on their amylose contents. Correlation between amylose and ethanol yield were 96.20% (flour) and 86.39% (starch). The yields of ethanol from filtrates of slurries obtained from fermented cassava starch samples were higher than that of the flour samples. Ethanol yields from starch of TMS 98/0505, TMS 419 and NR 8082 were 20.49%, 18.98% and 18.21%, respectively. Those of flour samples were 14.01%, 14.04% and 12.56%, respectively. The glucose contents and the pH of the fermenting slurries of the flours and starches decreased as fermentation progressed, whereas their TTA and temperatures generally increased. Ethanol yields from starch of TMS 98/0505 were the highest when compared with the other varieties used. The study recommends the use of starch from cassava variety TMS 98/0505 as raw material in ethanol production.

Keywords: cassava, flour, starch, fermentation, ethanol yield.

INTRODUCTION
The markets for domestic and industrial starches are expanding and cassava (Manihot Esculenta Crantz) is mostly satisfied as one of the crops. Cassava is particularly important as a source of starch in tropical and sub-tropical regions.

Starch and flour, the main plant carbohydrates are the most important plant derivatives used by man. They have unlimited importance in industry and food and can be modified to suit various applications using in-expensive methods making them ideal for a number of purposes (Nadir et al., 2009). Starch consists of two polysaccharides, the linear molecule, amylose and a highly branched molecule, amylopectin.

Termamyl, an α-amylase isolated from Bacillus licheniformis, a soil bacterium. This enzyme hydrolyses 1, 4-α-glucosidic linkages in starch and possesses a high degree of heat stability. It is used for the continuous liquefaction of starch at temperatures of up to 105-110ºC, breaking them rapidly to dextrins and oligosaccharides. Amyloglucosidase (AMG), an exo-1, 4-α-Dglucosidase (glucoamylase) was obtained from a selected strain of the fungus, Aspergillus niger. This enzyme hydrolyses 1, 4- and 1, 6-α-glucosidic linkages in liquefied starch in stepwise manner from the non-reducing end of the substrate molecules (Alais and Linden, 1999).

Bio-ethanol is a strategic raw material with wide range of applications in food, pharmaceutical, cosmetic, and petrochemical industry (Baras et al., 2002). Also, it has been used as a modern biofuel, applied directly as a gasoline improver or gasoline substituent (Demirbas, 2006), or in the form of ETBE (ethyl tertiary buthyl ether), to substitute for currently added synthetically-produced octane enhancers (Rosenberger, 2005), and in ethanol-diesel blends with particular purpose to reduce the emissions of exhaust gasses (Hansen et al., 2005). Works have been carried out by comparing the yields of ethanol obtained from starches and flours of sweetpotato varieties (Etudaiye et al., 2012). There is dearth of information on the comparative evaluation of ethanol produced from cassava starch and cassava flour. The objective of this work is to evaluate the quality of ethanol produced from starches and flours of different cassava varieties.

MATERIALS AND METHODS
Fresh roots of three (3) cassava varieties TMS 98/0505, TMS 419 and NR 8082 were harvested at about 11 months old from field trial of cassava Programme, National Root Crops Research Institute, Umudike. The Cassava Mosaic Disease (CMD) resistant varieties (TMS 98/0505 and TMS 419) were developed for food, feed and industrial use (Dixon et al., 2005). Termamyl Type L Novoenzyme AYN02215 (an alpha amylase), glucoamylase from A.niger and dried form of Saccharomyces yeast(BP1422-500,Fischer Scientific,Pittburgh,PA) were obtained from the International Center for Tropical Agriculture (CIAT), Palmira, Colombia.

Processing of fresh cassava roots to starch and flour

Cassava starch and flours were produced using the recommended standard methods described by the International Institute of tropical Agriculture (IITA, 2005). The starch constituted 100% particles that passed through a 425 µm sieve.

Determination of moisture and dry matter contents

Moisture and dry matter contents of flour and starch samples were determined by the AOAC methods (1996)

Determination of pH and Titratable Acidity (TTA)

At constant weight (90g) of the fermenting mash, each sample of flour and starch from each variety was analysed for pH, titratable acidity (TTA) and mash temperature. pH and TTA of the fermenting cassava mash were determined by the AOAC methods (1996).

Determination of mash/slurry temperature

Temperature of fermented slurries of starch and flour samples was determined using a calibrated thermometer.

Determination of amylose and amylopectin

Amylose and amylopectin of the flour and starch samples were determined following the colorimetric standard procedure of Sanchez et al., 2009.

Statistical analysis

Data obtained were subjected to statistical analysis with the aid of Statistical Analytical System (SAS) software, version 8, 2009. Analysis of variance (ANOVA) was done. Mean separation by Fischer LSD to determine significant difference (p at 0.05) was carried out.

RESULTS AND DISCUSSION

Table 1 shows values of some biochemical contents of flours from cassava varieties for ethanol production. Moisture contents (MC) were low and ranged from 8.77- 9.60%. Dry matter contents (DM) were high and ranged from 90.40-91.27%. Fibre ranged from 1.06-1.12%. Amylose contents were in appreciable levels and ranged from 17.93-18.74%. There was a significant difference ($p < 0.05$) in the parameters determined. Table 2 shows values of some biochemical contents of starches from cassava varieties for ethanol production. MC were low and ranged from 5.76- 6.18%. DM contents were high and ranged from 93.82-94.24%. Fibre ranged from 0.25-0.30%. Amylose contents were in appreciable levels and ranged from 19.82-20.28%. There was a significant difference ($p < 0.05$) in the parameters determined. Table 3 shows ethanol yields of flours and starches from cassava varieties after 72hrs fermentation. Ethanol yield was highest from the flour of Cassava variety TME 419 (140.4g/L) and highest in the starch of cassava variety TMS 98/0505(204.9g/L). There was no significant difference ($p > 0.05$) in the ethanol yields from flours of cassava varieties TME 419 and TMS 98/0505. There was a significant difference ($p < 0.05$) in the ethanol yields from starches of three cassava varieties used. Table 4 and 5 show some changes in the physic-chemical parameters during 72 hours fermentation of cassava flour and starch slurries, respectively. Glucose, pH and temperature of the slurries decreased as fermentation progressed while the TTA and temperatures decreased. Values of pH and TTA were similar to the previous values reported by Ajibola et al, 2012. Tables 6 and 7 show a positive correlation between amylose and ethanol yields from flour and starch samples. High amylose content gives rise to high ethanol yields and this can be used as a practical approach in determining the production potential and marketability of ethanol. This is in line with previous report of Etudaiye et al., 2012.

CONCLUSION

The study revealed that flours and starches produced from the cassava varieties used are suitable for ethanol production. They were found to have good qualities in terms of high dry matter and high amylose contents. However, cassava variety TMS 98/0505 stands out as it starch has shown very high potential for ethanol production.

Table 1: Biochemical properties of flours from cassava varieties used for ethanol production

Cassava variety	Moisture (%)	Dry matter (%)	Fibre (%)	Amylose (%)	Amylopectin (%)
TMS 98/0505	8.73c	91.27a	1.08ab	18.74a	81.16c
TME 419	9.60a	90.40c	1.12a	18.53b	81.47b
NR8082	9.45b	90.55b	1.06b	17.93c	82.07a
LSD (0.05%)	0.04	0.06	0.06	0.07	0.04

Values with different letters are significantly different (P<0.05)

Table 2: Biochemical properties of starches from cassava varieties used for ethanol production

Cassava variety	Moisture (%)	Dry matter (%)	Fibre (%)	Amylose (%)	Amylopectin (%)
TMS 98/0505	5.76c	94.24a	1.26a	20.28a	79.32c
TME 419	6.18a	93.82c	0.30a	20.19b	79.81b
NR8082	5.84b	94.16b	0.25a	19.82c	80.08a
LSD (0.05%)	0.05	0.07	0.07	0.04	0.03

Values with different letters are significantly different (P<0.05)

Table3: Percentage Ethanol yield (v/w) from flours and starches of cassava varieties after 72 hours fermentation

	% Ethanol yield (v/w)	
Cassava variety	**Cassava flour**	**Cassava starch**
TMS 98/0505	14.01a	20.49a
TME 419	14.04a	18.98b
NR8082	12.56b	18.21c
LSD (0.05%)	0.489	0.200

Values with different letters are significantly different (p<0.05)

Table 4: Some changes in physico -chemical parameters during 72hrs fermentation of cassava flour

	Glucose			pH			TTA			Temperature		
Cassava variety	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**
TMS 98/0505	8.90	3.20	(-)	4.90	3.16	(-)	0.58	0.78	(+)	29	30	(+)
TME 419	8.63	2.94	(-)	4.85	3.42	(-)	0.52	0.70	(+)	28	32	(+)
NR8082	8.16	2.70	(-)	4.92	3.40	(-)	0.48	0.67	(+)	29	32	(+)

Table 5: Some changes in physico -chemical parameters during 72hrs fermentation of cassava starch

	Glucose			Ph			TTA			Temperature		
Cassava variety	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**	**0hr**	**72hr**	**Changes**
TMS 98/0505	8.76	2.85	(-)	4.65	2.94	(-)	0.58	0.78	(+)	28	32	(+)
TME 419	8.45	2.70	(-)	4.74	3.25	(-)	0.52	0.70	(+)	29	30	(+)
NR8082	7.62	2.56	(-)	4.85	3.34	(-)	0.48	0.67	(+)	28	31	(+)

Table 6: Correlation coefficient between dry matter, amylose and ethanol yield using cassava flour

	Dry matter (%)	Amylose (%)	Ethanol yield (%)
Dry matter	1	0.57	0.34
Amylose		1	0.96
Ethanol yield			1

Table 7: Correlation coefficient between dry matter, amylose and ethanol yield using cassava starch

	Dry matter (%)	Amylose (%)	Ethanol yield (%)
Dry matter	1	0.15	0.36
Amylose		1	0.86
Ethanol yield			1

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THE EFFECT OF CASSAVA PROCESSING EFFLUENT ON THE GROWTH PERFORMANCE OF ABELMOSCUS ESCULENTUS L. MOENCH

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ABSTRACT
The effect of cassava processing effluent on the growth performance of Abelmoscus esculentus L. Moench was studied at the University of Port Harcourt Botanical Garden. Experimental treatments were obtained by mixing thoroughly 3kg of loam- sandy soil with 0, 25, 50, 75 and 100% of cassava processing effluent. 0% (unpolluted soil) was used as control. One seed was maintained in a polybag containing the various levels of cassava processing effluent with garden soil. Each level of treatment was replicated three times and maintained for 7 weeks, significant (P=0.05) reduction in the leaf number, fresh weight, dry weight, moisture content, plant height, root length were recorded from cassava processing effluent treated soils. Increase in the concentration of the effluent at 100% level of pollution did not support any growth of Abelmoschus esculentus. This study therefore, shows that cassava effluent is injurious to the growth of Abelmoscus esculentus.
Keywords: Cassava processing effluent, Growth performance, Abelmoscus esculentus.

INTRODUCTION
In Nigeria cassava (Manihot esculenta Crantz) is regarded as a staple food crop due to its rich carbohydrate content (Idem and Showemimo, 2006). However the processing of cassava into usable products generates a lot of liquid waste. These waste product generated from the processing activities get disposed on land and have been shown to constitute negative impacts on soil and plant growth (Kapanen and Itavaara, 2001). Fresh cassava roots contain 60-70% water which make them to deteriorate within 2-4 days after harvest. They also contain Cyanogenic glucosides (Linamarin and Lotaustralin) and endogenous enzyme linamarase, when the enzyme comes in contact with the cyanogenic glucosides, a poisonous substance, hydrogen cyanide (HCN) is released. Processing of cassava root after harvest is therefore very necessary to reduce the risk of cyanide poisoning during their consumption. However, the waste water generated in the process still contains considerable quantity of Cyanogenic glucoside, which has been known to suppress plant growth (Kapanen and Itavaara, 2001). Incidents of deleterious impacts of liquid wastes discharged into the environment are prevalent and thus require serious consideration. The anticipated directional upset of the ecosystem balance may now become emergent or alter the growth and physiological processes in plants as a result of the negative impact of toxic liquid waste (Conley and Olenik, 1992).
It is on this basis that this research is conducted in order to evaluate the effects of waste water generated from cassava processing mills on the growth and nutrient contents of Okro (Abelmoschus esculentus L. Moench).

MATERIALS AND METHOD
The mature seeds of Abelmoschus esculentus were collected from Akwa Ibom State, Agricultural Development Project (AKADEP). Loam - sandy soil was obtained from the University of Port Harcourt Botanical Garden. Waste water cassava processing effluent was obtained from cassava processing mill in Ini Local Government Area. The effluent was analyzed for physico-chemical properties (A.O.A.C, 1984).
Three kilogram (3kg) of the loam-sandy soil was weighed using a triangular weighing balance. The treatment were obtained by mixing thoroughly 3kg of loam-sandy soil with 0, 25, 50, 75 and 100% of cassava processing effluent, samples with or without cassava processing effluent were placed in perforated polybags. The seeds were sterilized with approximately 0.01% mercuric chloride Solution for 30 seconds, thoroughly washed several times with sterile distilled water and air dried (Esenowo and Umoh, 1996). During this treatment floating seeds or those that had bubbles were discarded and the good once were used for the research. Three seeds of were sown directly in each perforated polythene bag containing the various levels of cassava effluent and after germination it was thinned down to one seedling per bag. Each level of treatment was replicated three times using Randomized Complete Block Design. The experimental work was maintained under light condition. The plant watered as need arose and allowed to grow' for 7 weeks in order to determine the growth and yield performance.
Growth parameters were measured and recorded at the end of the studies (7weeks). The plant height (cm), root length (cm), leaf number, shoot/root ratio, fresh weight (g), dry weight (g), moisture contents were determined and recorded.

Data generated from this study were subjected to analysis of variance (ANOVA) according to the method of Obi (2000).

RESULTS AND DISCUSSION

The physico-chemical properties of the cassava processing effluent showed that the effluent was acidic with a pH of 4.50. The proportions of calcium, sodium, magnesium, potassium, lead and iron were high, while the copper and manganese contents were low. The cyanide contents (0.61 MgL^{-1}) and the total dissolve solids content (9, 600 MgL^{-1}) of the effluent were high (Table 1). The effluent used in this study is characterized by an acidic pH, and a biological oxygen demand level that is within the permissible level of 30-70ppm for river discharge (Olorunfemi et al., 2007).

There were significant (P=0.05) reductions in plant height of Abelmoschus esculcntus with increase in the concentration of cassava effluent (Fig.1).100% concentration of cassava effluent treatment did not support the growth of Abelmoschus esculentus (0.00). The leaf number of Abelmoschus esculentus was significantly reduced with increase in the concentration of cassava effluent.Values recorded in cassava effluent treatment were comparatively lower than the control as shown in Fig.1. The root length of Abelmoschus esculentus was significantly (P=0.05) reduced with increase in the concentration of cassava effluent as shown in Fig.1. Similarly, the shoot/root ratio decreased with increased in the concentration of cassava effluent.

In this study, cassava processing exhibit deteriorative effect on the growth parameters of Abelmoschus esculentus. This result agrees with the work of Olorunfemi et al., (2007) who reported that cassava processing effluent posed an inhibitory effect on the germination of some cereal crops. There was significant (P=0.05) reduction in fresh weight of Abelmoschus esculentus with increase in the concentration of cassava effluent .The dry weight of Abelmoschus esculentus decreased with increase in the concentration of cassava effluent. There were slight increase in moisture content ot Abelmoschus esculentus at 25% concentration above the control treatment. In addition the moisture content of Abelmoschus esculcntus increased at 50% and 75% concentrations of effluent above those of the control (Fig.2). The overall decrease in the growth of Abelmoschus esculentus in cassava processing effluent agrees with the work of Ogboghodo et al., (2003). This shows that nutrient unavailability is one the factors that limit growth of crops in acidic medium (Bannister, 1980). In this study the characteristics of the cassava effluent showed the presence of some heavy metals as well as cyanide content. These physico-chemical properties are consistent with the work of Onwueme and Sinha, (1991). Thus, the presence of heavy metals in the cassava effluent together with cyanide contents could have contributed significantly to the reduced growth of Abelmoscus esculentus.

CONCLUSION

This study showed that cassava processing effluent inhibited the growth of Abelmoscus esculentus.The growth parameters such as plant height, leaf number, root length, shoot/root ratio, fresh weight, dry weight and moisture content of the crop were negatively affected by cassava processing effluent. Therefore, this study suggests that cassava processing effluent should be disposed off properly to avoid contamination of the environment.

Table 1: Physico-Chemical Characteristics of Cassava Processing Effluent

Characteristics	Concentration (mgL)
pH	4.50
Cyanide (μgML^{-1})	0.61
Total dissolved solids	9,600
Total suspended solids (ppm)	1,800
Biological Oxygen Demand (ppm)	66.40
Magnesium	20.30
Calcium	46.91
Potassium	52.70
Sodium	72.14
Copper	1.32
Manganese	0.63
Iron	1.74
Lead	6.47

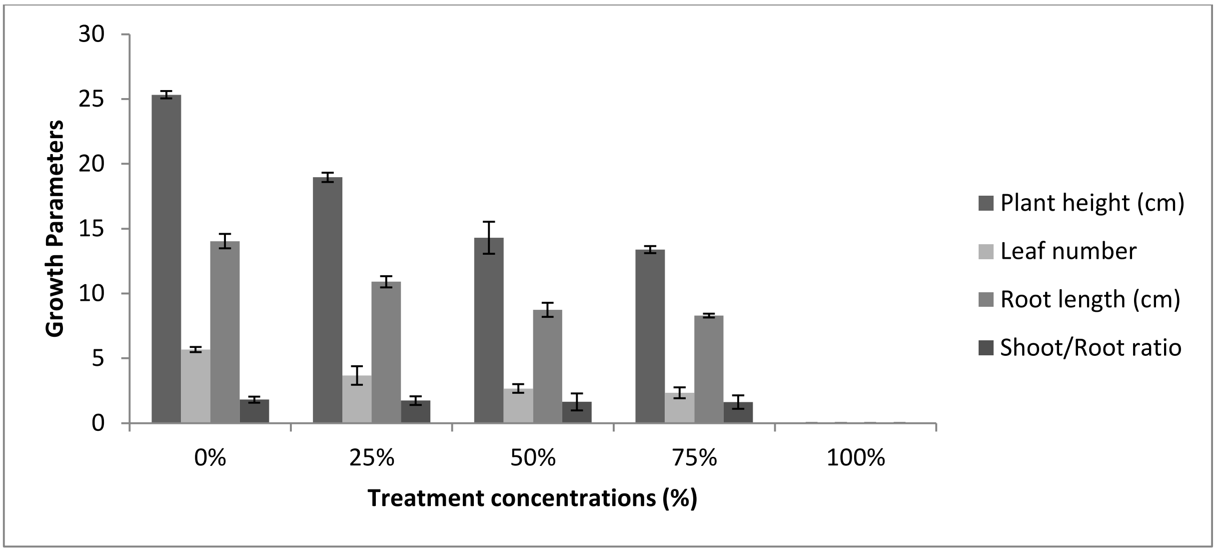

Fig. 1: Growth Parameters of Abelmoschus esculentus grown in soil treated with cassava effluent.

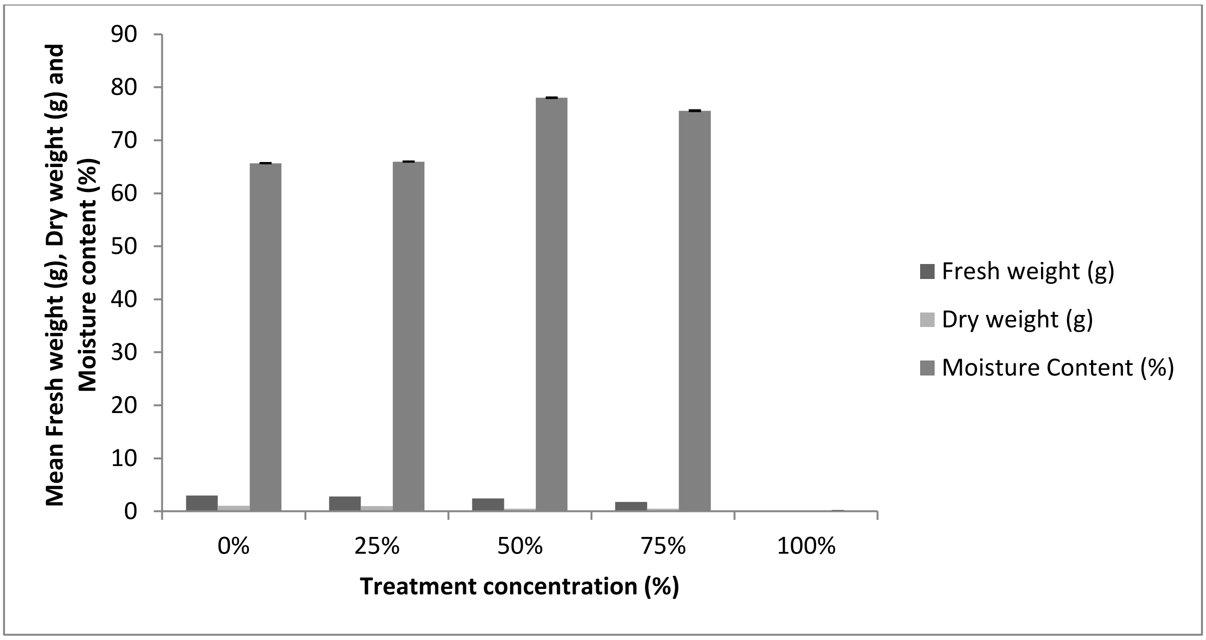

Fig. 2: Mean Fresh weight (g), Dry weight (g), and Moisture content (%) of Abelmoschus esculentus grown in cassava effluent treated soil

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THE EFFECTS OF DIFFERENT RATES OF POULTRY MANURE ON THE PERFORMANCE OF FLUTED PUMPKIN (TELFERIA OCCIDENTALIS) IN IMO STATE

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ABSTRACT
The experiment was carried out in the demonstration farm of Imo State Polytechnic Umuagwo. The experimental land was divided into three (3) blocks each containing four (4) beds to give a total of 12 beds. Each bed sizes was 1mx2m and with 0.5m gap between beds. The blocks were spaced 1m apart to ease movement during cultural operations. A bed contained 2 plants. The treatments involved four (4) different rates of poultry manure application. (i) 0 ton/ha (ii) 5 tons/ha (iii) 10 tons/ha (iv) 15 tons/ha. The treatments were assigned into the plots in a randomized complete block design (RCBD) with three (3) replications. Seed was sown per hole at a spacing of 1mx1m. Data were collected at 2 weeks after planting and at 2 weeks intervals thereafter. The data collected during the experiment included the following parameters; vine length, stem girth, number of branches, and number of leaves and finally grain yield after harvest. Analysis of variance (ANOVA) and Fisher's least significant differences (FLSD) at $p \leq 5\%$ was undertaken on the data collected. The results of the study showed that 10 tons/ha level of poultry manure application was effective in increasing growth parameters and yield of fluted pumpkin.
Keywords: Poultry manure, performance, fluted pumpkin
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INTRODUCTION

Telfairia occidentals is a tropical vine grown in West Africa as a leaf vegetable and for edible seeds. Common names for the plant include fluted gourd, Fluted pumpkin and Ugu. It is a palatable leafy vegetable in Eastern Nigeria. Telfairia occidental is a member of the Curcurbitaceae family and is indigenous to Southern Nigeria. The seeds are high in protein and fat, and can therefore contribute to a well-balanced diet. The plant is dominantly used by the Igbo tribe, who continue to cultivate the gourd for food source and traditional medicines (Ali, 2005). Fluted pumpkin produces a lot of biomass and its nutrient requirements are generally considered to be high.

Poultry manure is abundantly available in many parts of Nigeria, wasting and sometimes constituting nuisance where it is generated as a by-product of poultry farms-it has been established that poultry manure (pm), contains sizeable levels of nitrogen and that 60-80% of its nitrogen is organic form, while the remaining 20-40% is an inorganic fractions and that approximately 50% of the organic is mineralizeable within 90 days under laboratory conditions. Organic fertilizers including farmyard manure, sheep manure and poultry manure may be used for the crop production as a substitute of the chemical fertilizers becomes the importance of the organic manure cannot be overlooked. Worldwide, there is growing in test in the use of organic manure due to depletion in the soil fertility. Organic manure (OM) improves soil structure, water, air and nutrient retention in the soil, buffers soil chemical imbalances, supports living organisms (I.F.A.S, 2005). Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients in contrast to chemical fertilizer, it adds organic matter to soil which improves soil structure, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa et al., 2008). It was also indicated that poultry manure more readily supplies to plants than other organic manure sources (Garg and Bahla, 2008).

In agriculture, the main reasons for applying PM include the organic amendment of the soil and the provision of nutrients to crops (Warren et al, 2006). Poultry manure is an excellent organic fertilizer as it contains high nitrogen, phosphorus, potassium and other essential nutrients. In contrast to chemical fertilizer, it adds organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity and water infiltration (Deksissa et al, 2008).

The objective of this study was to evaluate the effect of different rate of poultry droppings on the performance of Fluted pumpkin in the research farm of Imo State Polytechnic Umuagwo.

MATERIALS AND METHODS

The experiment was carried out in research farm of Imo State Polytechnic Umuagwo in Ohaji-Egbema Local Government Area of Imo State, Southeastern Nigeria. The experimental site lies between latitude $5^{0}17'$N, and longitude of $7^{o}54$E. It lies within the low lying geomorphology of South Eastern Nigeria (Orajaka et al., 1978).

Palm trees and cassava are the predominant tree and plant respectively in the area. The rainfall pattern is bimodal between April and October. The town is in wet humid equatorial rainforest zone with 2250-2500mm of annual rainfall, annual relative humidity of 88% with mean temperature of 27°C and the soil type is sandy loam.

The conventional tillage operations which include land clearing and preparation of beds were carried out to conserve the soil and its nutrients. The land was cleared and beds were constructed. The experimental land was divided into three (3) blocks each containing four (4) beds to give a total of 12 beds. Each bed size was 1mx2m and with 0.5m gap between beds. The blocks were spaced 1m apart to ease movement during cultural operations. A bed contained 2 plants. The treatments involved four (4) different rates of poultry manure application: T_0 – 0 ton/ha, T_1 - 5 tons/ha, T_2 – 10 tons/ha, T_3 – 15 tons/ha. The treatments were assigned into the plots in a randomized complete block design (RCBD) with three (3) replications.

Fluted pumpkin (Telfairia Occidentalis) seeds were extracted from pods which were obtained from the Agronomy Department, Michael Okpara University of Agriculture Umudike, Umuahia Abia State. They were air dried for 24 hours before planting. Thereafter the beds were irrigated to improve soil moisture content, seed germination and seedling emergence. Planting was done early in July, 2014. Two seeds were sown per hole at a spacing of 1mx1m and later thinned down to one seedling per stand at four weeks after sowing (WAS). Application of fertilizer treatments were done according to the rate allocated to each plots by band placement. Watering of seedling was done every morning at two days interval only when there is no rainfall for two (2) days to avoid wilting and to improve the growth and development. Weeds were controlled twice manually by hoe at 4 and 8 weeks after sowing.

Data were collected 2 weeks after planting and at 2 weeks intervals thereafter. The data collected during the experiment included the following parameter; vine length, stem girth, number of branches, leaf area, number of leaves and finally grains yield after harvest, number of flowers when flowering starts. At pod maturity (at 10 weeks after planting), the pod yield and the yield components collected included number of pod per plant, fruit weight (kg) per plant; number of seeds per pod.

Analysis of variance (ANOVA) was undertaken on the data collected so as to determine if there were any significant differences.

RESULTS AND DISCUSSION

The results of the treatment on growth parameters are presented in tables 1, 2, 3, 4 and 5. Stem girth increased significantly with organic manure application beginning from 2 WAP (Table 1). The increase appears to peak at 10 tons as application of 15 tons did not lead to any further increase in stem girth. Number of leaves of fluted pumpkin increased with application of 5-15 tons of manure beginning from 6 WAP. Application of 15 tons/ha was not better than 10 tons/ha in terms of number of leaves produced (Table 2). Number of branches was similar in all treatments at 2-4 WAP but increased with the application of 10-15 tons of manure per hectare beginning from 6-10 WAP. Again plants that received 15 tons of manure did not produce more branches than those that received 15 tons (Table 3). Vine length followed a trend similar to that of stem girth and number of leaves (Table 4). Average yield increased significantly ($p \leq 0.05$) with poultry manure application up to 10 tons. Thereafter further addition did not increase yield (Table 5).

The result of the study showed that fluted pumpkin growth and yield parameters were improve by the application of 5,10,15 ton/ha of poultry manure. This experiment showed an increase in growth parameter and yield when compared with the control treatment. The mean values of vine length, number of leaves, stem girth; number of branches and yield were positively correlated with different levels of poultry manure application. Plants that received 10tons/ha of poultry manure gave the tallest vine length, highest number of stem girth, number of leaves and branches when compared with other treatments. Application of 15tons/ha of poultry manure has a significant different with T_0 and T_1 and no significant difference where observed when compared with T_2. This result was in line with work done by (Ewulo, 2005) which reported that application of different levels of poultry manure increase the growth parameters and yield of fluted pumpkin.

CONCLUSION

The results showed that the effect of different levels of poultry manure application on fluted pumpkin yield was significant ($p \leq 0.05$). Application of 10 tons/ha level of poultry manure obtained higher yield when compared with other treatments. The data presented in tables illustrated the positive effect of different levels of poultry manure application. The growth parameter and yield were significantly increased by the application of 5, 10 and 15 tons/ha levels of poultry manure when compare to the plot with no application of poultry manure, which showed a reduction in yield.

Table 1: Effect of different rate of poultry manure on stem girth of fluted pumpkin

Growth parameter	Treatment	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Stem Girth (mm)	T_0-0ton/ha	2.9c	4.5a	3.9c	4.6c	4.6b
	T_1-5tons/ha	3.4c	4.2a	4.3b	5.1b	5.1a
	T_2-10tons/ha	3.9b	4.4a	5.2a	5.9a	5.9a
	T_3-15tons/ha	3.3b	4.0a	5.1a	5.8a	5.8a

$FLSD_{0.05}$ row values with different letters are significantly different @ p = 5%

Table 2: Effect of different rate of poultry manure on number leaves of fluted pumpkin

Growth parameter	Treatment	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Number of leaves	T_0-0ton/ha	13b	28b	32c	37c	56c
	T_1-5tons/ha	15b	29b	36b	42b	62b
	T_2-10tons/ha	17a	32a	42a	47a	69a
	T_3-15tons/ha	17a	32a	42a	45a	68a

$FLSD_{0.05}$ row values with different letters are significantly different @ p = 5%

Table 3: Effect of different rate of poultry manure on number of branches of fluted pumpkin

Growth parameter	Treatment	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Number of branches	T_0-0ton/ha	2a	3a	4b	7.3b	10.7b
	T_1-5tons/ha	2.3a	4a	4.7b	8.7b	13b
	T_2-10tons/ha	3a	4.7a	6.3a	11.3a	15.7a
	T_3-15tons/ha	3a	4.3a	6a	11a	15a

$FLSD_{0.05}$ row values with different letters are significantly different @ p = 5%

Table 4: Effect of different rate of poultry manure on vine length of fluted pumpkin

Growth parameter	Treatment	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP
Stem Girth (mm)	T_0-0ton/ha	46c	59.7c	80.7c	100.3c	125c
	T_1-5tons/ha	54b	68.7b	88.3b	112.7b	142.3b
	T_2-10tons/ha	62a	79.3a	114a	132.3a	159.3a
	T_3-15tons/ha	60.7a	79a	113a	130.7a	158.7a

$FLSD_{0.05}$ row values with different letters are significantly different @ p = 5%

Table 5: Effect of different rates of poultry manure on the average yield of fluted pumpkin

Treatment	Average (kg/ha)
T_0	1.41_c
T_1	1.52_b
T_2	1.93_a
T_3	1.92_a

$FLSD_{0.05}$ row values with different letters are significantly different (p = 5%)

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EFFECT OF STAND DENSITY ON THE PERFORMANCE OF MAIZE VARIETIES AT LAPAI, SOUTHERN GUINEA SAVANNA OF NIGERIA

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ABSTRACT
The study was carried out in the Teaching and Research Farm of Ibrahim Badamasi Babangida University, Lapai, Niger State during 2014 and 2015 cropping season to evaluate the performance of three maize varieties in terms of Stand density in Lapai. It was a factorial experiment carried out in a Randomized Complete Block Design (RCBD) with three replicates. Three maize varieties (SAMMAZ 16 and 17 and a Local (Kabako)as check) were evaluated under two different plant stand density (1 and 2 maize stand per hill) for such growth characters as plant height, number of leaves, leaf area and days to 50% flowering at 10 weeks after sowing (WAS) and dry cob weight and grain yield. The results obtained indicate that maize varieties responded significantly in combination with plant height and number of leaves at 10 WAS such that the local variety produced the tallest plant with increasing number of leaves in 2014 and 2015 respectively. Yield and yield components were also not significant in this study. It is recommended that with adequate application of all agronomic practices being observed, SAMMAZ 16 and 17 with Local (kabako) maize varieties will always give higher grain yield in the study area.
Keywords: Variety, Stand Density, Growth, Maize, Yield Components

INTRODUCTION

Maize (Zea mays L.) is an established and most important crop grown among all cereals in Nigeria. World production of maize stood at 872.8 million metric tons in 2012 and 9.4 million metric tons which represent 1.1% of the world total production in 2012 (FAO, 2014). Maize is a multipurpose crop which provides feed for poultry and livestock fodder (Undie et al., 2012). It also serves as source of human consumption such as roasted, baked, fried, pounded or fermented (Agbato, 2003). 100 million hectares of land had been put into maize production in developing countries with almost 70% of the production coming from low and lower middle income countries (FAOSTAT, 2010)

Most importantly, It is a known fact that the yield potential of a crop is depend on its genetic makeup as well as the environment in which it is grown. The genetic potential however, can be exploited to the maximum by providing favorable growth environments (Asghar et al., 2010). Successful Maize production requires an understanding of various management practices as well as environmental conditions that affect crop performance (Eskert, 1995).

The spread of maize can also be attributed to its adaptability to a wide range of soils and climatic conditions. It is therefore most appropriately to select cultural practices such as cultivars, sowing dates and planting densities that have been shown to affect Maize yield potential and stability (Norwood, 2001) and therefore Cultivar selection should be based on adaptation to growing environments coupled with good return.

Against this background, the broad objective of this study, therefore, was to identify variety of maize most suited or adapted to Lapai area and the appropriate stand density for growth and yield of these varieties.

MATERIALS AND METHODS

Experimental site

The study was conducted in Lapai in the 2014 and 2015 cropping season at the Teaching and Research Farm of Ibrahim Badamasi Babangida University, Lapai, Niger State. Lapai lies between Latitude 9^0 2'N and Longitude 6^0 34'E. The soil pH of the experimental site is 5.46 (Garba et al. 2015). The seeds of maize which are tagged SAMMAZ 16 and 17 were sourced from the Institute of Agricultural Research (IAR) Ahmadu Bello University, Zaria. SAMMAZ 16 is a Striga resistant maize variety while SAMMAZ 17 is a tolerant maize variety. The Local variety (Kabako) is the farmers maize variety and it is collected from Lapai market in Niger State.

Experimental Design

The 2 years field experiment consisted of factorial combination of 3 maize varieties (SAMMAZ 16 and 17 and Local (Kabako) maize varieties) and plant stand density (1 and 2 seed per hill). The experiment is laid out in a Randomized Complete Block Design with 6 treatments replicated 3 times. Each plot contained 4 ridges at 2m

×3m (6m^2) and 75cm inter-row spacing. Five maize plants were sampled for data collections from each net plot. Plots were manually weeded at 3 and 6 weeks after sowing (WAS). Side placement of half-dose of NPK 15:15:15 fertilizer was applied at the rate of 120 kg/ha and second –half dose was applied at 6 WAS. The parameters assessed include stand count, plant height, number of leaves, days to 50% flowering and silking, leave area, dry cob weight, 100 grain weight and grain yield. At harvest, the cobs were removed, dehusked and dried. It was later weighed, threshed and winnowed to obtained clean grains and weighed again. Data collected were subjected to analysis of variance (ANOVA) using statistical analysis software (SAS, 2002) and Duncan's multiple range test (DMRT) was used to separate treatment means at 5% levels of probability.

RESULTS AND DISCUSSION

Table 1 shows the response of maize varieties and stand density of stand counts, plant height, number of leaves at 10 weeks after sowing (WAS) and days to 50% flowering during the 2014 and 2015 cropping season in Lapai. The Statistical Analysis revealed that maize stand count and days to 50% flowering were not significant in both years, but significant difference was revealed in both years in combination with plant height and number of leaves such that SAMMAZ 17 produce similar taller plant height with the Local variety (Kabako) in 2014 which is similar with Local variety in 2015, each with an increasing number of leaves. However, SAMMAZ 16 recorded the shortest plant height in this study Increase in plant height with an increasing of number of leaves of the Local variety could be as a result of adaptation of the Local variety to its environment. Similar results were obtained from the same location under Striga infestation where the Local variety recorded taller plants height with increasing number of leaves at 9 WAS as against an improved maize variety (Garba et al., 2015). It was also reported that Local maize varieties are taller than the improved varieties (Raemaekers, 2001). The interaction effects of the treatments were not significant on all parameters (Table 1).

The effect of Maize Varieties and Stand Density on dry cob weight and grain yield at Lapai during the 2014 and 2015 cropping season is presented in Table 2. It was observed from the results obtained in this study that increasing stand density from one to two plants per stand did not significantly affect dry cob weight and grain yield in 2014 and 2015 respectively. However the result shows that maize varieties does not differed significantly with stand density in both years. The results could be attributed to a uniform application of all agronomic or cultural practices to all treatments from planting to harvest and that must have been optimum for similar higher yield of the varieties tested. There was an interaction between variety and stand density on dry cob weight in both years and grain yield in 2015. This reveals that all maize varieties produced similar highest dry cob weight in both years and grain yield in 2015 at all levels of stand density.

CONCLUSION

Based on the result obtained from the study In terms of grain yield of all the varieties tested, , it can be concluded that all the varieties can be adopted by maize growers with adequate agronomic or cultural practices for greater grain yield.

Table 1. Effect of Maize Varieties and Stand Density on Growth Parameters at 10 WAS at Lapai during the 2014 and 2015 Rainy Season

	Stand Count		Plant height (cm)		Number of Leaves		Days to 50% Flowering	
	2014	2015	2014	2015	2014	2015	2014	2015
Variety								
SAMMAZ 16	97.0	96.2	136.9b	114.0c	9.0b	8.1b	6.0	62.0
SAMMAZ 17	95.9	95.5	149.6a	125.6b	9.0b	8.0b	61.1	63.1
Local	95.8	93.0	154.8a	137.8a	10.0a	9.0a	60.8	63.3
SE±	1.096	1.154	3.383	3.734	0.251	0.213	0.603	0.667
Stand Density								
1	96.4	95.1	148.9	126.2	9.3	9.5	60.9	63.4
2	96.1	94.7	145.3	125.5	9.1	9.2	60.3	62.2
SE±	0.895	0.942	2.761	3.049	0.205	0.174	0.492	0.544
Interaction								
V×SD	NS	NS	NS	NS	NS	NS	NS	NS

Means with the same letter are not significantly different (P>0.05).

Table 2. Effect of Maize Varieties and Stand Density on Yield Parameter at Lapai during the 2014 and 2015 Rainy Season

	Dry Cob weight (kg ha^{-1})		Grain yield (kg ha^{-1})	
	2014	2015	2014	2015
Variety				
SAMMAZ 16	1504.6	1796.3	1356.4	1587.9
SAMMAZ 17	1550.9	1924.1	1430.5	1694.4
Local	1587.9	1731.5	1435.1	1541.6
SE±	77.743	45.551	65.530	45.000
Stand Density				
1	1580.2	1796.3	1435.1	1589.5
2	1515.4	1838.2	1379.6	1626.5
SE±	63.477	37.159	53.508	36.742
Interaction				
V×SD	NS	NS	NS	NS

Means with the same letter are not significantly different (P>0.05)

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EFFECT OF SEEDLING AGE AT TRANSPLANTING ON GROWTH AND YIELD PARAMETERS OF AMARANTH (AMARANTHUS CAUDATUS L.) IN NORTHERN GUINEA SAVANNA ECOLOGICAL ZONE OF NIGERIA

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ABSTRACT
A field experiment was conducted 2014 cropping season at the Federal College of Agricultural Produce Technology Research Farm, Barkum, Bunkure Local Government Area of Kano State in the northern Guinea savanna ecological zone of Nigeria to assess the effects of seedling age at transplanting on growth and yield parameters of vegetable amaranth (Amaranthus caudatus L.). The treatments consisted of combinations of three transplant ages (2, 3 and 4 weeks after sowing) laid out in a randomized complete block design and replicated three times. Based from the results shown, seedlings transplanted at 4 weeks of age were significant taller with shoot fresh weight than 2-weeks old seedlings at the initial growth stage. Transplant age had no effect on these growth parameters such as plant height, number of leaves and branches per plant and are were significantly (P=0.05) at later stage. All the other growth parameters were not affected by transplant age. Also shown that in the results, transplanting age of between two and three weeks after emergence, which roughly corresponded with three to four weeks old seedlings would benefit the farmers most when transplanted with an optimum yield.
Keywords: Transplanting, seedling age, growth and yield parameters, Amaranth

INTRODUCTION
Amaranth (Amaranthus cruentus) is a dual purpose crop with edible leaves and seeds (Olufolaji and Dimakin, 1988). Apart from its uses as a vegetable, it has also been used as an effective alternative to drug therapy in people with hypertension and cardiovascular disease (CVD) (Martiorosyan and Miroshnichen, 2007). The demand for this crop as vegetable has increased, especially in the urban centre where people are not involved in primary production (Schippers, 2000). Grubben and Van Slotten, (1981) reported that vegetable amaranth is grown primarily for its tender stems and succulent leaves. Its succulent tender stem and young leaves are used in preparing soup and stew; young shoots are sometimes dried for future use as a forage crop for feeding livestock. This has made the vegetable to become an important commodity in our market and production an important economic activity for the rural women (Law- ogbomo et al., 2009). The yield per hectare of this crop is low (7.60 t ha-1) when compared to that of United States (77.27 t ha-1) and world average (14.27 t ha-1) (FAO, 2007). For commercial production, optimum performance of the crop must be desirable through changes in cultural practices (Sterrett and Savage, 1989). Anon, (1984) pointed out that leaf protein concentrate can be extracted from amaranth and used for feeding young children and person's requiring high protein, vitamin A and Iron. Amaranth has also been found to contain high levels of nutritionally critical amino acids, lysine and methionine (Koch et al.,1985). Originally, the bulk of vegetables consumed in Nigeria were supplied by subsistence farmers. Vegetable supply to areas of high demand has remained low and seasonal as the subsistence farmers continue to rely on natural rainfall. Today, high demand for vegetables in the cities and towns has stimulated the growth of market gardening along perennial rivers and streams (Akparobi, 2009). Advantages of using transplant as reported by Vantine and Verlinden (2003) was that seeds are not wasted because seeds growing in a Greenhouse or secured place have a higher germination rate than those growing in the field where various environmental factors can lead to low survival rates. Also when transplants are planted in the field, they are likely to be more uniform since they start off in the field at the same growing stage. Harvesting times are reduced because the plants will likely ripen at the same time. Another merit of transplant was that the harvesting season is longer because transplants yield earlier harvests which are good news for growers who wish to grow warm-season crops. Equally plants get a "head start" in the greenhouse/ secured garden when it is too cold to plant outside in temperate area as they will be ready to plant when the weather is ideal, and the crop will be ready to sell or eat earlier than usual. Orzolek (2009) highlighted that all vegetable transplants have an ideal age/size which enables them to continue active growth in the field after transplanting and be somewhat resistant to environmental stress. In the same vein, younger plants than 6 weeks are not as resistant to desiccation from wind, low temperatures (below 45°F) and soil moisture deficits. On the other hand, older plants (greater than 10 weeks) have a relatively large vegetative mass that has initiated flowers and may be heading into the reproductive phase of growth; hence the plants will produce fruit, but only a fraction of their full potential. Khairul alum et al.,(2010) reported that growers tend to manipulate sowing time in order to obtain better growth and higher quality yield as the time of sowing is also adjusted so as to synchronize with time of harvest and market demand. This study

was therefore conducted to evaluate the effect of seedling age at transplanting on growth and yield parameters of vegetable amaranth (Amaranthus caudatus L.).

MATERIALS AND METHODS

A field experiment was conducted during the months of July to September, 2014 at the research farm Federal College of Agricultural Produce Technology Research Farm, Barkum, Bunkure Local Government Area of Kano State (11^0 39' 0^0 N, 8^0 39' 0 E). The study area has dominant features of the dry savanna of Nigeria with two main seasons: the wet and the dry season. The wet season usually starts from July and ends in October with an annual rainfall varying from 200mm in the north to 650mm per annum with an annual average temperature of 29 ^{0}C to 42 ^{0}C (KNARDA, 2009). The treatments consisted of combinations of three transplant ages (2, 3, and 4 weeks after sowing) laid out in a randomized complete block design and replicated three. The gross plot size was 3.0m x1.8m.(LxB respectively). Seed of amaranth (Large Green Amaranth) cultivar from National Institute of Horticultural Research Station (NIHORT) Bagauda Substation was collected and sown at a college farm nursery site on 4 July, 11 July and 18 July, 2014 for the two, three and four weeks old seedlings ,respectively. The experimental site was ploughed, harrowed and ridged with tractor, thereafter; the plots were laid out and flattened into raised beds. The plots were marked out and a 1.5m border separated each plot from the other plot. The two, three and four weeks old seedlings were transplanted in the evening into moist seed beds of a dimension of 5.4m^2 on 25 July, 2014 at an inter row spacing of 30cm and intra row spacing of 10cm giving a population of 40 plants/plot. The field was weeded manually with hoe in the morning before transplanting the seedlings in the evening on the 25 July, 2014; another hoe weeding was done at three weeks after transplanting (WAT). The established seedlings in each plot were counted and recorded on 31 July, 2014. The parameters measured were plant height, shoot fresh weight, shoot dry weight and usable yield. The data collected were subjected to analysis of variance using SAS system (SAS, 1991). Significant means were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

At 10 DAT (days after transplanting), results show that there is no significant differences in the production of taller plants between 2 and 3 and 4 weeks transplant age at the sampling period of 10, 20, 30 and 40 DAT. The numbers of leaves per plant were significantly higher at each sampling periods of 10, 20, 30 and 40 DAT of 2, 3 and 4 weeks old transplant. As shown in table 3, there is no significant difference observed at the sampling period in the amount of branches produced by the plant at sampling period between 2, 3 and 4 weeks old transplant. The usable yield produce by the plant at the sampling periods of 10, 20, 30 and 40 DAT were statistically at par with the usable yield produce by the amaranth of 2,3, and 4 weeks old transplant.

CONCLUSION

Based from the study on the effect of seedling age at transplanting on growth and yield parameters of vegetable amaranth (Amaranthus caudatus L.) in Northern Guinea Savanna Ecological Zone of Nigeria, it shows that there is no significant differences in transplanting age between 2, 3, and 4 weeks old transplant in terms of plant height, number of leaves, number of branches and usable yield parameter. This correspond with the work of Mulundana et al.,(2009) who transplanted vegetable amaranth at one, two, three and four weeks after emergence found that the best transplanting age was between two and three weeks after emergence. Vavrina, (1990) reported that, the effect of transplant age on yield remains an issue of major interest to growers of horticultural crops because when transplants are too old, growth and yield are adversely affected as transplanting age depends on the crop, environment and cultural conditions. The conflicting results on literatures on transplant age may likely be due to the differences in environmental and cultural conditions that the plants were subjected to (Vavrina, 1991).

Table 1: Effects of seedling age on plant height (cm) of amaranth at Samaru during the 2014 wet season.

	Days after transplanting			
Treatment	10	20	30	40
Seedling age (weeks)				
2	8.59b	10.98b	15.72a	24.96a
3	9.07a	11.74ab	14.31a	23.06a
4	11.39a	15.11a	16.09a	22.55a
SE±	0.73	0.83	1.18	2.19a
PxS	NS	NS	NS	NS

Means followed by the same letter(s) with in the same column are not statistically different using DMRT at 5% level of probability.

Table 2: Effect of seedling age on the leafiness of amaranths at Samaru during the 2014 wet season

Treatment	Days after transplanting 10	20	30	40
Seedling age (weeks)				
2	10.03a	12.31a	16.33b	22.96a
3	10.61a	10.86a	15.69b	23.06a
4	11.39a	12.56a	21.24a	24.96
SE±	0.57	1.03	1.41	2.19
PxS	NS	NS	NS	NS

Means followed by the same letter(s) with in the same column are not statistically different using DMRT at 5% level of probability.

Table 3: Effect of seedling age on number of branches per plant of amaranth at Samaru in 2014 wet season.

Treatment	Days after transplanting 20	30	40
Seeding age (weeks)			
2	1.68a	1.36a	2.47a
3	1.42a	1.04a	3.33a
4	1.91a	1.08a	2.94a
SE±	0.36a	0.30	0.39
PXS	NS	NS	NS

Means followed by the same letter(s) with in the same column are not statistically different using DMRT at 5% level of probability.

Table 4: Effect of seedling age on the usable yield (g/plant) of amaranth at Samaru during the 2014 wet season

Treatment	Days after transplanting 20	30	40
Seedling age (week)			
2	5.90a	10.38a	16.65a
3	5.28a	10.87a	15.09a
4	8.45a	8.01a	19.97a
SE±	1.47	1.84	3.40
PXS	NS	NS	NS

Means followed by the same letter(s) with in the same column are not statistically different using DMRT at 5% level of probability.

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GENOTYPE X ENVIRONMENT ANALYSIS OF YIELD OF SOME SUGARCANE VARIETIES IN NIGERIA

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ABSTRACT
Twenty five sugarcane varieties were planted in two locations with different ecologies for two years. In each location, the trial was planted using randomised complete blocks with three replications. Data on yield and yield components were collected in all the locations although only cane yield data was used for the G X E analysis. Significant differences were observed for yield and yield components in all the locations although there was better performance for cane yield in Badeggi than Edozhigi (hydromorphic soil) location. Significant G X E interaction was observed for yield with environments contributing more to the variation. AMMI biplot shows that genotypes BD2002-037 and IMO-001 have high and stable yield while genotypes BD2002-36, BD2007-43, KNB9180 and Co957 appear to be high yielding but relatively unstable. The best environment with highest yield was Badeggi14. Due to differences displayed in the analysis, care must be taken in selecting the best variety for different environment considering high yield and stability of the genotype across the environment.
Keywords: Genotype X Environment, Sugarcane varieties, yield and yield components, AMMI analysis

INTRODUCTION

Sugarcane (Saccharum hybrids L.) is the major raw material from which refined sugar is manufactured and is a source of revenue for many resource-limited sugarcane growers in the Nigeria(Agboire et al,1999). Sugarcane is an important industrial and cash crop in Nigeria. Besides sugar production, sugarcane produces numerous valuable byproducts like alcohol used by pharmaceutical industry, ethanol used as a fuel, bagasse used for paper and chip board manufacturing and also for burning sugar mills furnaces, and press mud used as a rich source of organic matter and nutrients for crop production.
Although sugarcane occupies an important place in cropping pattern of Nigeria and brings large dividends to growers, but its yield and production has become stagnant for the last two decades. Main reason for lower cane yield is lack of high yielding varieties in the country. Most of exotic varieties imported by the sugar companies have dwindling cane and sugar yield and cannot meet up the cane and sugar yield desired by the companies (Olaoye1999).
Productivity of a good sugarcane variety in favourable environments is however important although this does not indicate its adaptability and stability, whereas performance of a genotype in diverse environments is somehow a true evaluation practice of its inherent potential. The use of genotype-environment (GE) interaction in the relative performance of genotypes represents the change due to environmental variations (Gauch, 1992). A method that has been used in studies of GE and its interaction is AMMI (Additive Main Effects and Multiplicative Interaction analysis). This method can contribute both to the identification of widely adapted genotypes with high yields (Gauch and Zobel 1988).
The purpose of this study was to evaluate the stability and adaptability of some exotic, local and hybrid sugarcane germplasm in different ecological zones of Nigeria by the AMMI method and GGE biplot, with a view to determine the effect of GxE interaction on cane yield of the sugarcane genotypes.

MATERIALS AND METHODS

Twenty-five sugarcane varieties (thirteen exotic, ten hybrids bred in the institute and two varieties are local) were evaluated for two years at two locations. The first year was the plant crop while the second was first ratoon. One of locations (Badeggi) is upland while the second location (Edozhigi) is semi-hydromorphic (fadama). The experiment was planted using randomized complete block design with three replications. The plots size was 5m x 6m, spaced 1.50 m apart. Ten (10) cane sett were planted per row and were evenly distributed along the rows of each plot. All the agronomic and cultural practices of sugarcane production were followed as per the recommendation of NCRI. Data was obtained on the following parameters: germination and establishment percent count; stalk length, girth and weight; number of stalks per stool; number of millable stalks per plot, brix % (sugar yield) and cane yield per plot.
Analysis of variance procedure was adopted to test the significance of location, genotype, and first order interactions assuming the location effects as random and genotype effect as fixed. To determine the effect of genotype X environment interaction on cane yield, the data were further subjected to Additive Main and Multiplicative Interaction (AMMI) analysis. GGE-biplot methodology, which is composed of 2 concepts, the biplot concept (Gabriel, 1971) and the GGE concept (Yan et al., 2000) was used to visually analyze the data.

This methodology uses a biplot to show the factors (G and GE) that are important in genotype evaluation and that are also the source of variation in GEI analysis. In the current study, genotype-focused scaling was used in visualizing for genotypic comparison, with environment-focused scaling for environmental comparison. The entire statistical analysis was conducted using the Integrated Breeding Platform Breeding Management System version 3.0.8

RESULTS AND DISCUSSION

Significant differences were observed for all traits in Badeggi location during the plant crop (2013) except stalk girth, number of stalks per stool and brix percent (Table 1). This shows the diversity in the population under study. Similar observations were made by Olaoye and Ishaq (2009) when they studied different populations of sugarcane from different geographical locations. Highly significant differences were observed for cane yield per plot which is the trait of paramount importance in GXE analysis. Significant differences were observed at Edozhigi location during plant crop (2013) for all traits except stalk girth and brix percent (Table 2). The varieties generally performed better at Badeggi than Edozhigi during the plant crop. This is probably due to the soil types in the locations. Edozhigi soil is hydromorphic and suitable for rice and chewing sugarcane production. Most of the sugarcane varieties evaluated were industrial canes cultivated on upland.

The ratoon crop presented a different picture in terms of performance of the varieties. Table 3 shows the first ratoon performance of the varieties at Badeggi location. Significant differences were observed for all the traits except internodes length per plot. The ratoon yield is however much lower than was observed in the plant crop. This shows that most of the sugarcane varieties studied have poor ratoonability and may not be suitable for long term cultivation. Similar trend was observed in the ratoon crop of Edozhigi (Table 4). In Edozhigi location significant differences were observed for all the traits except stalk girth. Although there was significant difference in yield in the four environments (Badeggi 2013, Badeggi 2014, Edozhigi 2013 and Edozhigi 2014), there was better performance among varieties in Badeggi location than Edozhigi.

Highly significant Genotype X Environment Interaction (GEI) was observed in the regression analysis (Table 5). Genotypic differences were also significant which shows the wide differences in the varieties as well as response of the varieties to the environments. Identifying high yielding and stable genotypes is easier when such significant differences are observed (Eberhart and Russell 1966; Ishaq et al 2015). Table 6 shows the mean values for yield and regression coefficient (b), for 25 varieties of sugarcane over four environments. Genotypic sensitivity which shows the changes in the environmental quality is shown by the slope (b value).

According to Eberhart and Russell (1966), an ideal cultivar would have both a high average performance over a wide range of environments plus stability. The existence of genotype x environment interaction (GEI) raised the need to identify high yielding and stable genotypes. Genotypic sensitivity is indicated by b value which shows changes in the environmental quality; where values of $b > 1$ mean genotypes with a higher than average sensitivity ($b=1$), and such genotypes are less stable; while $b < 1$ means genotypes that are less sensitive and more stable. Six genotypes (B991114, BBZ921104, BD 2002-04, BD2002-037, IMO-001 and KNB9218) had more than average mean performance (67.11t/ha) and b value more than 1 hence they are above average sensitivity (i.e. below average stability or less stable). Seven genotypes (BD2002-36, BD2007-43, BD2007-45, Co957, DB75159, ENU-001 and KNB9180) had more than average mean performance and b value less than 1 hence they are below average sensitivity (i.e. above average stability or more stable).

Although IMO-001(78.72t/ha) does better than KNB9218 (70.16t/ha) in the average performance, KNB9218 is superior to IMO-001 in the high-quality environments. This is because KNB9218 has a better ability to exploit improved environmental conditions, which is reflected in the higher genotypic sensitivity of the former ($b_{KNB9218} = 1.5196 > b_{IMO\text{-}001} = 1.1090$). However both genotypes has potential to respond to increase in environmental quality in a predictable way (dynamic stability). High yielding genotypes like BD991114, BBZ921101, BD2002-37, BD2007-43, ENU-001, IMO-001 and KNB9218 had high static stability (1.e. ability to give same performance across environments).

The AMMI Analysis of variance shows the environmental variance was significant and higher than both the genotype and GEI variance. The genotype variance was however higher than the GEI variance (Table 7). The result showed that the environment main effect (E) was the most important source of variation, due to its large contribution to the total sum of squares for yield. The large sum of squares for environments indicated that the environments were diverse, with differences among environmental means causing high variation in cane yield. This might probably be due to differences in growing season rainfall and type of soil in the environments. Variation due to genotype was larger than that due to GEI, meaning that differences among genotypes vary across environments.

Similar observations were obtained by Admassu et al (2008) and Ishaq et al 2015 in their studies. The presence of GEI was demonstrated by the AMMI model, when the interaction was partitioned among the first two Interaction Principal Component Axis (IPCA) as they were significant. The IPCA1 explained 73.32% of the interaction while IPCA2 explained 19.09%. They cumulatively captured 92.41% of the total GEI. This implied that the interaction of the 25 sugarcane with four environments was predicted by the first two principal components of genotypes and environments, which is in agreement with Guach and Zobel (1996).

The biplot of the best genotypes in each of the environments for cane yield is presented in Figure 1. The polygon view of the GGE-biplot explicitly displays 'which-won-where' i.e. (best genotype in each environment) and it is a summary of the GEI pattern of a multi-environment yield trial data. The polygon is formed by connecting the genotypes that are further away from the biplot origin such that all other genotypes are contained within the polygon. To each side of the polygon, a perpendicular line, starting from the origin is drawn and extended beyond the polygon so that the biplot is divided into several sectors, and the different environment were separated into different sectors. The genotype at the vertices of each sector is the best performer at environments included in that sector. In this study there were four sectors only and three mega environments identified. Edozhigi13 and Edozhigi14 formed one environment while Badeggi13 and Badeggi14 formed separate mega environments. BBZ921101won or was the best genotype in Badeggi13 while BD2007-43 won in Edozhigi13 and Edozhigi14 mega environments. Badeggi14 mega-environment fell in the four sector close to the pivot point on the perpendicular line and varieties mostly in this mega environment have high yield and are also stable. This environment also had the highest mean yield across other environments. Genotypes at the vertices of the polygon and do not fall in any mega environment are not the highest yielding genotypes at any environment. However, genotypes within the polygon, particularly those located near the plot origin, were less responsive than the vertex genotypes.

CONLUSION

Selection of suitable genotypes in a multiple environment trial is sometimes difficult due to complication in the environment and the genotype response. The occurrence of the genotype X environment interaction further complicates the selection of superior genotypes. The presence of the G X E interaction confirms particular genotypes being superior in particular environments. In this study, BD2002-37 and IMO-001 were high yielding and stable while BD2002-36, BD2007-43, KNB9180 and Co 957 were high yielding but unstable. The best environment was Badeggi14

Environmental factors are complex and similarities in environments can be deceptive and non-repeatable. For instance, two environmental conditions may be similarly poor, one due to poor soil fertility and the other due to rainfall shortage. Also, same genotype may express different phenotypes in different environments

Table 1: Mean Performance of Sugarcane varieties at Badeggi in 2013 (Plant crop)

Variety	%G	%E	SGt	SSW	Mc/pt	St/st	St/pt	In lgt	StHt	%Brix	Yld
B 00279	16.33	54.00	2.90	1.47	36.33	11.64	28.16	15.33	147.80	22.37	81.40
B 881104	53.33	58.67	2.30	0.94	111.67	12.90	13.00	17.87	176.67	21.87	114.17
B 881602	13.00	44.33	2.37	1.32	69.00	13.12	16.10	13.70	195.80	22.03	58.03
B 93261	30.00	31.00	2.43	1.29	58.67	11.48	9.00	16.40	193.47	20.97	82.93
B 991114	25.00	75.33	2.23	1.20	160.00	14.39	20.69	20.53	222.80	22.87	157.53
BBZ 921101	30.00	49.67	2.30	1.27	141.67	16.20	28.10	18.60	218.20	22.67	190.33
BBZ 551034	37.67	71.33	2.27	0.97	97.33	11.32	18.66	17.50	182.80	21.57	140.37
BD 2002- 004	43.67	75.00	2.07	1.09	178.33	9.43	18.28	20.53	172.47	23.80	113.70
BD 2002-022	41.67	58.67	2.23	0.74	143.33	13.50	10.78	18.53	157.33	20.53	99.87
BD 2002–036	40.00	49.00	2.10	0.82	120.00	5.98	29.60	20.13	181.40	21.87	69.63
BD 2002-037	43.00	53.33	2.13	0.97	145.00	9.32	13.11	22.13	190.67	21.67	126.0
BD 2003–016	46.00	62.00	1.93	1.05	136.67	5.67	19.10	20.67	211.07	23.33	101.90
BD 2003–024	52.33	72.33	1.77	1.09	156.67	8.43	21.81	18.93	167.60	22.57	95.37
BD 2003– 35	27.67	42.33	2.03	0.89	158.67	11.45	9.92	21.40	172.33	20.97	113.67
BD 2007– 43	66.33	72.67	1.50	1.87	156.67	12.46	18.61	16.47	175.67	21.63	119.53
BD 2007– 44	68.33	86.67	1.43	0.63	171.67	6.76	14.26	17.20	181.47	22.77	97.70
BD 2007- 45	47.00	74.00	1.67	0.70	168.33	8.42	20.19	17.00	177.47	22.53	99.83
BD 75159	22.67	39.00	2.33	1.21	93.33	3.33	24.81	21.67	226.00	23.17	104.83
BR 00009	23.67	32.00	2.53	1.19	125.00	9.39	7.96	15.90	212.33	23.17	85.40
BR 971007	25.00	39.67	2.73	1.28	138.33	8.76	20.41	18.60	230.33	22.23	131.40
CO 957	43.33	47.67	2.27	1.19	151.67	6.87	23.69	21.67	167.47	23.23	120.17
ENU – 001	50.00	51.33	2.40	1.36	135.00	12.40	17.16	18.33	194.33	20.43	113.80
IMO – 001	63.67	71.00	2.83	1.54	107.33	7.66	25.11	18.00	195.20	19.87	125.83
KB 9180	54.67	36.00	2.93	1.25	135.00	4.30	14.18	18.60	215.33	21.70	101.67
KNB 9218	53.00	48.00	2.00	1.12	64.00	4.38	11.00	16.47	175.67	21.73	139.53
CV	31.44	48.76	9.09	41.28	28.06	2.18	17.61	13.05	17.73	5.72	41.02
P- value	0.000	0.014	0.300	0.043	0.000	0.492	0.014	0.047	0.027	0.130	0.034

%G-% germination, %E-% establishment, SGt- Stem girth (cm), SSW-Single stalk weight, Mc/P-Malleable cane/plot, St/St-Stalk/stool, St/p-Stool/plot, In-Lgt-Intem length (cm), StHt-Stalk height, % Brix, Yield (kg)

Table 2: Mean Performance of Sugarcane varieties at Edozhigi in 2013 (Plant crop)

Variety	%G	%E	SGt	SSW	Mc/pt	St/st	St/pt	In lgt	StHt	%Brix	Yld
B 00279	31.00	54.11	2.43	1.07	85.33	5.20	14.67	30.07	250.67	19.61	69.27
B 881104	36.00	64.55	1.90	0.93	95.00	8.87	23.00	19.47	185.67	20.72	39.50
B 881602	40.11	63.33	1.87	0.80	104.33	7.73	11.67	24.53	195.33	24.35	40.10
B 93261	52.67	59.00	2.20	1.10	125.67	9.53	20.33	30.60	240.00	23.25	101.33
B 991114	48.11	57.00	1.70	1.10	106.33	7.73	10.67	24.87	236.33	21.78	52.97
BBZ 921101	40.21	52.00	1.97	1.10	96.33	6.40	17.00	20.57	234.67	23.35	48.60
BBZ 551034	31.00	60.99	1.57	0.70	87.67	5.73	18.00	23.40	198.53	20.93	46.53
BD 2002- 004	39.92	59.00	2.00	1.30	58.33	9.40	21.67	23.13	166.70	25.53	96.73
BD 2002-022	40.62	42.67	1.70	0.70	109.00	6.80	16.33	22.00	170.60	25.57	47.40
BD 2002-036	43.00	48.00	2.00	1.37	137.33	11.40	27.00	21.33	193.87	26.67	126.60
BD 2002-037	41.44	49.61	2.03	1.20	118.33	7.47	20.67	22.60	179.80	25.43	88.53
BD 2003–16	47.22	56.44	1.57	0.60	76.00	4.60	4.33	17.47	198.40	26.93	13.40
BD 2003-024	52.21	63.00	1.47	1.50	70.67	4.53	10.33	18.13	176.80	24.60	32.77
BD 2003– 35	30.67	59.00	1.70	0.93	60.00	6.60	13.67	23.40	167.87	24.17	35.70
BD 2007– 43	41.00	50.00	1.27	0.47	98.00	12.67	30.00	20.33	185.47	26.27	129.17
BD 2007– 44	59.16	61.00	1.27	0.50	93.00	6.73	19.00	18.07	163.67	23.10	42.07
BD 2007- 45	49.00	71.11	1.37	0.63	54.33	9.13	23.67	18.07	171.27	23.43	77.53
BD 75159	25.00	56.90	1.37	1.20	75.33	5.80	27.00	21.80	176.00	24.37	70.43
BR 00009	37.93	37.11	1.50	0.53	106.67	5.67	20.00	20.80	168.17	18.43	68.30
BR 971007	22.00	51.00	1.67	0.80	131.67	5.20	23.33	15.07	166.47	26.07	26.70
CO 957	40.91	51.27	1.97	1.50	111.00	12.87	23.00	22.40	198.53	26.17	129.07
ENU – 001	49.78	49.77	2.67	1.30	136.33	8.60	23.67	20.07	192.40	25.83	103.50
IMO – 001	40.60	59.00	2.13	1.40	97.67	5.73	25.00	21.13	190.87	23.63	96.17
KNB 9180	30.42	51.00	2.47	2.07	65.33	6.67	27.33	24.60	192.27	25.17	111.73
KNB 9218	40.61	49.77	1.43	1.21	126.67	6.90	17.67	18.87	186.87	21.43	68.53
CV	24.48	18.20	0.26	0.26	27.99	1.43	19.62	3.03	17.49	1.27	19.50
P-value	0.049	0.041	0.123	0.013	0.004	0.002	0.035	0.096	0.022	0.610	0.001

%G-% germination, %E-% establishment, SGt- Stem girth (cm), SSW-Single stalk weight, Mc/P-Malleable cane/plot, St/St-Stalk/stool, St/p-Stool/plot, In-Lgt-Intem length (cm), StHt-Stalk height, % Brix, Yield (kg)

Table 3: Mean Performance of Sugarcane varieties at Badeggi in 2014 (Ratoon crop)

Genotype	Girth	St/St	Mc/p	In/np	InL/np	StHt	%Brix	SSW	Yld/kg
B 00279	2.84	6.02	24.73	18.88	13.39	178.64	20.73	0.75	48.78
B 881104	3.03	7.77	37.17	19.79	13.39	202.09	20.73	0.69	51.15
B 881602	2.76	5.86	22.14	17.85	13.98	185.50	20.18	0.70	51.75
B 93261	3.25	6.50	27.31	18.89	13.61	186.18	20.44	0.75	51.97
B 991114	2.68	6.50	59.00	18.88	13.86	207.32	21.12	0.69	47.83
BBZ 921101	3.01	8.09	46.56	18.85	14.12	199.85	21.39	0.70	49.77
BBZ 9551034	2.48	7.61	29.89	18.82	14.13	202.42	20.75	0.80	46.89
BD 2002-004	3.01	8.88	35.52	20.21	13.50	200.39	20.52	0.58	51.36
BD 2002-022	2.90	9.20	36.23	19.19	13.62	175.42	20.85	0.61	52.88
BD 2002-036	3.23	10.32	35.76	19.88	13.62	181.69	20.71	0.60	55.18
BD 2002-037	3.01	9.20	50.55	20.24	13.79	178.50	21.07	0.76	49.63
BD 2003-016	3.21	7.14	28.48	20.82	13.67	194.21	21.42	0.63	51.14
BD 2003-024	2.88	7.93	43.50	19.38	13.49	188.14	21.71	0.61	53.09
BD 2003-35	2.80	7.29	59.70	20.44	13.87	130.88	21.16	0.64	49.83
BD 2007-43	2.68	11.59	97.03	19.11	13.68	195.07	21.05	0.60	53.12
BD 2007-44	3.15	8.88	83.65	19.14	13.79	199.41	20.91	0.59	50.49
BD 2007-45	2.66	9.68	63.93	18.69	13.63	194.46	22.01	0.61	50.54
BD 75159	2.93	5.86	36.81	19.86	13.39	220.70	21.58	0.82	52.08
BR 00009	2.70	6.34	43.74	18.41	14.00	230.36	21.30	0.73	47.61
BR 971007	2.93	7.14	48.90	18.55	14.21	243.85	20.78	0.70	52.13
CO 957	3.21	9.52	46.67	20.12	13.99	180.01	22.81	0.83	55.45
ENU- 001	3.07	7.45	47.26	19.11	13.62	190.45	20.98	0.66	46.68
IMO 001	3.07	6.34	29.65	19.48	13.79	198.64	21.42	0.61	51.41
KB 9180	3.19	8.09	38.81	18.99	14.32	191.45	19.89	0.70	55.54
KNB 9218	2.72	7.45	44.68	19.24	13.80	201.77	20.21	0.60	51.49
%CV	16.588	62.25	73.2	12.42	18.46	19.2	7.65	46.41	28.38
p-value	0.004	0.026	0.001	0.047	0.285	0.002	0.011	0.087	0.176

Table 4: Mean Performance of Sugarcane varieties at Edozhigi **in 2014 (Ratoon crop)**

Genotype	Girth	St/St	Mc/p	In/np	InL/np	StHt	%Brix	SSW	Yld/kg
B 00279	2.12	11.83	54.63	5.74	7.67	163.48	21.76	0.47	22.01
B 881104	2.06	16.86	72.02	8.26	7.11	128.58	21.57	0.82	37.11
B 881602	2.09	9.42	29.54	4.34	7.31	114.81	21.82	0.43	38.33
B 93261	2.12	14.85	68.04	6.18	8.11	128.41	21.82	0.45	24.60
B 991114	2.11	12.84	49.41	6.44	7.41	119.83	21.38	0.41	12.14
BBZ 921101	2.09	16.05	49.41	6.70	7.69	126.95	21.72	0.43	20.07
BBZ 9551034	2.06	15.25	63.32	7.74	7.18	125.15	21.68	0.41	20.19
BD 2002-004	2.06	15.45	69.04	7.27	6.72	126.35	21.79	0.41	28.71
BD 2002-022	2.07	14.24	50.16	7.79	6.67	126.61	21.41	0.43	26.24
BD 2002-036	2.13	17.66	81.70	12.47	7.11	141.48	21.51	0.75	85.10
BD 2002-037	2.13	16.45	91.14	9.82	7.67	138.09	21.71	0.63	47.45
BD 2003-016	2.09	10.43	36.50	4.89	6.99	121.70	21.13	0.43	22.01
BD 2003-024	2.04	13.84	40.72	7.22	6.56	134.77	20.89	0.45	16.90
BD 2003-35	2.71	15.45	46.43	6.34	6.50	125.33	21.50	0.51	21.37
BD 2007-43	2.01	19.67	126.66	13.61	8.16	158.46	20.95	0.55	101.08
BD 2007-44	2.05	17.26	70.53	10.29	8.44	146.36	21.06	0.47	38.49
BD 2007-45	2.04	17.26	111.76	9.87	7.47	141.00	21.16	0.43	47.97
BD 75159	2.16	15.85	62.58	6.68	6.86	148.67	21.59	0.57	41.40
BR 00009	2.08	13.24	54.63	5.61	7.92	128.34	21.35	0.39	20.48
BR 971007	2.10	16.05	50.16	5.77	7.56	134.25	21.42	0.47	23.19
CO 957	2.15	17.06	87.42	11.63	7.38	148.12	21.51	0.57	55.73
ENU- 001	2.20	15.25	68.54	8.52	8.18	150.51	21.12	0.65	38.46
IMO 001	2.15	13.84	54.13	6.86	7.28	144.32	21.17	0.63	41.45
KB 9180	2.28	16.25	70.77	8.36	8.21	163.44	20.81	1.12	64.42
KNB 9218	2.08	15.65	47.43	5.82	7.35	126.57	21.84	0.41	21.07
%CV	68.86	33.67	58.4	47.80	24.67	26.8	6.33	68.58	79.9
p-value	0.306	0.003	0.000	0.000	0.044	0.014	0.096	0.003	0.000

Table 5: Analysis of variance using F&W Regression Analysis

Source	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Genotypes	24	19647.36	818.64	1.82	0.038
Environments	3	80767.23	26922.41	59.93	<0.001
Sensitivities	24	17616.92	734.04	1.63	0.074
Residual	48	21562.80	449.23		
Total	99	139594.32	1410.04		

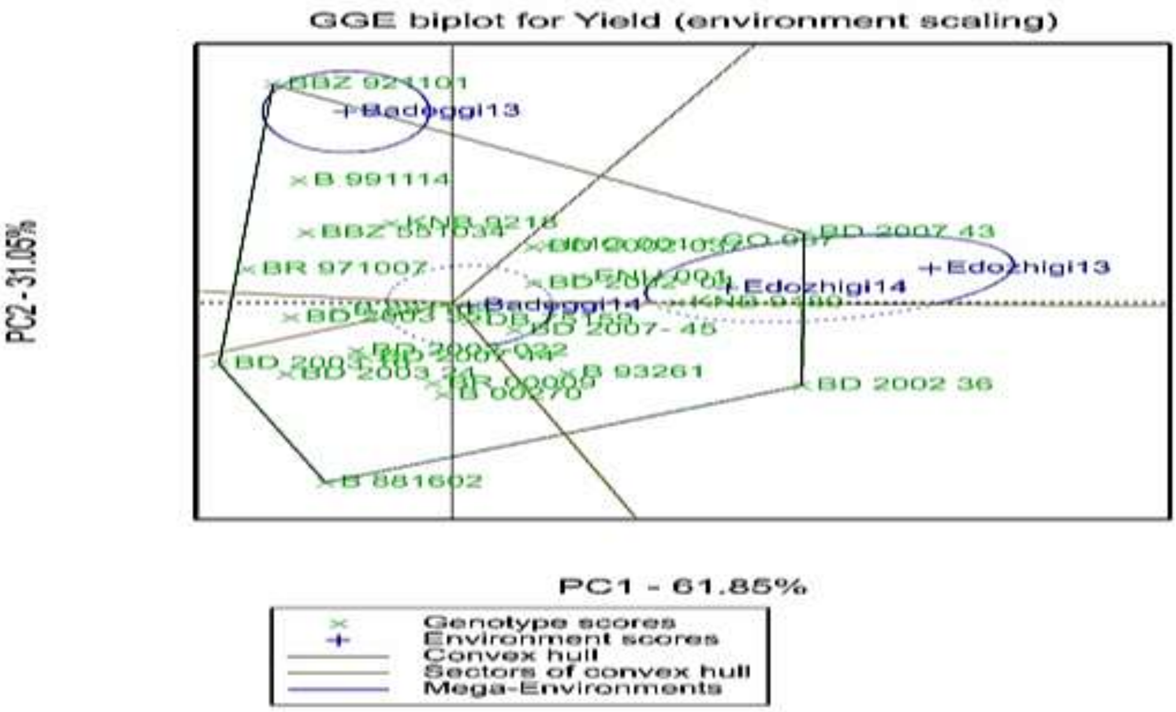
Table 6: Mean values for yield and regression coefficient (b), for 25 Sugarcane genotypes over four environments

Genotype	Mean Cane Yield(t/ha)	Sensitivity(b value)	Dynamic stability	Static stability	Mean square Deviation
B 00270	55.37	0.6938	2719	676	226.2
B 881104	60.48	1.0384	2244	1319	214.5
B 881602	39.55	0.5047	4257	489	316.4
B 93261	65.21	0.6484	2271	1148	1034.3
B 991114	67.62	1.8881	1856	3923	53.8
BBZ 551034	63.50	1.5789	1993	2783	97.3
BBZ 921101	77.19	2.2775	1636	5877	333.9
BD 2002 36	84.13	-0.1409	1854	951	1393.9
BD 2002- 04	72.62	1.0547	1522	1550	505.6
BD 2002-022	56.60	0.9218	2560	964	56.7
BD 2002-037	77.90	1.0699	1088	1384	204.6
BD 2003 16	47.11	1.0293	3437	1553	659.6
BD 2003 24	49.53	0.9578	3175	1153	229.6
BD 2003 35	55.14	1.1867	2625	1658	183.2
BD 2007 43	100.72	0.4261	627	1143	1417.6
BD 2007 44	57.19	0.7915	2514	755	107.9
BD 2007- 45	68.97	0.6995	1713	602	102.9
BR 00009	55.45	0.7705	2659	782	202.2
BR 971007	58.35	1.4215	2506	2538	502.1
CO 957	90.10	0.8482	872	1601	1225.7
DB 75159	67.18	0.8325	1792	774	27.0
ENU 001	75.61	0.9775	1314	1485	664.3
IMO 001	78.72	1.1090	1103	1553	318.0
KNB 9180	83.34	0.5202	1189	758	693.9
KNB 9218	70.16	1.5196	1584	2524	10.2
G. Mean	**67.11**				

Table 7: AMMI Analysis of variance for Genotypes and Environments

Source	d.f.	s.s.	m.s.	v.r.	F pr
Genotypes	24	19647	819	1.50	0.0946
Environments	3	80767	26922	49.47	<0.001
Interactions	72	39180	544		
IPCA 1	26	28725	1105	8.17	<0.001
IPCA 2	24	7479	312	2.30	0.0266
Residuals	22	2976	135		

Fig1: GGE biplot for best genotypes in different environments for cane yield



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COMPARATIVE ANALYSIS OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES FOR PRODUCTION OF DIOSCOREA DUMETORUM IN SOUTH EAST AGRO-ECOLOGICAL ZONE, NIGERIA

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ABSTRACT
The study was carried out in 2009 and 2010 cropping seasons at research field of NRCRI, Umudike. The test crop was Dioscorea dumetorum due to decrease in the growth and yield of the crop. It was tested with different soil nutrient management practices. Soil nutrient management practice comprised three levels of NPK 15:15:15 fertilizer such as 0, 300, and 600 kg/ha and three levels of poultry manure (0, 2 and 4) t/ha. The fields were allowed to undergo fallow for two years and then post-harvest soil and poultry manure analysis was carried out. All the stages of land preparation were done mechanically with tractor. The ridges were laid out in plot size of 4mx5m in a randomized complete Block Design replicated three times. Planting was done on ridges with a planting distance of 1mx1m. The tuber weight planted was 5.00kg per plot in 2009 and 5.5kg per plot in 2010. Treatments were applied 8 weeks after planting and the yam specie was harvested 7 months after planting for 2009 and 8 months after planting for 2010. Each treatment represents a technology and data were collected on each activity carried out using cost-route approach. Data collected were subjected to gross margin analysis to compare the technologies with the traditional method. Results show that 300kg/ha of NPK 15:15:15 plus 4t/ha of poultry manure had the highest comparative advantage over the other techniques including the traditional system as the gross margin was ₦16, 447.58/ha and therefore was recommended to resource limited farmers.
Keywords: Dioscorea dumetorum, **Soil nutrient management, Gross Margin, Nigeria**

INTRODUCTION
The yam specie - Dioscorea dumetorum occupies very important position among farming families in Africa because of its carotenoid content and good source of food for diabetics. In Nigeria, the yam specie is popularly grown by subsistence farmers in Abia, Akwa Ibom, Anambra, Edo, Delta, Rivers, Cross River, Ebonyi, Enugu, Kogi States and some states in Western part of the country among other states in Nigeria. The crop is mostly cultivated by women farmers who intercrop the crop with equsi-melon, cassava, okra, pumpkin, cowpea, maize etc. after the land has been allowed to fallow for not less two years. It is a trifoliate yam, the only species with compound leaves. The stems of the crop are strong and thorny, coiling from right to left (Janssens, 2001). The crop is noted for its medicinal value as it plays a significant role in the diets of the farming communities of these states. It is a hunger saving crop often harvested in piece meal. Dioscorea Dumetorum is usually consumed when there is nothing left of other yam species or probably when other yams have been tied up in the barn. The crop is superior nutritionally to other yam species commonly consumed as it has high protein, minerals and vitamin A contents. It has crude protein content of 11.07%, fibre content of 2.06% and total carotenoid content of 217.73ug/100g, but it has low carbohydrate compare to other yam varieties. This makes it a good source of food remedy for diabetics as revealed by research (Ezeocha et al., 2010).
Despite the medicinal value of the crop, it rate of production has been on decrease recently probably due to poor soil fertility management and total neglect of the crop in area of detailed research. The farmlands are no longer allowed to go into fallow due to high demand for other uses. The crop however, can be included among the neglected yam species in Nigeria. A multidisciplinary research to expose the potentials of the crop is therefore necessary. First, the study considered soil management innovations sustainable enough to improve the present yield of the crop. This was done by integrating nutrient management on soil which included inorganic and organic fertilizers options. The study looked at the effect of the different options on the yield of the crop in relation to the traditional method as well as it costs/benefits. The best innovation(s) were selected appropriate for dissemination to producers and adoption. The study used the concept of farm gross margin to select the best innovations. Farm gross margins provide a simple method for comparing the performance of enterprises or technologies that have similar requirements for capital and labour (The State of Victoria, 2016). A gross margin refers to the total income derived from an enterprise less the variable costs incurred in the enterprise. The use of gross margins became widespread in the UK from about 1960, when it was first popularized amongst farm management advisers for analysis and planning purposes (Barnard and Nix, 1979; Firth, 2002). They are not a

measure of farm profit as they do not include capital (land, buildings, machinery, irrigation equipment etc.) or fixed costs (building and machinery depreciation, administration, insurance, rates, taxes etc.). However, they do provide a useful tool in terms of farm management, budgeting and estimating the likely returns or losses of a particular crop. Therefore, the objective of the research was to compare the performance (costs/benefits) of different technologies of the integrated nutrient management on soil for the production of trifoliate yam specie.

METHODOLOGY

The experiment was conducted in 2009 and 2010 cropping seasons at research field of NRCRI, Umudike. The test crop was Dioscorea dumetorum. Soil nutrient management practices comprised three levels of NPK 15:15:15 fertilizer such as 0, 300, and 600 kg/ha and three levels of poultry manure (0, 2 and 4) t/ha. The fields were allowed to undergo fallow for two years and then post-harvest soil and poultry manure analysis was carried out. All the stages of land preparation were done mechanically with tractor. The ridges were laid out in plot size of 4mx5m in a randomized complete Block Design replicated three times. Planting was done on ridges with a planting distance of 1mx1m. The tuber weight planted per stand was 250g totaling 5.00kg per plot in 2009 and 275g per stand summing up to 5.5kg per plot in 2010. Treatments were applied 8 weeks after planting and the yam specie was harvested 7 months after planting for 2009 and 8 months after planting for 2010. Manual weeding was performed 8 and 16 weeks after planting. Each treatment represents an enterprise/technology and data were collected on each activity carried out using cost-route approach. The data collected were on input cost such as planting materials (seed yams), inorganic and organic fertilizers, hiring of tractor, all the various labour activities performed such as planting, fertilizer application, weeding, harvesting and carting. Price of the tubers harvested. Data were subjected to gross margin analysis per hectare for the different technologies. The Gross Margin Method is expressed as;
Gross Margin (GM) = GR- VC.
Where GM = Gross Margin or Net Return,
GR = Gross Revenue and
VC = Variable Cost (Farris et al., 2010; Mbanasor, et al., 2014; Paul and Katherine, 2010; The State of Victoria, 2016).

RESULTS AND DISCUSSION

Comparison of improved soil amendment practices and traditional system

The result of the soil fertility management practices and the traditional system is presented in Table 1. The application of 300kg/ha of NPK 15:15:15 plus 4t/ha of poultry manure had the highest comparative advantage over the other techniques and the conventional system as the gross margin was ₦16, 447.58/ha. This means that the technique could be recommended to producers to promote the yield and growth of the yam specie. The next technique with the second highest gross margin was 600kg/ha of NPK 15:15:15 plus 4t/ha of poultry manure, as the gross margin was ₦15, 306.14. This means that the technique could be selected as alternative to the first innovation. However, there is a set back to the choice of the alternative because it has the highest total variable cost of ₦363, 836.60. Here the concept of cost minimization takes precedent in the selection of this technique. Comparing the two innovations that show promises, first innovation is of a better choice to the second because of costs. Although 600kg/ha of NPK 15:15:15 plus 4t/ha of poultry manure was profitable, it can only be recommended for commercial farmers and not to resource limited farmers. The third technique (300kg NPK + 2t poultry manure) show little promise with gross margin of ₦9, 214.16. This means that the technique could be selected as the best alternative to the first innovation as it has a much lower costs of production and reasonable yield. The three innovations of soil fertility management practices were far better than the traditional system in terms of tuber yield, gross return and gross margin. Thus, the first innovation with the highest gross margin should be recommended to resource limited farmers.

CONCLUSION

From the result, it could be concluded that NPK 15:15:15 alone could not be used for Dioscorea dumetorum production. However the application of 300kg NPK 15:15:15 had the highest comparative advantage over the other treatments and had a reasonable contribution to soils quality amendment. Therefore this treatment is recommended for the production of Dioscorea dumetorum. The second technique with the highest gross margin will not be totally discarded but could be recommended to commercial producers who can afford the cost involved. The third technique could serve as alternative to the first technique and could be recommended to resource limited farmers. However, we should note that the use of gross margin analysis in the selection of the techniques does not measure profit as it did not include fixed costs inputs and therefore appropriate model based on it concept.

Table 1: Comparison of Soil Fertility Management Techniques and Traditional Method using Gross Margin (₦/ha)

Techniques	Mean Yield (t/ha)	Gross Return (₦/ha)	Total Variable cost (₦/ha)	Gross Margin (₦/ha)
0kg NPK+ 0t Poultry	18.05	257,857.07	288,020.60	-30,163.53
0kg NPK + 2t poultry	20.56	293,714.20	301,368.60	-7,654.40
0kg NPK + 4t poultry	22.06	315,142.76	314,696.60	446.16
300kg NPK + 0t poultry	19.06	272,285.63	312,590.60	-40,304.97
300kg NPK + 2t poultry	23.46	335,142.76	325,928.60	9,214.16
300kg NPK + 4t poultry	24.9	355,714.18	339,266.60	16,447.58
600kg NPK + 0t poultry	21.24	303,428.48	337,160.60	-33,732.12
600kg NPK+ 2t poultry	23.73	338,999.90	350,498.60	-11,498.70
600kg NPK + 4t poultry	26.54	379,142.74	363,836.60	15,306.14

Source: Authors' Computation

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COMPARATIVE EVALUATION OF PALM BUNCH RESIDUES, POULTRY MANURE AND INORGANIC FERTILIZER FOR SUSTAINABLE PRODUCTION OF YAM IN SOUTHERN NIGERIA

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ABSTRACT
The study is a systematic inquiry in the comparative evaluation of palm bunch residues, poultry manure and inorganic fertilizer for sustainable production of yam in southern Nigeria. The intention is to maintain the soil fertility and keep the ecosystem of the soil stable. It becomes important as to manipulate the erosion of the ecosystem in such away as to maintain soil fertility and productivity. The basic idea is to achieve physical and chemical, stability as to enhance a high level of production. The intention is to determine the level of availability of the plant nutrients to total output of the yam spp. by laying emphasis on the soil acidic level. Different combinations include; NPK fertilizer, palm bunch residues, poultry manure, NPK/Palm bunch, NPK/Poultry manure, and NPK/Palm bunch/Poultry manure residues. The application of the organic manure was based on existing rate, NPK 15:15:, 400kg/ha is equal to equivalent of nitrogen. Comparatively the combination showed that in 2014 on single dosage palm bunch gave 10.40kg/ha, followed by poultry manure with a yield weight of 8.87kg and lastly with NPK which gave 6.69kg/ha. In the compositions, NPK/palm bunch resulted with the highest yield of 8.73kg/ha, while NPK/Poultry manure gave 8.65kg/ha while the 3 combination gave 6.63kg/ha. In 2015, palm bunch gave 10.94kg/ha, followed by NPK with a mean weight of 5.72kg/ha and poultry manure with 5.34kg/ha. Under the combinations, NPK/Palm bunch resulted with the highest mean weight of 12.49kg/ha, followed by NPK/Poultry manure gave 5.64kg/ha and lastly the NPK/PB/PM gave the mean weight of 5.63kg/ha.
Keywords: Inorganic fertilizer, poultry manure, palm bunch, residues

INTRODUCTION

Soil degradation is associated with low CEC (cation exchange capacity) mineralization and leaching which causes the soil to be acidic, but research has shown that the life wire of our soil is the organic matter. (Shiyam, Y.O, Oko, B.F.D., Obiefuna, Y.C. and Ofoh, M.C. (2010) indicated that the optimum fertilizer rate for high yield was 20 tonnes of sawdust plus 150kg NPK/ha. The adoption of this combination would enhance productivity of the intercrop mixture. Indiscriminate burning of the farm land leads to volatility that loss of nutrient. Grazing of land, the abuse associated with use of fertilizer, chelation (immobility of P), road construction, harvesting and deforestation are limitation to soil out –put. Mulch is any material placed on the surface of the soil to cool the soil and thereby prevent excessive loss of water through evaporation. (Ogbonna, P.E. and Nweze, N.J. (2012) confirmed that high levels of some nutrients elements have been reported to inhibit the availability of others especially micro nutrient elements. Mulch performs some other subsidiary functions. Cover crops are crop which are grown to be plough under into the soil to improve the soil fertility. Legumes may be defined as a plant of the family leguminaceae e.g. Field bean, field peas, cowpea, groundnut and soya beans. (Ojeniyi, S.O., Amusan, O.A. and Adekiya, A.O.(2013) revealed that application of poultry manure significantly improved soil structure and soil moisture content as well as the uptake of N.P.K Ca and mg by cocoyam. Mulch is needed to mulch crops after planting in other to protect it from excessive heat or desiccation. This operation is particularly important if planting is done during dry season, this time soil temperature is very high. Care should be taken to avoid mulch material that contains weed seeds and vegetable propagated plant parts. After planting on beds or ridges, they are mulched with green leaves dry grass, farm yard manure or compost to prevent the beds from drying and to prevent weed growth and break the force of rains biting on the beds surface. Up to tons per hectare of green leaves mulch may be used. Green leaves provide organic matter to the soil and reduce carbon to nitrogen ratio to the soil. (Uwah, O.F., Udoh , A.U and Iwo, G.A (2011) revealed that the adoption of the combination of 15t/ha PM and 80kg k/ha could optimize yield in this agroecology for cocoyam production. This will help to overcome poor drainage due to closure of pore space. Critical appraisal of organic manure include; organic manure enrich the soil with organic matter. They supply minor and trace elements. They contain plant growth regulatory substances similar to hormones and vitamins in the animal body. They are simpler to prepare and in expressive in terms of cash out lay. They are profitable way of disposing refuse so that the farmers holding and farm shade are left clean. In chemical fertilizer lesser labour is involved in applying a mixture than in applying each of the components separately. The chemical fertilizer mixture tends themselves more early to granulation and granules are comparatively from small dust like particles they can loss early and carried by wind. They retard the reaction of the fertilizer within the soil so that nutrient release is not wastefully too fast. There is room for correcting residual acidity in mixture through the adding of conditioners such as dolomite (CaMg $(CO_3)2$). Small quantities of micro-nutrient or trace elements can be incorporated in mixtures so that these trace elements become more easily distributed in the field. Looking at the limitations of organic manures and the disadvantages of mixtures of chemical fertilizer, there is need to into grated the organic fertilizer and inorganic fertilizer to achieve an optimum level of crop production. The basic principle which is to achieve physical stability and chemical stability should be enhanced.

1. To determine the capability of the combination of the residues, inorganic fertilizer and the soil to obtain the optima nutrient status of the soil of Umudike.
2. To determine the level of availability of nutrient to total output of the yam spp.

MATERIALS AND METHODS

Total N (%)	0.11	
Org. C (%)	1.40	
Org. M (%)	2.41	
Av. P (mg/kg)	32.60	
pH (H_2O)	5.30	5.70
Exch. Cations		
Ca	4.80	
Mg	2.40	
	6mol/kg	
K	0.23	
Na	0.07	
Exch. Acidity	1.68	

Mechanical Analysis

	A	**B**
Sand (%)	64.0	58.0
Silt (%)	7.00	7.00
Clay (%)	29.0	35.00
Texture	SCL	SCL

It is a randomized complete block designed and replicated 3 times. The area is prepared by tractors and ridges are formed. We used six different treatments which include, NPK fertilizer, palm bunch residues; poultry manure residues, palm bunch/NPK, poultry manure/NPK, and NPK/Palm bunch/poultry residues. he organic manure (materials) was applied based on the existing rate, that N.P.K 15:15:15, 400kg/ha is equal to equivalent of nitrogen. Also that rice mill waste 30 tons/ha will supply the same 60kg/ha equivalent of nitrogen. The experiment was planted on the following dates; 8th of May 2014 and the second planting was on the 20th of May, 2015 respectively, on mound at one metre apart in a plot size of 6m x 5m. A pre-emergence herbicide application was carried out and followed with treatment application as it is demanded. Two major weeding was carried out and all the management practices observed. The harvesting was carried out 8 months after planting. The yield were subjected to analysis of variance (ANOVA) using GENSTAT discovery edition 3 and significant means separated with LSD at 5% alpha level. The combination was on the normal application single application while for the combination it was at 50:50 dosage and lastly 33.33% for the NPK/PB/PM application.

RESULTS AND DISCUSSION

The result for the year 2014 and 2015 shows levels of awareness in the levels of applications. Comparatively, in 2014, the palm bunch resulted in the highest yield with a total output of 10.40kg, followed by PM with total weight of 8.87kg. In the combinations the PB/NPK out weighted the other with the mean weight of 8.73kg, followed by PM/NPK with a mean weight of 6.69kg and lastly the 3 combination with a mean weight of 6.63kg. In the table for the second year it was quite in variance from the first year result. The total mean yield for PB/NPK tend to out weight every other application with a mean weight of 12.49kg and followed by the mean weight of palm bunch with a mean weight of 10.94kg. Under single dosages, including N.P.K, palm bunch (PM), and poultry manure (PM), the palm bunch showed a high level performance in 2014 and 2015, with the 2014 resulting to 10.40kg and in 2015 with a mean weight of 10.94kg respectively. In all the integrations which include; NPK/PB, NPK/PM and NPK/PB/PM for the two years, the NPK/PB in 2014 yielded the highest weight of 8.73kg and in 2015 it also resulted to the highest out-put weight of 12.49kg. Really from the LSD (0.05%), there was no significant difference from the total result. From the initial soil analysis of the area of cropping it indicated that the soil was acidic since the pH level remained within 5.3-5.7; showing that the level of alkalinity was very low and mineralization will be very difficult.

CONCLUSION

It is necessary and imperative that we start to improve the soil state of the institute by making use of available local resources of origin like palm Bunch in composition with in-organic fertilizer to reduce cost. It will improve the soil physical and chemical properties. The additions of the biosolids of palm bunch in combination with in-organic fertilizer will enhanced the total out-put of the yam and reduce the antagonism association with in-organic fertilizer.

Table 1: Yield on the comparative evaluation of palm bunch, poultry manure and in-organic fertilizer for sustainable yam production

Treatment	2014 Mean weight value (kg/ha)	2015 Mean weight value (kg/ha)
N.P.K	6.69	5.72
Palm Bunch (PB)	10.40	10.94
Poultry manure (PM)	8.87	5.34
NPK/PB	8.73	12.49
NPK/PM	8.65	5.64
NPK/PB/PM	6.63	5.63
LSD	0.3	1.5

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RESPONSES OF CUCUMBER (CUCUMIS SATIVUS) TO POULTRY MANURE AND NPK FERTILIZER IN OWERRI

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ABSTRACT
A field experiment was carried out at the Federal University of Technology Teaching and Research Farm to ascertain the responses of Cucumber (Cucumis sativus) to Poultry Manure and NPK Fertilizers during the 2013 cropping season. The experiment was laid out in a 3 x 3 factorial in Randomized Complete Block Design replicated three times. The treatments include poultry manure rates of 0, 5 and 10 tons/ha while the NPK rates were 0, 200 and 400kg/ha respectively. Data on various growth and yield parameters of Cucumber were measured and subjected to analysis of variance. Mean separation was done using the least significant differences at 5% level of probability. Results indicated that 10 tons/ha of poultry manure and 400kg/ha of NPK fertilizer gave highest number of broad leaves (15.80cm), longest vine (154.83cm), widest fruits (19.56cm) longest fruit (20.77cm) and highest fruit yield of (6.40kg) per plot. Manured cucumber effectively suppressed weeds and branched extensively. Based on these results, it is strongly recommended for farmers to use 10tons/ha poultry manure combined with 400kg/ha of NPK 15:15:15 for best yield returns of Cucumber.
Keywords: Cucumber, Poultry Manure, NPK 15:15:15.

INTRODUCTION

Cucumber is an annual vegetable crop that belongs to the family of Cucurbitaceae which comprises of 90 genera and 750 species (Onyia et al., 2012). It is native to Africa and Asia where its consumption dates back to over 3000 years (Okonmah, 2011). Cumber is an ancient vegetable and one of the most improved members of the Cucurbitaceae family (Thao, 1998).

Cucumber is cultivated for its fruits which are sources of minerals, vitamins A, C, K and B6, potassium, magnesium, phosphorus, copper and manganese (Vimala, et al., 1999). The fruit is eaten alone as salad and in combination with other vegetables. The juice is often recommended as source of silicon to improve the health and complexion of the skin (Duke, 1997). The ascorbic acid contained in cucumber helps to reduce skin irritation (Okonmal, 2011).

Despite the economic potentials of the crop, the full production potentials of the crop in Southeastern Nigeria have not been realized. Low crop yields of the crop have been reported especially in intensive cropping systems due to the imbalance in the use of fertilizers. Also continuous cropping has led to several nutrients becoming deficient (Mahmood et al, 1999).

Reports on the relevance of organic manure and mineral fertilizer in tropical agriculture have been presented by various researchers. Adediran et al. (2005) reported a positive vegetative growth, root development and fruit yield of tomatoes to complementary application of organic manure with mineral fertilizer. Singh et al., (2003) in their report considered nitrogen as one of the major nutrients required by plants for growth, development and yield. Duruigbo et al., 2007 reported that application of 10tons/ha or 15tons/ha of poultry manure significantly increased the aggregate yields of yam/maize/cassava relay intercrop. Also in a similar research, Ibeawuchi et al. (2012) reported that use of NPK 15:15:15 at 0kg/ha and 10tons/ha poultry manure gave the highest cassava yield of 13.38tons/ha, Sorghum 0.113tons/ha and groundnut 0.073tons/ha respectively. The complementary use of organic and inorganic fertilizers has been recommended for sustenance of long term cropping in the tropics (Ipimoroti et al., 2002). Murwira and Kirohman (1993) observed that nutrient use efficiency might be increased by combining manure and inorganic fertilizers. This research paper is thus specifically aimed at evaluation of the responses of Cucumber (Cucumis sativus) to poultry manure and NPK fertilizer combinations in Owerri.

MATERIALS AND METHODS

The field experiment was carried out at the Federal University of Technology Teaching and Research Farm, Owerri in the 2013 cropping season using a 3x3 factorial in Randomized Complete Block Design (RCBD). The poultry manure rates include: 0, 5, and 10tons/ha while NPK fertilizer rates are; 0kg/ha, 200 and 400kg/ha respectively. The area was cleared, marked out and tilled. Poultry manure was applied before planting of cucumber. Cucumber seeds were planted at two seeds per hole at a spacing of 75cm x 75cm.

Data on all growth and yield parameters were measured and subjected to analysis of variance while mean separation was done using least significant differences at 5% level of probability.

RESULTS AND DISCUSSION

The preplanting soil physical and chemical properties are presented in Table 1: Results indicate that the soil pH is 4.80 which is acidic. Nutrient contents of the soil were low indicating that the soil is highly infertile. Highest mean number of cucumber leaves was recorded in the 10tons/ha of poultry manure and 400kg/ha NPK fertilizer at 4, 6 and 8 weeks after planting (Table 2). This agrees favorably with work done by Aduloju et al., 2010, Dada and Fayimminu, 2010, who reported that nutrients from mineralization of organic matter promoted growth and yield of cucumber. Highest fresh fruit yield (6.40kg/plot) was also recorded in plots treated with 10tons/ha poultry manure in combination with 400kg/ha NPK fertilizer (Table 3). The fruit girth also increased proportionately with increase in poultry manure and NPK fertilizer while the lesser the manure rate, the greater the reduction in fruit girth. This is also in agreement with work done by Ayoola and Adeniran 2006. The zero manure and fertilizer treatments produced significantly lower fruit yield of cucumber in all replications.

Table 1 Pre-planting Soil Physical and Chemical Analysis of Experimented Site

Soil Physical and Chemical Properties	Topsoil (0.15cm)
pH in Water	4.7
pH in Kcl	4.6
Organic Matter (%)	1.57
Organic Carbon (%)	0.91
Available Phosphorus (Cmol/kg)	2.01
Calcium (Cmol/kg)	1.55
Magnesium (Cmol/kg)	1.56
Potassium (Cmol/kg)	0.04
Sodium (Cmol/kg)	0.03
E.C.E.C	3.10
Base Saturation	53
Percent silt	1.88
Percent slay	28.40
Percent sand	69.72
Textural Class	Sandy loam

Table 2: Cucumber Number of Leaves at 4, 6, and 8 Weeks after Planting as Influence by NPK Fertilizer and Manure Rates.

	Poultry Manure Rates (tons/ha)			
NPK (kg/ha)	0	5	10	Mean
4 WAP				
0	2.90	3.00	3.57	3.16
200	3.00	3.83	3.83	3.46
400	3.23	3.87	4.03	3.71
Mean	3.04	3.47	3.81	
6 WAP				
0	7.67	8.17		
200	8.07	9.23		
400	8.50	9.87		
Mean	8.08	9.08		
8 WAP				
0	12.12	12.57	15.53	13.41
200	11.83	15.57	15.67	14.36
400	15.20	15.80	15.60	15.53
Mean	13.06	14.64	15.60	

LSD 0.05: NPK 4(WAP) 0.15; 6(WAP) 0.39; 8(WAP) 0.38; Poultry Manure 4(WAP) 0.26, 6(WAP) 0.42; 8(WAP) 0.38; NPK&Poultry 4(WAP) NS; 6(WAP) NS; 8(WAP) 0.66

Table 3: Effect of Poultry Manure and NPK Fertilizer on Cucumber Fresh Fruit yield (kg/ha)

NPK	Poultry	Manure	Rate	Tons/ha
Kg/ha	0	5	10	Mean
0	1.03	2.27	2.70	2.00
200	2.07	3.43	5.17	3.56
400	2.23	4.97	6.40	4.76
Mean	1.78	3.56	4.76	

LSD 0.05: NPK – 0.43; Poultry Manure: 0.56; NPK x Poultry Manure: 0.75

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EFFECTS OF POLYETHENE COLOUR AND SOIL SOLARIZATION DURATION ON WEED POPULATION DYNAMICS IN MAIZE (ZEA MAYS L.) IN CALABAR, NIGERIA

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ABSTRACT
Field experiments were conducted in the 2014 and 2015 early cropping seasons at the University of Calabar Teaching and Research Farm, Calabar, to assess the impacts of polyethene colour and soil solarization duration on weed population dynamics in maize (Zea mays L.). The experiment was a split-plot laid out in Randomized Complete Block Design (RCBD) with three replications. The twelve treatment combinations comprised of three colors of polyethene (white, green, and black) as the main plots, and four solarization durations (0, 2, 4 and 6 week- periods) as the sub-plots. Data were collected on weed density, weed morphological groups and number of seeds per maize cob, and analyzed. Weed density consistently reduced as soil solarization duration increased from 0 to 6 weeks, whereas it was not significantly ($p < 0.05$) affected by polyethene colour in both years . Soil solarization for 4 to 6 weeks significantly ($p < 0.05$) affected broadleaf, grass and sedge weeds in both years. White polyethene significantly ($p <.0. 05$) reduced grass weed population compared to the black in both years. The number of seeds per cob of maize significantly ($p < 0.05$) increased as soil solarization duration increased each year. Compared to the unsolarized control, soil solarization for 2, 4, and 6 weeks increased the number of grains per cob by 18.97 %, 43.71 %, and 91.31 % in 2014, and by 24.87 %, 57.81 % and 105.30 % in 2015, in that order. Interactively, the number of grains per cob was enhanced as the duration of solarization increased among the three polyethene colours, but the white at 6 weeks solarization gave the highest values which were statistically higher than all other treatment combinations indicating superiority.
Key words: Polyethene colour, soil solarization, weed density, weed morphological group, maize

INTRODUCTION

Weed infestation remains a major factor limiting crop production. It has been noted that crops cannot be grown on the soil without the certainty that weeds will thrive (Khan et al., 2002). Weeds generally compete with crops for growth factors (Nwagwu et al, 2000). Weed density and weed types present are among the major weed factors that influence their competitiveness with crops, resulting in reduced yields. The decrease in maize grain yield due to weeds has been estimated at an average of 40 to 100 % in Nigeria, 38.0 % in Africa and 29.2 % world-wide, (Takim, 2012). Effective weed management is therefore a vital practice necessary to ensure optimum grain yield of maize (Narayan, 2012; Tahir, 2014). Manual weeding is the most common weed management method in West Africa. However, the drudgery, high cost and the need for repeated operations associated with handweeding have made the practice undesirable, especially in large scale crop farms. Furthermore, no one method of weed management has been able to adequately control weeds in crop farms at all times.

The use of soil solarization as an efficacious and hazard-free practice for reducing weed infestation has become increasingly popular (Yaduraju, 1993, Marenco and Lustossa, 2000, Pathel et al., 2005) and can be applied to maize production. According to Pokharel and Hammon (2010), soil solarization is a hydrothermal process which takes place in wet soils that are covered with plastic films and allowed to be heated by sunlight. The duration of soil solarization and colour of the plastic films, as well as their interaction, can have varying effects on weed incidence and the performance of a subsequent crop; however, information is currently scarce on this in Nigeria, especially in the southeastern rain forest area, where maize is widely grown as staple crop. This research therefore investigated the influence of polyethene colour and soil solarization duration on weed population dynamics and maize yield in Calabar, Nigera.

MATERIALS AND METHODS

Field experiments were conducted in the 2014 and 2015 early cropping seasons at the University of Calabar Teaching and Research Farm, Calabar, to determine the impacts of soil solarization duration and polyethene colour on weed incidence in maize. Calabar is located at the southeastern rainforest agro-ecological zone of Nigeria (4.5^0N - 5.2^0N, 8.3^0E), about 39 m above sea level and has a bimodal annual rainfall distribution that ranges from 3,000 mm to 3,500 mm with mean annual temperature range of 27^0 C to 35^0 C and relative humidity of 75 % to 88 % (Effiong, 2011). The experimental site, which was in secondary vegetation with predominantly annual weeds, was cleared with machete and the debris packed. The land was mapped out into uniform plot units to meet the design specifications. Raised seed beds measuring 2.9 m x 1.2 m were made, harrowed and levelled using a spade. The split-plot experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. There were twelve treatment combinations comprising of three colors of polyethene (white, green and black) as the main plots, and four solarization durations (0, 2, 4 and 6 weeks) as the sub-plots. The polyethene materials with thickness of 100 microns (100 µ) each were laid uniformly on the respective plots in March each year. The plots for 6 weeks solarization were covered with polyethene first, those for 2 and 4 weeks solarization were covered 2 and 4 weeks later, respectively. At the end of the sixth week, the polyethene films were removed with the unsolarized plots as the control. Short (70 days) duration maize (Oba Super 2) seeds were then sown at 75 cm × 25 cm spacing, two per hole, and later thinned to one, giving a population of 53,333 plants per hectare. Data were collected on weed density and weed flora count at 3 and 6 weeks after sowing (WAS) and the mean values for both weeks computed and recorded. Weed density was determined by placing a 1 m x 1 m quadrant randomly on each treatment plot and the total number of weeds enclosed within the quadrat counted and recorded. The weeds within the quadrat were then harvested and separated into morphological groups - broadleaves, grasses and sedges, and the number of each group counted and recorded. Maize cobs were harvested from six middle plants per plot at 80 days after sowing (DAS), de-husked, and the number of grains per cob counted and the mean recorded. Data collected were subjected to analysis of variance (ANOVA) using the GenStat Package Version 8.1. Significant means were separated using the Fishers Least Significant Difference (FLSD) method at 5% level of probability.

RESULTS AND DISCUSSION

Weed density

Weed density consistently reduced as soil solarization duration increased from 0 to 6 weeks in both years (Table 1). In 2014, weed density was significantly ($p < 0.05$) reduced with every 2-week increase in soil solarization period. In 2015, all solarized plots recorded significantly ($p < 0.05$) lower weed density than the unsolarized control with 6-week solarization duration resulting in significantly ($p < 0.05$) lower values than the 2 - week solarization duration. The generally lower weed density recorded in solarized plots in comparison with the unsolarized control indicates that the soil solarization treatments were effective in weed suppression and supports the report of Pathel et al. (2005), who noted that soil solarization was an efficient way of reducing weed infestation in crop farms. The better weed suppression recorded as duration of soil solarization increased from two to six weeks could be attributed to more solar heat trapped and transmitted through the polyethene into the soil that must have killed more weed propagules over the longer period compared to the shorter durations. This finding agrees with those of Chittapur and Hosmani (2000) and Marenco and Lustossa (2000), who reported progressive decline in weed populations with increasing solarization durations. Pathel et al. (2005) also reported that, soil solarization for 6 to 8 weeks controlled weeds in Chilli in India through the succeeding maize crop.

Weed density was not significantly ($p < 0.05$) affected by polyethene colour in both years, which indicates that the three colours of polyethelene investigated were equally effective in weed suppression. This is further supported by results of the interaction of polyethene colour and solarization duration, in which the use of black, green or white polyethene significantly ($p < 0.05$) reduced weed density at 6 weeks solarization duration, compared to 2 weeks solarization and the unsolarized control.

Weed flora distribution

Soil solarization significantly reduced populations for 4 to 6 weeks significantly ($p < 0.05$) affected broadleaf, grass and sedge weeds in both years Soil solarization significantly ($p < 0.05$) affected the populations of broadleaf, grass and sedge weeds in both years (Table 1). The 6 week solarization duration significantly ($p < 0.05$) reduced the population of broadleaf weeds compared to all other solarization durations in 2014 and compared to 2 weeks solarization and the unsolarized control in 2015. Soil solarization for 4 to 6 weeks in 2014 and for 6 weeks in 2015 significantly reduced grasses compared to shorter solarization durations in that order. In 2014, soil solarization for 4 and 6 weeks significantly reduced sedge weed populations compared to shorter solarization durations, while in 2015; all solarized plots recorded significantly lower sedge weeds than the control. These findings suggest that the effect of soil solarization on the various weed morphological groups becomes more pronounced when the treatment is allowed for 4 weeks or more. This is in line with the report of Seman-Varner and McSorley (2012), that soil solarization for 4 and 6 weeks reduced populations of weeds such as Indigofera hirsuta and Cyperus rotundus.

Whereas the effect of polyethene colour on broadleaf and sedge weeds was not consistent in 2014 and 2015, grass weed population was significantly ($p < 0.05$) reduced by white polyethene compared to the black in both years. This finding suggests that white polyethene was more effective in the suppression of grass weeds compared to the black, and this could be attributed to better light interception and heat retention and transmittance by the white polyethene to levels that could desiccate grass weed propagules as was also reported by Habeeburrahman and Hosmani (1996).

Number of seeds per maize cob

The number of seeds per cob of maize significantly ($p < 0.05$) increased as soil solarization duration increased in both years (Table 1). Compared to the unsolarized control, soil solarization for 2, 4, and 6 weeks increased the number of grains per cob by 18.97 %, 43.71 %, and 91.31 % in 2014, and 24.87 %, 57.81 % and 105.30 % in 2015, in that order. The progressive increase in number of seeds per cob as soil solarization duration increased could be attributed to the superior weed suppression achieved in the solarized plots compared to the control, which increased with solarization duration up to 6 weeks, and reflects an inverse relationship between weed populations and yield of the maize crop. Khan et al., (2002) reported that the yields of crops are usually higher where weed density is low.

White polyethyene resulted in significantly ($P \leq 0.05$) higher number of maize seeds per cob compared to the black or green in 2014. Interactively, the number of grains per cob was enhanced as the duration of solarization increased among the three polyethene colours, but the white at 6 weeks solarization gave the highest values which were statistically higher than all other treatment combinations in both years. This finding indicates that the maize crop generally benefited best from soil solarization with polyethene films when the solatization duration was up to 6 weeks with white the most effective polyethene colour.

CONCLUSION

Soil solarization was effective in reducing weed populations across the three morphological groups (broadleaves, grasses and sedges) especially from 4 to 6 weeks duration in both years. The maize crop benefited best from soil solarization with polyethene films when the solatization duration was up to 6 weeks with white as the most effective polyethene colour.

Table 1: Effect of polyethene colour and soil solarization duration on weed population and number of grains per maize cob in 2014 and 2015 early cropping seasons in Calabar.

	Mean weed density (no/m^2)		Weed morphological group (mean no/m^2) ǂ						Number of seeds per cob	
	2014	2015	2014			2015			2014	2015
Treatment Solarization duration			Br	Gr	Sg	Br	Gr	Sg		
0 weeks	100.90	59.40	14.60	8.56	76.80	44.30	5.67	9.56	226.70	179.20
2 weeks	73.90	34.70	11.00	7.89	54.90	24.90	4.56	5.33	269.70	223.80
4 weeks	40.10	26.60	13.70	4.22	22.20	16.20	5.00	5.33	325.80	282.80
6 weeks	26.60	17.70	7.10	3.89	15.60	12.20	2.11	3.22	433.70	367.90
$LSD_{(0.05)}$	21.24	12.05	6.65	3.66	22.10	9.73	2.18	2.99	19.46	24.79
Polyethylene colour										
Black	61.00	38.80	10.80	8.75	41.60	26.20	5.33	77.33	296.20	255.00
Green	55.70	35.60	14.90	4.58	32.20	24.80	4.67	6.08	305.40	259.40
White	64.40	29.30	9.10	5.08	49.30	22.20	3.00	4.17	340.20	275.80
$LSD_{(0.05)}$	NS	NS	5.76	3.17	NS	NS	1.88	2.59	22.81	NS
(Colour x duration)										
Black x 0 weeks	104.00	61.30	9.70	10.67	84.00	43.3	7.33	10.67	235.00	184.00
Green x 0 weeks	79.30	65.30	17.70	7.00	54.70	50.00	5.00	10.33	214.30	180.00
White x 0 weeks	119.30	51.70	16.30	8.00	91.70	39.70	4.67	7.67	230.70	173.70
Black x 2 weeks	65.30	39.70	18.00	12.67	44.70	30.33	4.00	5.33	238.70	220.00
Green x 2 weeks	69.00	33.30	16.00	5.67	47.30	19.00	6.67	7.67	275.50	225.30
White x 2 weeks	87.30	31.00	19.00	5.33	72.70	25.30	3.00	3.00	295.00	226.00
Black x 4 weeks	43.00	30.00	13.30	7.67	22.00	15.70	5.67	8.67	311.30	269.30
Green x 4 weeks	46.30	26.00	20.30	1.33	24.70	16.30	6.00	3.67	317.90	278.30
White x 4 weeks	31.00	23.70	7.30	3.67	20.00	16.70	3.33	3.67	348.30	300.70
Black x 6 weeks	31.70	24.30	12.00	4.00	15.70	15.30	4.33	4.67	399.70	346.70
Green x 6 weeks	28.00	17.70	5.70	4.33	18.00	14.00	1.00	2.67	414.30	354.00
White x 6 weeks	20.00	11.00	3.70	3.33	13.00	7.30	1.00	2.33	487.00	403.00
$LSD_{(0.05)}$	36.76	20.87	11.52	6.34	38.27	16.84	3.77	5.19	33.55	42.94

ǂ Br = Broadleaves, Gr = Grasses, Sg = sedges

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EFFECT OF ON- FARM FUNGICIDE APPLICATION ON GROWTH AND YIELD OF FRESH COCOYAM (COLOCASSIA ESCULENTA) CORMS AND CORMELS

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ABSTRACT
The field trial was conducted at NRCRI to evaluate the effect of two different fungicides (Nordox and Koside) on the growth and yield of cocoyam (colocassia esculenta) corms and cormels. Data generated were subjected to the analysis for significant differences between treatments. Means were tested using LSD at 0.05 probability level. The finding of this study shows no significant difference in yield with the 2 different fungicide applications. NCe 011 had a significant yield difference against NCe 012. This study recommends the application of both fungicides since they are effective and intensify the cultivation of Nce011.
Keywords: On-farm fungicide, growth, yield, fresh cocoayam

INTRODUCTION
Cocoyam (colocassia esculenta) contributes a significant proportion of the carbohydrate content (starch) of the diet in many regions of developing countries and provides edible starchy corms and cormels. Although, it is a major staple like cassava and yam, research interest on it has been poor compared with cassava and yam (Chukwu et al., 2012). In terms of nutrition, cocoyam has an advantage over root crops like yam and cassava (Foster-Powell et al., 2012). In addition, cocoyam is known to contain considerable amount of protein, starch, vitamins and minerals (Eleazu et al., 2013).The use of fungicide was reported to control Taro Leaf Blight (Chukwu et al., 2011). From this study, the effect of these fungicide applications on the growth and yield of cocoyam was investigated.

METHODOLOGY
The cocoyam varieties used for the study are (NCe 011 and NCe 012). Clean and healthy cocoyam samples were obtained from Cocoyam Programme of NRCRI, Umudike. The materials were planted, application of fertilizer was done 6 weeks after planting, and fungicides were applied after at an interval of 4 weeks after planting. Data generated were analyzed statistically using SAS 2003.

RESULTS AND DISCUSSION
The result in Table 1 shows the effect of fungicide application on the yield and yield components of cocoyam. The result shows that there were no significant difference in the number of corms, weight cormels, total number of corms and cormels and total weight of cocoyam on application of the two treatments. The treatments used were Nordox and Koside. The result in Table 2 shows the effect of fungicide application on the growth and yield of two cultivars of cocoyam. The result shows that there were no significant difference in the No of corms and weight of corms for the two cultivars of cocoyam- NCe 011 and NCe 012. The result also shows a significant difference in the weight cormels, total number corms and total weight of corms and cormels for the two cultivars. The cultivar NCe 012 performed better than NCe011 in terms of weight of cormels, total number corms and cormels and total weight. There was an increase of about 34.50%, 19.21% and 31.43% in weight of cormels, total No of corms and corms, and total weight for NCe 011 and NCe 012.

CONCLUSION
The result shows no significant difference in yield with the 2 different fungicide applications. NCe 011 performed better than NCe 011 in terms. The result therefore recommends the application of both fungicides since they are effective and intensify the cultivation of NCe 011.

1. **Table: Effect Of On-Farm Fungicide Application On The Growth And Yield Of Cocoyam**

Treatment	No of corms	Weight of cormels	Total No of corms/cormels	Total weight
T_1	44.167^a	10.400^a	454.17^a	15.90
T_2	45.833^a	10.933^a	399.33^a	17.26
LSD	9.24	3.78	128.67	4.95

Table 2: Effect of Fungicide Application on the Growth and Yield of Two Cultivars of Cocoyam

Cultivars	No of corms	Weight of corms	Weight of cormels	Total No of corms/cormels	Total weight
NCe011	45.00[a]	45.00[a]	461.33[a]	11.800	506.33[a]
NCe012	45.00[a]	45.00[a]	302.17[b]	9.533	347.17[b]
LSD	9.24	1.229	3.785	128.67	4.959

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BENEFICIAL HEALTH EFFECTS OF TURMERIC (*Curcuma Longa Linn*)

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ABSTRACT
T*urmeric is an errect perennial plant, grown as an annual crop for its rhizomes (underground root-like stem). It belongs to the same family as ginger (zingiberacae). Turmeric is very important spice, native of india. It is a natural antiseptic, which exhibits great therapeutic properties. The active components of turmeric are curcuminoids, which include mainly curcumin (diferiloylmethane) which is a yellow pigment present in turmeric, demethoxy curcumin and bid emethoxycurcumin. These active principles of turmeric (curcumin and curcuminoids) have been shown to exhibit antioxidative, anti-inflammatory, antiviral, analgesic, anti-bacterial, anti-fungal, anti-protozoal, anti-ulcer, anti-cancer, and hypocholesteremic activities, and thus has a potential against various malignant diseases, diabetes, arthritis, allergies, Alzheimer's diseases and other chronic and hard curable diseases. The purpose of this review is to provide an understanding of the emerging health benefits of turmeric (curuma longa). Recent studies have authenticated the use of turmeric as hepatoprotective, nephroprotective, anticoagulant and anti-HIV to combat AIDS. Turmeric has been found to be used traditionally as a non-toxic plant to bring remedy for the cure of wide variety of diseases. Current research has focused on turmeric's anti-oxidant, hepatoprotective, anti-inflammatory, anti-carcinogenic, cardiovascular, gastrointestinal and anti-microbial properties.*
***K*eywords: Turmeric, Curcumin, Health effects**

INTRODUCTION

Turmeric (Curcuma longa) is a spice native of India. It is the rhizome of an under-ground stem of a ginger-like plant. The plant is a herbaceous perennial, 60-90cm high, with a short stem tuffed in. It's flowers are yellow, between 10-15cm in length. No fruits are known for this plant. The rhizome is yellowish brown, with a dull orange interior that looks bright yellow when powdered. The rhizome measures between 2.5-7.0cm in length, and 2.5cm in diameter, with small tuber branching off. Turmeric requires a temperature of 20 and 30^0 c(68 and 86^0F)and a considerable amount of rainfall to thrive. It is used as a spice, and also a natural colouring agent for food, cosmetics or dye. In the Ayurvedic tradition, turmeric or ''haldi'' works well with the doshas, with its main action being to remove mucus from the system . Turmeric is considered to be one of the most important herbs in Ayurvedic tradition. The extensive survey of the literature reveals that turmeric is highly regarded as a universal panacea in the herbal medicine, with a wide spectrum, of pharmacological activities. It is found to be beneficial in the treatment of a wide range of health disorders like circulatory problems, liver diseases, dermatological disorders, blood purification and other chronic diseases (sirinicasan et al, 1992: Osewa et al). Current traditional medicine claims turmeric powder against gastro-intestinal diseases, especially for biliary and hepatic disorder, diabetic wounds, rheumatism, inflammation, sinusitis, anorexia, coryza, and cough. Turmeric contains curcuminoids which are antioxidants. These curcuminoids are three, all of which are major bioactive components (Curcumin, desmethoxycurcumin and bisdesmethoxy curcumin). The yellow pigmented curcuminoids represent 2-5% of the turmeric root, typically composed of 85% as curcumin, 10% as demethoxycurcumin and 5% as bisdemethoxycurcumin. Apart from turmeric's richness in circuminoid pigments and essential oils (5%), turmeric also contains carbohydrates (69.43%), protein (6.3%), mineral (3.50%), on dry wet basis (Nunes 1989), sarkur 2000 and Olojede 2005). Other naturally occurring constituients of turmeric include vitamin C, vitamin B1, vitamin B2, vitamin B3, calcium, magnesium, potassium, zinc,phosphorus, Ash, fats, iron sodium and water. Turmeric also contains sesquiterpenes, turmorone, atlantone, zingiberione, turmeronol, bisabolene, resins and caffeic acid.

MECHANISM OF ACTION

Antioxidant Effect: Turmeric shows a very strong oxidative property due to its extra ordinary molecular structure. Circumin the best researched active component of turmeric, comprising 0.2 – 5.0% of raw turmeric, is a free radical scavenger. It acts as a shield against certain kinds of environmental toxins. It has been shown that curmumin inhibits lipid peroxidation, using lineleate, a pollyunsaturated fatty acid that is able to be oxidized and form a fatty acid radical. A study of Ischemia in the feline heart demonstrated that curcumin pre-treatment decreased Ischemia-induced oxidative stress and changes in the heart. The antioxidant activity of turmeric is comparable to vitamin C and E. It can protect lipids or haemoglobin from oxidation. An invitro study measuring the effect of curcumin on an inducible protein resulted in enhanced cellular resistance to oxidative damage. Curcumin present in turmeric can protect the DNA against single strand breaks induced by single oxygen.

Turmeric, and curcumin in particular, suppresses the mutagencicity of several common mutagens including cigrate smoke and benzopyrene. (Sondanini et al 1995).

Anti-inflammatory Effects: Due to the extra-ordinary molecular structure of turmeric, it also shows a very strong anti-inflammatory property. Its most important anti-inflammatory mechanism centers on its effects on the prostaglandins (PGs), a large family of potent lipids produced by the body. PG1 and PG2 calm the body while PG3 inflammes the body. Turmeric is a potent inhibitor of cyclooxygenase 5 – lipoxygenate and also 5-HETE production in neutrophils. Reducing these enzymes, means less arachidonic acid metabolism, which means less PG2 ,which equally means less pain and inflammation. Curcumin reduces the neutropils infiltration in inflammatory conditions and inhibit platelet aggression. Turmeric therefore is very good in the treatment of arthritis, rheumatioid arthritis, injuries, trauma and stiffness from both under activity and over activity. A hydroethanolic extract of turmeric extract was recently found to inhibit activation of human dendritic cells in response to inflammatory cytokines (Krasovsky et al 2009). Curcumin has been found to counteract inflammation and irritation associated with inflammatory skin conditions and allergies when applied topically.

Anti-Carcinogenic Effects: Carcinogenesis occurs by means of several biological pathways, and through the de-regulation of hundreds of molecules. Circumin present in turmeric reduces cancer growth by targeting several of these pathways and de-regulation of molecules (shishodia et al. 2007). Studies have demonstrated that curcumin is able to inhibit carcinogenesis at three stages, angiogenesis, tumour promotion and tumor growth. In two studies of colon and prostrate cancer, curcumin was shown to inhibit cell proliferation and tarnor growth. Turmeric and curcumin are also able to suppress the activity of several common mutagens and carcinogens. The anti-caranogenic effect of turmeric have been related to direct antioxidant and free-radical scavenging effects, as well as their ability to indirectly increase glutathione levels, thereby aiding in hepatic detoxification of mutagens and inhibit nitrosamine formation.

The mutagenic induction effect of UV rays has been shown to be inhibited by circumin. It has been proved that the antioxidants present in curcumin neutralize carcinogeric free radicals (Kutton et at 1985)

Hepatoprotective Effect: The hepatoprotective effects of turmeric are mainly due to its antioxidant properties, as well as its ability to decrease the formation of pro-inflammatory cytokines. The hepatoprotective characteristics of turmeric is similar to that of silymarin. Turmeric and curcumin have been found to have reversed biliary hyperplasia, fatty changes, and necrosis induced by aflatoxin production. Soduim curcuminate, a salt excretion of bile salts, cholesterol and bilirubin, as well as increasing bile solubility, therefore possibly preventing and treating cholelithiasis. The choleric activity of curcumin which increases bile output and solubility may be helpful in treating gallstones.

Anti-microbial Effect: Turmeric has been shown to inhibit the growth of a variety of bacteria, pathogenic fungl and parasite. For centuries, turmeric has been used to heal open wounds and infections (Aggarival et al, 2007). The growth of histamine producing bacteria (vibro parahaemolyticus, Barcillus cereus, pseudomonas aeruginosa and proteus mirabilis) was inhibited by turmeric at a 5% concentration (Paremawsam, Thengaradjou and Kannan 2007). Turmeric extract was found to inhibit growth of food born pathogen V.parahaemolyticus, with good sensitivity (Yano, Satomi and Oikawa 2006). Curcumin has been found to have moderate activity against plasmodium falciparum and Leishmania major organisms.

Cardiovascular Effects: Turmeric has wonderful protective effects on the cardiovascular system. These include, lowering cholesterol and triglyceride levels, decreasing susceptibility of low density lipoprotein (LDL) to lipid peroxidation, and inhibiting platelet aggregation. The ability of turmeric constituents to inhibit platelet aggregation is thought to be via potentiation of prostacyclins synthesis and inhibition of thromboxane synthesis. Curcumin can stop the build-up of plaque (atherosclerosis), which can block the arteries and cause heart attacks and strokes. Turmeric effect on cholesterol levels may be due to decreased cholesterol up take in the intestine, and increased conversion of cholesterol to bile acids in the liver.

Gastrointestinal Effects: Turmeric exerts several protective effects on the gastro intestinal tracts. It also inhibits ulcer formation caused by stress, alcohol, indomethacin, reserprine, phylonic and litigation. Turmeric also inhibits intestinal spasm, and increases bicarbonate, gastrin, secretion and panerectic enzyme secretion. In cerulean or ethanol induced pancratitis, curcumin was found also to be able to inhibit the inflammatory mediatiors, resulting in amelioration in disease severity, and measured by histology, pancreatic trypsin, serum amylase and neutrophil infiltration.

A HOST OF BENEFITS OF TURMERIC (curuma longa)

According to Dr Andrew Weil, founder and program director of Arizona Center of integrative medicine. ''The bottom line is that the therapeutic advantages of turmeric are almost too numerous to list :

- Turmeric has been found to have hepatoprotective characteristics which is similar to that of silymarin
- The volatile oils in turmeric exhibit potent anti-inflammatory effects
- Turmeric and curcumin are capable of suppressing the activity of several common mutagens and carcinogens in a variety of cell types in both invivo and invitro studies .

- Constituents of turmeric exert several protective effects on the gastrointestinal tract.
- Extracts of turmeric suppresses symptoms associated with arthritis
- Turmeric extracts and its essential oils inhibit the growth of a variety of bacteria, parasistes and pathogenic fungi
- Turmeric and its constituents affects Alzlaeimer's and Parkinson diseases
- Turmeric,s protective effects on the cardiovascular system include: lowering cholesterol and triglyceride levels, decreasing susceptibility of low density lipoprotein to lipid peroxidation, and inhibiting platelet aggregation.
- Turmeric and its extracts inhibits angiogenesis
- Turmeric oil exhibited potent anti-trypsin and antihyaluronidase activity
- Turmeric enhances wound healing
- Turmeric extract reduces the incidence of cholesterol gall bladder stone formation
- Constituents of turmeric inhibit proliferation of vascular smooth muscle cells
- Turmeric protects against pancreatitis
- Turmeric lower serum cholesterol levels
- Turmeric stimulates muscle regeneration
- Turmeric suppresses the induction of adhesion molecule
- Constituents of turmeric blocks the replication of HIV
- Extracts of turmeric corrects cystic fibrosis defects
- Turmeric oil containing turmerones exhibited a potent antroxidant activity in β-carotene linoleate model system and the phosphomolybdenum method
- Constitutents of turmeric inhibit androgen receptor and androgen receptor (AR)- related cofactor
- Turmeric volatile oils suppresses acute oedema
- Constitutents of turmeric inhibits scorring
- Turmeric constituents inhibit farnesyl protein transferase (FTPase)

CONCLUSION

Turmeric is the unique source of various types of chemical compounds which are responsible for a variety of activities, which include: Anti-oxidant, hepatoprotective, anti-inflammatory, anti-carcinogenic, cardio vascular, gastrointestinal and antimicrobial activities.

Many studies show promising results for the efficacy of turmeric and its active ingredients curcumin against many important diseases. Turmeric has been found to be used traditionally as a non-toxic plant to bring remedy for the cure of a wide variety of diseases. As the global scenario is now changing towards the use of non-toxic plant products, having traditional medicinial use, development of modern drugs from turmeric should be emphasized, for the control and cure of various diseases. Further investigations needs to be carried out on turmeric, in order to explore the concealed areas and their practical clinical applications which can be used to improve human welfare.

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EFFICACY OF POWDERED PEEL EXTRACT OF ORANGE ON PEARL MILLET (PENNISETUM GLAUNCUM) STORED PEST (CRYPTOLESTES FURRUGINEUS)

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ABSTRACT

In the current study the insecticidal activity of powdered orange peel extract was studied against stored millet pest Cryptolestes furrugineus under laboratory condition. The stored pests were introduce to five powdered extract of orange peel (20 g, 40 g, 60 g, 80 g, and 100 g), placed in plastic containers with grain of pearl millet and observed for mortality for 15 weeks. It was observed that the Cryptolestes furrugineus survived for more than 15 weeks in 0 g (control) but did not survive beyond 6 weeks in 100 g of orange powdered peel extract; however, the results indicated the activity of orange powdered peel extract to be insecticidal as well as week dependent. The powdered peel extract was most effective (P < 0.05) against Cryptolestes furrugineus at 100 g causing 100 % mortality in 15 weeks. The results from this study offer great potential as an alternative insecticide that is available, cheap and effective in the control of stored pests. Thus, farmers could store their grains regularly with orange powdered peel extract.

Keywords: Stored Pests, Orange Peel Extract, Insecticide, Cryptolestes furrugineus, Mortality.

INTRODUCTION

Millets are in the family of cereals grown globally with importance across continents and within regions of the world (Igbal et al., 1992). They form a diverse group of small grains cultivated in diverse and adverse environment, mostly in the semi-arid and sub-humid drought-prone agro ecosystem. Production of millets is still at subsistence level by smallholders (farm size) and consumed as staple food and drink in most areas (Onu, 1996).

Millets are high energy, nutritious foods recommended for the health and well-being of infants, lactating mothers, elderly and convalescents. Their good nutritional values including high levels of quality protein, ash, calcium, iron and zinc make millet nutritionally superior than most other cereals (Burkil, 1997).

The insect species of importance in the tropics are pests of stored food grains, including pulses. They establish themselves on undamaged grains of millet (McFarlane, 1988 and Rajapakse, 2006).

The chemical preparations of insecticides contain chlorinated hydrocarbons and pyrethroids (Tayor, 1991). Chemical insecticides usage possesses a health risk; there have been reports of increased residues in grains and development of resistance (Acanvola and Walker, 1982; Atoili, 1998). Some of the chemical insecticides are toxic and misapplication can lead to a serious consequence to human health (farmers) in terms of application (Tayor, 1991; Acanvola and Walker, 1982).

To the rural farmers, the technical knowhow for application of chemical insecticides is not available and the chemicals are expensive and toxic. Hence a need to research for cheaper, formidable and easily available plant alternative that are ecologically safe and do not leave residues in environment.

Orange (Citrus sinensis) is an evergreen tree growing up to 9m. It has leaves throughout the year. Its fruits contain a wide range of ingredients which are rich in vitamin C, flavonoids and volatile oil. Citrus sinensis is an appetizer (Kenferm, 1997). Also, a smoke of the dried peel is used as a mosquito repellent in many villages in Imo State.

MATERIALS AND METHODS

Collection and Identification of Stored Millet Pests

Adult stored pest of pearl millet were collected from naturally infested pearl millet pests from Ekeonunwa market in Owerri Imo State. Collection was by carefully removing the pests with hands and placing them into sample containers with proper ventilation. They were transported to the Entomological laboratory of Imo State Polytechnic Umuagwo-Ohaji for examination, identification and experimentation. The stored pearl millet pests were examined under the light microscope and identified following various identification keys (Acanvola and Walker 1982; Igbal et al., 1992; Hill and Waller 1982). Stored pearl millet pests of the species Cryptolestes furrugineus was used for this study.

Preparation of Powdered Peel Extract

Orange fruits were purchased from the market and the peel removed and allowed to dry at room temperature (away from sun radiation). The dried peels were ground into a powder, using mortar and pestle, and then sieved to obtain uniform sized particles. The residue was discarded and 20 g, 40 g, 60 g, 80 g and 100 g of the powdered filtrate were weighed and used for this experiment.

Effect of the Powdered Orange Peel Extract

A total of 480 healthy stored pearl millet pests belonging to the species Cryptolestes furrugineus were placed in six groups of 20 Cryptolestes furrugineus each, in plastic containers covered with nets in six different treatments ~~of~~ powdered peel extract of 0 g, 20 g, 40 g, 60 g, 80 g and 100 g respectively (Salem et al., 2007).

Each treatment had four replicates. The Cryptolestes furrugineus were observed for mortality at 3 weeks, 6 weeks, 9 weeks, 12 weeks and 15 weeks. The Cryptolestes furrrugineus were considered-dead when they did not respond to pricking with sharp object or when they turned upside down.

Data Analysis

The numbers of Cryptolestes furrugineus alive and dead were recorded in table as mean ± Se and percentage (%) mortality was calculated. Data obtained were subjected to analysis of variance to know differences at 5% level of significance; Duncan Multiple Range Test was used to compare the effect of powdered orange peel extract on Cyptolestes furrugineus.

RESULTS AND DISCUSSION

The results of the effect of powdered orange peel extract on C. furrugineus appeared to be effective as week's progresses. It can be seen from table 1 that a range of 15 % – 100 % C. furrugineus were killed by 20 g, 40 g, 60 g, 80 g, and 100 g of the powdered peel extract while the control (0 g) did not produce any lethal effect on C. furrugineus. However, the 100 g powdered peel extract effectively killed all C. furregineus within 9 weeks, with 100% efficiency. Statistical analysis indicated significant difference (P<0.05) between 20 g, 40 g, 60 g, 80 g, and 100 g powdered peel extracts respectively on their effects on C. furruginues, but no statistical difference (P<0.05) existed between the effects of 0 g and 20 g powdered peel extract against C. furrugineus. The result indicated that 100 g powdered peel extract was significantly (P<0.05) more effective against C. furrugineus in this study. Many other authors have reported the insecticidal effect of various plants extracts Makanuola, 1989; Emeasor et, al., 2005 and Rajapakse, 2006). The insecticidal activity of orange powdered peel extract seen in this study is not surprising because Mwaiko, 1992 and Amusan et al; 2005 reported differently that orange peel extract contained carvicidal properties on mosquito larval.

The high mortality rate recorded by this extract could be due to presence of linalool and d-limonene, which are the active ingredients. These two compounds are reported to be the most effective insecticidal compounds present in the extract. This could be corroborated with the findings of some researchers which indicate that heightens sensory nerve activity in insects thereby causing massive over stimulation of motor nerve that leads to convulsion, paralysis and eventually death (Mwaiko, 1992).

CONCLUSION

The results presented in this study have shown that extracts of orange peel have great potentials as bio-pesticides and could provide suitable alternatives for pest control on stored pearl millet of small and low input agriculture as commonly practiced in tropical countries without degrading the environment. In Nigeria, orange fruits are readily available in our environment and the local markets all the year round for farmers to use and protect their stored products. The fruit extract is safe cheap, easily biodegradable and environmentally friendly. It could provide valuable alternatives to synthetic insecticides in the management of post-harvest insect pests of pearl millet to resource poor farmers.

Table 1: Mortality (%) of C. furrugineus treated with different concentrations of Powdered Orange Peel Extract (n=20).

Treatments	3 weeks		6 weeks		9 weeks		12 weeks		15 weeks		Total	
(g)	N	%	N	%	N	%	N	%	N	%	N	%
0	0.0±0.0	0.0	0.0±0.0	0.0	0.0±0.0	0.0	0.0±0.0	0.0	0.0±0.0	0.0	0.0±0.0	0.0
20	0.0±0.0	0.0	0.0±0.0	0.0	0.0±0.0	0.0	1.0±0.1	5 .0	2.0±0.1	10.0	3.0 ±0.8	15.0
40	1.0 ±0.1	5.0	1.5±0.1	7.5	2.5±0.2	12.5	2.5±0.2	12.5	3.0±0.3	15.0	10.5±1.0	52.5
60	1.5±0.1	7.5	2.0±0.1	10.0	2.5±0.2	12.5	3.0±0.3	15.0	3.5±0.4	17.5	12.5±1.3	62.5
80	2.0±0.1	10.0	2.5±0.2	12.5	3.5±0.4	17.5	4.5±0.6	22.5	5.0±0.7	25.0	17.5±1.9	87.5
100	4.5±0.6	22.5	6.5±0.8	32.5	9.0±1.0	13.0	-		-		20.0±2.1	100

N=mean number of death recorded,% = percentage mortality: means on the same column and with different letters differ significantly (P<0.05)

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CONSTRAINTS TO THE MANAGEMENT OF CASSAVA GENETIC RESOURCES IN S.E. AGRO-ECOLOGICAL ZONE OF NIGERIA

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ABSTRACT
The study was conducted in S.E. Agro-ecological zone of Nigeria to assess the constraints to the management of cassava genetic resources. Cassava genetic resources are lost regularly due to poor management. The sample size was 480 in three states purposely chosen from the zone. Data were collected using structured interview schedule and these were analyzed using descriptive statistics such as frequencies, percentages and ranking. The result showed that 61.5% of the respondents were males and the mean age was 26years. Mean farm size was 2.5ha and only 13.0% of the respondents did not have any form of formal education. About 54.5% of the respondents lose cassava varieties due to low yield; while pests and diseases account for 63.0% as the most natural disasters in the management of genetic resources. Introduction of high yielding cassava varieties also is a major cause of loss of genetic resources. Based on the importance of cassava to man and animals, effort should be made towards it conservation for future use.
Keywords: Cassava, Constraint, Genetic Resources, Management

INTRODUCTION
Cassava is an important crop for more than 900million people in the tropics and sub-tropics (Nassar and Dorea, 1982). Domestication of cassava probably began with selection of large roots, more erect plant types with less branched growth and the ability to establish easily from stem cuttings. The population increase in the tropics and the use of cassava for animal feed and other industrial purposes has resulted in an increased demand for cassava, stimulating the development of diverse projects. To support this, cassava germplasm ought to be available and well characterized and documented. It is necessary to determine cultivars which have low cyanide content and to use them in breeding programmes. Maintenance of materials in the field is often very difficult since it requires year to year cultivations and this result in loss of germplasm through collaboration in all aspects of cassava genetic resources work. Most cassava fields are faced with catastrophically high incidence of viral diseases. Alternative methodologies of conservation of cassava germplasm such as in vitro slow growth, in vitro cryopreservation and seed could be intensified through a network.
The major causes of genetic resources loss are land use change, shift from traditional shifting cultivation to less permanent land tenure systems (Siemonsma and Lemmens, 2009). Others are introduction of high yielding varieties and its effect-replacement of the traditional genetic resources by high yielding crops, road network development, population pressure, leasing of land for other land uses, shortening of fallow periods, etc. Other causes are policy conflict, ignoring traditional customs and lack of awareness and understanding or knowledge about the values of natural resources and their management led to loss of genetic resources in all levels. The worldwide effort was created in part because of the belief that genetic legacy of our ancestors was threatened by modern conditions, especially, record high population, technological changes and infrastructural development (Frankel, 1970).
Projections about genetic erosion in farming systems of centers of crop resources rested on two conjectures. First, it is believed that modern crop varieties would diffuse throughout in these systems and secondly, it was thought that the adoption of modern crop varieties would lead farmers to stop planting land races (Daltrymple, 1986). However, farmers do not necessarily replace local varieties even when they adopt modern crop varieties. Until recently, the only means of conserving these species was in the field genebank, where the material is maintained in the vegetative state. In genetic resources, the techniques of in vitro culture can also be used for collections, disease elimination and multiplication, creation of variability and distribution of materials in aspetic conditions. To be efficiently managed and efficiently utilized, germplasm collections must be well characterized.
Management of cassava genetic resources is expected to result in effect or impact which is any immediate significant changes brought about by a given intervention action or series of actions. Such effects essentially consist of improved management practices of the genetic resources to reduce genetic erosion and enhance farmers' perception and adoption of improved management practices to safe-guard the genetic resources base. Therefore, this study was carried out to assess the constraints to the management of cassava genetic resources in Southeast Nigeria.

METHODOLOGY

The study was conducted in three states of South-east agro-ecological zone of Nigeria. The area lies mainly on plains under 200m above sea level with a human population of about 18.92million people (NPC, 2006). About 60-70% of the people engage in agriculture. Cassava production is the predominant agricultural activities in the states. The states under study were Akwa-Ibom, Abia and Ebonyi, purposely chosen because they each represent the major vegetative zones, i.e. the mangrove swamp, rainforest and savannah. Two agricultural zones were randomly selected from each state; Umuahia and Ohafia zones from Abia. Eket and Oron from Akwa-Ibom and Ebonyi South (Afikpo) and Ebonyi north (Abakaliki) from Ebonyi. In the second stage, two blocks were randomly selected. Finally, ten cassava farmers were randomly selected from each circle, giving a sample size of 160 respondents from each state. There were 480 respondents from the three states.

Data were collected using structured interview schedule for the 480 respondents sampled. Data were collected on the socio-economic characteristics of the farmers and on constraints to the management of genetic resources resulting to genetic erosion. Data collected were analyzed using descriptive statistics such as frequencies percentages and ranking.

RESULT AND DISCUSSION

Socio-economic characteristics of the respondents:

The distribution of respondents according to sex, age (yrs.), household size, farm size, (ha) and educational attainment are shown in table 1. The table shows that 61.5% of the respondents were males. Low percentage of the female folks in the study area may be attributed to their limited access to land and other production resources. About 38.5% of the respondents were in the age range of 41-50years with mean age of 26years. This means that the respondents were in their productive age.

The household size of 3-7 people constituted 65.0%, with mean size of 10. Idiong (2005) reported that large household size enhances the availability and cheap labour in the farm. Farm size of 1-2ha accounted for 39.2% and the mean farm size was 2.5ha. Azih (2004) revealed that small scale farm holdings predominate in Nigeria and account for about 95.0%s of agricultural output. Majority of the respondents had one form of education or the other. Only 13.0% did not have any formal education. Education makes communication easy as educated farmers are known to be less conservative and willing to explore their environment.

Causes of genetic erosion and commonest natural disaster which leads to loss of cassava

The result showed that 54.5% of the respondents lose cassava varieties as a result of low yield, while under commonest natural disaster which leads to loss of cassava, pests and diseases ranked first, accounting for 63.0%. This is shown in tables 2.

It was observed that 63.5% of the respondents identified introduction of high yielding cassava varieties as the major cause of loss of genetic resources. The introduction of improved varieties may have a short term effect on the environment as they tend to break down as a result of biotic and abiotic stresses.

CONCLUSION

Based on the importance of cassava to man and animals, efforts should be made towards its conservation for future use, especially for breeding and accessibility to farmers when needed. Most varieties have been lost due to bad management practices and conservation for not adopting different conservation methods. Collaboration between farmers and government should be improved upon to harness this effort and for future safe-guard of the cassava genetic resources base.

Table 1: Distribution of respondents according to sex, age (yrs.), household size, farm size and educational attainment

Variable	Frequencies	Percentage
Sex		
Male	295	61.5
Female	185	38.5
Total	**480**	**100.00**
Age (yrs.)		
< 30	18	3.8
31-40	69	14.3
41-50	185	38.5
51-60	138	28.8
> 60	70	14.6
Total	**480**	**100.00**
Mean	**26.0**	**100.0**
Household Size		
< 3	15	3.0
3 – 7	313	65.0
8 – 12	106	22.0
13 – 17	28	6.0
> 17	18	4.0
Total	**480**	**100.00**
Mean	**10**	
Farm Size (Ha)		
< 1.0	84	17.5
1 – 2	188	39.2
3 – 4	88	18.3
5 – 6	68	14.2
7 – 8	23	4.8
9 – 10	15	3.0
> 10	14	3.0
Total	**480**	**100.00**
Mean	**2.45**	
Educational attainment		
No formal education	61	12.7
Primary school education	154	32.0
Secondary school education	119	24.8
OND	35	7.3
NCE	41	8.5
HND	31	6.5
B.Sc	31	6.5
M.Sc	8	1.7
Total	**480**	**100.00**

Table 2: Causes of genetic erosion and commonest natural disaster which leads to loss of cassava

Causes of genetic erosion			Commonest natural disaster		
Variable	***Freq.**	**%**	**Variable**	***Freq.**	**Rank**
Low yield	262	54.5	Pests and diseases	302	1st
Diseases and pests	228	47.5	Prolonged drought	264	2nd
Poor culinary value	39	8.1	Bush fire	228	3rd
High cyanid content	91	19.0	Flood	159	4th
Farmers preference	117	24.4	Others	25	5th
Annual bush fire	62	13.0			
Erosion/flood	43	9.0			
others	1	0.2			
Total	**843**	**100.00**		**976**	

*** Multiple responses**
Source: Field Survey Data, 2014.

Table 3: Distribution of respondents based on other causes of cassava genetic resources loss in the zone

Variable	Frequencies	Percentage
Land use change, i.e. change in land tenure system	77	16.0
Introduction of high yielding varieties and its effect	305	63.5
Shrinking of community land due to population pressure	17	3.5
Shortening of fallow period	3	0.6
Policy conflict	2	0.4
Lack of awareness and understanding	76	16.0
Total	**480**	**100.00**

Source: Field Survey Data, 2014.

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EFFECT OF DIFFERENT NITROGEN SOURCES ON NODULATION, NUTRIENT COMPOSTION, GROWTH AND YIELD OF SOYBEAN (GLYCINE MAX L.) IN KABBA KOGI STATE

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ABSTRACT
The experiment was carried out at agronomy section of Kabba College of Agriculture to investigate the effect of different nitrogen sources on nodulation, nutrient composition, growth and yield of soybean. The treatment consists of two nitrogen fertilizer (urea and N P K) and three animal manures (poultry manure, cow dung and pig manure). All these materials were applied at 20kgN/ha at planting. The growth character observed were plant height, number of leaves, stem girth, leaf area, fresh weight of plant and dry weight of plant. Yield characters observed were pod length, pod number, 1000seed weight, and number of grains per plant, grain weight per plant and yield per land area. Nodule characters observed were fresh weight of nodule and number of nodule produced per plant. Data were also collected on nutrient composition of soybean seed such as N P K, S, protein, oil, and carbohydrate. All the data collected were subjected to Analysis of Variance and treatment mean were separated using Least Significant Difference. The result shows that plot treated with N P K fertilizer at 20kgN per ha gave highest yield of soybean. It is therefore recommended to the farmers in the study area.
Keywords: Nitrogen, Nodulation, Nutrient composition, Soyabean, Manure and Fertilizer

INTRODUCTION
Soybean (Glycine max L.) is called a miracle golden bean because of its nutritive value, especially as a substitute or complement of protein. Soybean is an excellent source of protein and therefore, can supplement protein in human diet; the approximate composition of soybean is 40-45% protein 18-20% edible oil, 24-26% carbohydrate and a good amount of vitamins (Kaul and Das, 1986). It thus can play an important role in supplementing oil – protein deficiency. Soybean has one of the highest nitrogen requirements among the most agronomic crops.
Nitrogen is an integral component of many compounds including chlorophyll and enzymes, essential for plant growth processes. It is an essential component of amino acids and related proteins. Nitrogen is essential for carbohydrate use within plants and stimulates root growth and development as well as the uptake of other nutrients. This element encourages above ground vegetative growth and gives a deep green colour to the leaves (Brady, 1990). It is recognized that nitrogen is one of the key elements of soil fertility. Most of the developed countries are harvesting high yields and maintaining the soil nitrogen level by the application of chemical nitrogenous fertilizer. Soybean, being a leguminous crop, is capable to fix atmospheric nitrogen through symbiosis. However, several studies have shown that the symbiotic N – Fixation is not able to meet high N – requirement of this crop particularly under the Nitrogen deficient conditions. A number of workers (Duraisami and Mani, 201; Kumawat *et. al.*, 2000; Bachhau and Sabale, 1996; Sharma and Misra, 1997) reported the positive role of nitrogen in increasing yield, protein content and nutrient uptake of Soybean.
Soybean is a leguminous crop; there is need to plant leguminous plant in other to improve soil fertility. Nodule production determines the availability of nitrogen to crop at later stage of crop life. The crop has the ability to convert atmospheric nitrogen to the form that can be used by the plant. It also, determines nitrogen content of soybean seed. The work will examine the rate of nodule formation in soybean in Southern Guinea Savannah of Nigeria. Objectives of the study are to determine the effect of different nitrogen sources on nodulation, nutrient composition on soybean seed and on growth and yield of soybean.

MATERIALS AND METHODS
Area of the Study
The field experiment was conducted at Kabba College of Agriculture student experimental field during 2015 cropping season. Kabba is located in the Southern Guinea Savanna Ecological Zone of Nigeria. (07^0 53'N, 06^0 08'E). It has an average rainfall of about 1,570mm per annum with an annual temperature range of 18^0c – 32^0c. The mean relative humidity (R.H) of about 59% and four hundred and twenty seven meter (427m) above sea level.

Field work
The Soybean seeds that was source from Agriculture Development Office, Aiyetoro, Kogi State Nigeria. The experiment was conducted using single field of dimension 14.5m x 11m which consisted of six treatments and were replicated three times. The experiment was laid out in a Randomized Complete Block Design (RCBD).

The treatments consisted of the followings: The experiment consists of six nitrogen sources apply at 20kgN/ha T1= Urea (43.48kg urea/ha), T2= NPK (133.3kgNPK/ha), T3=Poultry manure (555.6kg pm/ha), T4=Cow dung (714.3kg cwd/ha), T5= Pig manure (1250kgpgm/ha), Control (No fertilizer).

The seeds for the experiment were collected from International Institute Tropical Agriculture, Ibadan. Sites were cleared manually using cutlass and later ridged with hoes and in the field, Seeds of Bambara nut were sown on a flat bed. Organic manure were uniformly spread on the flat beds and incorporated with hoes two weeks before planting. Urea and NPK fertilizer was applied at planting. The seeds were planting at the rate of two - plant-per-hole at a spacing of 50cm by 30cm which make up forty- nine stands per plot. Plots were weeded manually at three weeks intervals.

Data analysis

Data were statistically analyzed using GENSTAT. The analysis of variance (ANOVA) was performed to find out the significance of variation among the treatments while the significant difference between mean treatments were separated using least significance Difference at 5% level of probability.

RESULTS AND DISCUSSION

Pre-planting soil analysis and composition of animal manure used

The result of the pre-planting soil analysis showed that the soil was dominated by sand fraction at the surface at 60% followed by clay at 21.6% and silt at 18.1%.The soil was therefore classified as sand clay loam, by this classification, it could be inferred that the soil used for the study was of good drainage and well aerated for good root penetration. The soil pH showed that the soil was slightly acidic in reaction with pH value of 6.2. The organic matter content was low (2.14%) the low organic matter content could be attributed to the effect of erosion and seasonal burning that was very common in the area in early January and March annually. The total N was quite low at 0.19%). The low total nitrogen could also be attributed to low organic matter content (Nnaji et al, 2005). The available phosphorus was quite high at 31.4ppm. This could be as a result of low fixation of p in the study area by sesquioxides or as a result of the parent material. The exchangeable cation of Ca, Mg, K and Na were low. The cation exchange capacity (CEC) was low. Generally the percentage of base saturation was 23.3% and this infers that the soil had low fertility.

Plant height

Nitrogen sources influenced plant height of soybean significantly over control. 1norganic fertilizer influenced plant height better than organic nitrogen sources. Among the inorganic fertilizer tested NPK fertilizer produce taller plant. Plots treated with NPK were not significantly better than plots treated with urea. Animal manure plots were statistically inferior to plots treated with inorganic fertilize except in plots treated with poultry manure. Similar results were reported by Varon et al. (1984), Manral and Saxena (2003). The result also corroborate the finding of L1 and Mahler (1995) who obtained better vegetative development in wheat, most especially when soil was amended with poultry manure. N P K and poultry compete favorably in terms of growth characters of soybean. This could be as a result of many nutrients in both nitrogen sources. Among the animal manure, poultry manure produced tallest plant, followed by cow dung and the shortest plant occurred in plots treated with pig manure.

Number of leaves and leaf area were significantly affected by the different nitrogen sources applied. Plot treated with N P K produced the widest leaf area ($4.8m^2$). All the plots amend either with inorganic or animal manure were better than the control plot, there was no significant difference on stem girth.

Animal manure was significantly inferior to N P K fertilizer these experiments but, compete favorably with urea. The result is in line with the finding of Ogundare et al (2015).

Table 4.3 presented the result the of yield and yield components of soybean. Significant difference were observed in pod length, pod number , 1000seed weight (g) , number of grains weight of grains and grain yield per hectare due to different nitrogen sources, plot amended with inorganic fertilizer (urea and N P K) show better performance in yield and yield characters compared with plot amended with animal manure (poultry manure, cow dung and pig manure). Thought, N P K recorded higher pod number (66.8), grain number (148), grain weight per plant (43.4) and yield per hectare 4840kg (4.8 t/ha) which was not significantly better than plot treated with urea. Among the organic residues (animal manure) cow dung recorded greatest yield which was statistically different from plot treated with poultry manure and pig manure. Control plots were highly statistically inferior to plots amended with either organic or inorganic fertilizer in this study. Poultry manure performs better than either cow dung and pig manure. The better performance of poultry manures in all the growth character observed infers that the plant response to poultry which agrees with earlier finding of Olatunji and Oboh (2012). They reported increase in growth of tomato with the use of poultry manure. The better performance of the inorganic fertilizer in this study could be a result of nutrient released immediately into soil and crop. The findings of smith et al (1986) who reported that legumes crop do not need nitrogen, N P K treated plot perform better than urea treated plots. This observation could result from leaching effect of urea that make the nutrient unavailable to the crop, cow dung was the best animal manure in the experiment and significantly better than either poultry manure or pig manure in terms of yield. The result could attributed to the effects of phosphorus in cow dung which is a major nutrient in seed or grain production plots with no amendment produce the least yield and yield characters in this study. The results confirm that soybean response to different nitrogen sources.

Nodule characters in soybean

Fresh weight of nodule, dry weight of nodule and number of nodule per plant were significantly affected by the different nitrogen sources applied. Plot treated with poultry manure had largest nodule which was followed by N P K fertilizer, than urea and cow dung, pig manure plot had least number of nodules among the amended plots. However, unamend plots control show remarkly low number of nodules. Nodule number increase with the amended nitrogen sources over the control. The findings of Senerirantue et al, (2000) have shown that inoculation and fertilizer use promote plant growth and increase grain yield in soybean. Incorporating 23kg n/ha as the primary fertilizer application and adding 23kg n/ha at the end of flowering does not inhibit soybean nodulation. This show the importance of nitrogen fixation in the tropic even with fertilizer incorporation included. Nitrogen affect nodulation of legume (soybean). Yashima (2003) grain legume in nutrient solution containing 0 – 100 ppm nitrogen in the form of urea and found that maximum number of nodules was obtained at 25ppm nitrogen.
4.5: Table 4.5 presents the result of fresh weight of plants (g) and dry weight of plant (g). There was significant difference in fresh weight of plant and dry weight of soybean due to treatment. The result was not consistent.

Nutrient composition of soybean seed

Significant difference was observed in nitrogen, protein and oil due to different nitrogen sources. However, P, K, S and carbohydrate were not statistically affected by treatment. Though, the result on nutrient composition was inconsistent. Plots amended with urea had highest percentage of nitrogen and oil while plots treated with cow dung had highest percentage of protein. However, unamend plot had the least percentage of nitrogen, protein and oil.

CONCLUSION

Soybean responses to both inorganic and organic nitrogen source irrespective of the type of the soil. N P K fertilizer influenced growth and yield of soybean better than urea and among the organic sources poultry manure was the best. Nodule formation in soybean was also influenced by application of nitrogen sources irrespective of the kind of the sources. Growth and yield of soybean was positively influenced by inorganic and organic manure used as nitrogen sources. NPK fertilizer at 20kgN/ha influenced yield of soybean better than other sources, it is there recommend to the farmer for optimum yield. Further research should be carried out on other agronomy characteristics influence soybeans production.

Table 4.1a: Physical and Chemical Properties of Soil of soil used for the experiment

Properties	Values
Sand (%)	60.3
Clay (%)	21.6
Silt (%)	18.1
Soil texture	Sand clay loam
pH	6.2
Bulk density (g/cm^3)	1.38
Total porosity (%)	40.0
Organic matter (%)	2.14
Total N (%)	0.19
Available P (mg/kg)	3.11
Exchangeable K (Cmol/kg)	0.21
Exchangeable Ca (Cmol/kg)	2.67
Exchangeable mg (Cmol/kg)	1.57
Base saturation (%)	23.3

Table 4.1b composition of animal manure used

Nutrient (%)	Poultry manure	Cow dung	Pig manure
Organic carbon	**38.3**	**43.4**	**46.2**
Total N	**3.6**	**2.8**	**1.6**
C:N ratio	**10.6**	**15.9**	**28.9**
phosphorus	**1.3**	**1.1**	**2.28**
Potassium	**3.1**	**0.8**	**1.5**
Calcium	**1.23**	**1.2**	**1.1**
Magnesium	**0.32**	**0.24**	**0.6**

Table 4.2: Growth characters of soyabean as affected by application of different nitrogen sources.

Treatment	Plant height(cm)	Stem girth	Number of leaves	Leaf area(m2)
Urea	96.4	2.54	39.4	4.1
NPK	96.7	2.77	63.6	4.8
Poultry manure	95.4	2.34	45	4.6
Cow dung	86.6	2.87	45.1	3.9
Pig manure	80.4	2.6	71.6	4.2
Control	43.6	2.01	26.7	2.6
LSD	4.27	Ns	13.4	4.96

Table 4.3: Yield parameters of soyabean as affected by application of different nitrogen sources

Treatment	Pod length	Pod number	1000seed weight(g)	Grain number	Grain weight per plant	Yield (kg/ha)
Urea	6.41	65.1	7.6	134	42.6	4641
NPK	7.63	66.8	7.4	148	43.4	4840
Poultry manure	5.62	56.1	6.8	136	49.8	4210
Cow dung	6.34	63.4	5.6	127	48.3	4314
Pig manure	6.61	56.8	5.3	131	46.8	3724
Control	2.21	43.9	3.8	96	25.45	1360
LSD	1.22	6.81	1.44	10.66	6.28	26.44

Table 4: Nodule characters of soyabean as affected by application of different nitrogen sources

Treatment	Fresh weight of nodule (g/plant)	Dry weight of nodule (g/plant)	Number of nodule per plant
Urea	0.89	0.26	36.8
NPK	0.74	0.24	37.6
Poultry waste	0.64	0.18	39.4
Cow dung	0.73	0.21	36.8
Pig manure	0.58	0.23	31.4
Control	0.56	0.18	24.13
LSD	0.21	0.02	3.75

Table 4.5: Shoot fresh and dry weight of soybean plant as affected by application of different nitrogen sources

Treatment	Fresh weight of plant (g)	Dry weight of plant (g)
Urea	14.56	4.69
NPK	13.44	3.87
Poultry manure	13.08	3.94
Cow dung	14.48	4.11
Pig manure	14.69	3.95
Control	8.68	2.84
LSD	3.60	1.11

Table4.6: Nutrient composition of soybean seed as affected by application of different nitrogen sources

Treatment	N (%)	P (%)	K (%)	S (%)	Protein (%)	Oil (%)	Carbohydrate (%)
Urea	8.41	0.42	0.60	0.44	36.78	21.66	23.81
NPK	7.73	0.46	0.64	0.43	37.23	20.44	22.64
Poultry manure	7.56	0.44	0.61	0.41	41.14	20.13	22.83
Cow dung	8.31	0.42	0.62	0.48	42.82	19.46	23.46
Pigmanure	7.44	0.47	0.66	0.46	38.61	20.13	21.81
Control	6.36	0.46	0.61	0.40	36.42	17.64	22.63
LSD	0.56	Ns	Ns	Ns	1.21	2.40	Ns

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EVALUATION AND SELECTION OF HYBRID WHITE YAM (*Dioscorea rotundata*) GENOTYPES FOR ENHANCED AGRONOMIC AND MARKETABLE TRAITS FOR MULTILOCATIONAL TRIALS

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ABSTRACT
Eleven hybrid white yam genotypes plus three landraces of white yam were tested in the Western experimental field of N R C R I, Umudike in 2014 and 2015, the objectives was to Select high yielding hybrid yam genotypes with desirable agronomic and marketable characteristics, Select genotypes tolerant to pests and diseases attacking yams in the field and to recommend them for multlocational trial across the agro ecological zones for possible commercial yam production. The experiment was laid out in a randomized complete block design with three replications Yam setts weighing 40g were sown 45 cm apart on the crest of the ridges and 10 cm below the soil surface and 100cm between ridges in a plot size of 20m^2. Data were collected on: mean total tuber yield, ware tuber yield and Seed yam. Data on tuber marketability components such as tuber size, tuber surface texture and flesh colour were collected. Pests and diseases reactions of the tubers were scored. Result indicated that Four hybrid yam genotypes (Amo99/064, Amo99/109, Amo99/060, and Amo99/144) yielded more than the three check varieties and should be selected for multilocational trial to evaluate their performance across the agro - ecological zones of the country for possible release for large scale yam cultivation and commerce.
Keyword: hybrid yam, selection, multilocation trial, agroecology and market value

INTRODUCTION

The major aim of yam cultivation by the subsistence farmers is not only for consumption, but also to generate income by selling the yams in the market. However, not all yam tubers are acceptable by the consumers. There are qualities that the farmers as well as the consumer appreciate before the genotypes will be acceptable (Daisy 2000). It is therefore vital to develop hybrid yam genotypes with good agronomic characteristics for cultivation, morphological traits that will be ease for processing for consumption and eye appeal quality for commercial yam production. The genotypes with these qualities must be adaptable across all the agroecologies for commercial yam production. Therefore the objectives of this work was to: Select high yielding hybrid yam genotypes with desirable agronomic and marketable characteristics, Select genotypes tolerant to pests and diseases attacking yams in the field and to recommend them for multlocational trial across the agro ecological zones for possible commercial yam production.

MATERIALS AND METHODS

Eleven hybrid white yam genotypes plus three landraces of white yam were tested in the Western experimental field of N R C R I, Umudike in 2014 and 2015. The experiment was laid out in a randomized complete block design with three replications in an area of land that was mechanically ploughed, harrowed and ridged at 1m apart. Yam setts weighing 40g were sown 45 cm apart on the crest of the ridges and 10 cm below the soil surface and 100cm between ridges in a plot size of 20m^2. The plots were kept weed-free manually. There was no Fertilizer application. Pre-emergence herbicide (Diuron) was used immediately after planting and complemented with manual weeding at 12 weeks after planting (WAP). Data were collected on: mean total tuber yield, ware tuber yield and Seed yam. Data on tuber marketability components such as tuber size, tuber surface texture and flesh colour were collected. Pests and diseases reactions of the tubers were scored. Tuber yield was analyzed using Analysis of variance and means separation was done using standard error of difference means. Tuber Shape and Tuber Surface Texture was scored after determining the tuber shape index (Nwankwo, 2014).

$$TSI = \frac{L}{W}$$

Pests and Diseases were scored using the scale of 1 to 5. where 1=no pests or diseases, 2 =pests and diseases are present in a mild condition, 3= pests and diseases infestation and attack were moderate, 4 = pests and diseases infestation and attack were severe. 5= pests and diseases infestation and attack were so severe that the crop is almost dead.

RESULTS AND DISCUSSION

Tuber fresh weight: The result of the tuber fresh weight is presented in Table 1

Tuber fresh weight: The result in Table 1 indicated high significant (P<0.01) variability in the weight of the classes of tubers. Four genotypes Amo99/064 with mean total fresh weight of 36.6t/ha, Amo99/109 with 47.8t/ha, Amo99/060 with 35,2t/ha and Amo99/144 with 39.0t/ha of fresh weight were significantly (P<0.01) higher than that of the three check varieties (Table 1) and therefore should be nominated for multilocational evaluation

Flesh colour and tuber exudates: The flesh tuber ranges from cream to white (Table 1) with very low oxidation rate after being exposed to the air for 5 minutes. Two genotypes Amo99/040 and Amo99/095A slight turned to brown after being exposed to the air for 5 minutes. The colour could be an index for the acceptability or rejection of yam fufu. The tuber flesh colour of the hybrid yam genotypes including the landraces were all white in colour and would be good in yam flour or in the preparation of pounded yam a prestigious carbohydrate to welcome visitors especially in South eastern Nigeria. The exudates of the genotypes are gummy and non-irritant when it comes in contact with the human skin except Amo99/003 and Amo99/X5 and Adaka.. These are good processing qualities.

Tuber Skin thickness: The tuber skin of all the genotypes including the landraces have skin thickness above 1mm. The tuber skin thickness is not liable for bruises during careful harvesting and loading for transportation or tying on stakes at Rafia barns (Table 1).

Tuber morphology and other tuber surface characteristics: The result of Tuber morphology and other tuber surface characteristics are presented in Table 2.

.**Tuber size:**. The high significant (P<0.01) genotypic mean tuber size variation among the hybrid yam genotypes indicated the extent of fresh carbohydrate accumulation among the genotypes. The length and width of the tubers measures the tuber size which is the dimension, extent or how large the yam tubers were. The yam genotype with the longest tuber length was 99/Amo/056 with 34.30cm and tuber thickness of 9.19cm more than the two landraces (Table 1) which indicated high fresh carbohydrate accumulation as a result of high photosynthetic efficiency more than the two landraces. This indicated high bulking rate of the hybrid yam genotypes.
Tuber shape: The hybrid yam genotypes and the landraces have straight sides with almost circular ends of equal size and a constant circular cross section that can go for as cylindrical shape. This type of shape is not prone to damage during yam harvest and easy for tying on stakes during storage and easy for harvesting since the tubers are not branched. Branched yam tubers are liable for damage during harvesting. All the yam genotypes including the landraces have cylindrical shapes. Hence the tuber shape index is within region of general acceptance (TSI = >1 and < 4). The mean tuber shape of all the hybrid clones was 2.0 which is an indication of cylindrical shape. This shape lends itself for ease of peeling during processing for food than round or flat shape and hence have smooth skin texture (score 1). Yam tuber with cylindrical shape and smooth surface texture command high market prices. However, yam tubers with cylindrical shape grow deeper into the soil and less prone to breakage during harvesting and bruises as it has tuber skin which is more than 1.0mm (Table 2).

Pests and diseases reaction: The pests and diseases reaction of the hybrid yam genotypes show the field reaction of the white yam clones to the foliar and tuber pests and diseases of yam. There were mean mild reaction of the genotypes to yam mosaic virus diseases (with mean score of 1.12) and mild infestation of crickets. Generally, the result indicated that most of the white yam genotypes were field tolerant to the pests and diseases.

CONCLUSION

Four hybrid yam genotypes (Amo99/064, Amo99/109, Amo99/060, and Amo99/144) yielded more than the three check varieties and should be selected for multilocational trial to evaluate their performance across the agro - ecological zones of the country for possible release for large scale yam cultivation and commerce. They have high bulking rate an indication of accumulation of usable fresh carbohydrate more than the Check varieties. These genotypes have white flesh to cream colour, smooth skin and cylindrical shape (TSI = >1 and <4) that is acceptable to consumers and will command high market value. These genotypes are therefore nominated for multi-locational agro-ecological trial

Table 1: Number of tubers and fresh tuber weight of selected water yam cultivars

Name of cultivar	Total number of tubers	Number of ware yam tuber	Number of seed tuber	Total tuber weight	Ware tuber weight	Seed yam weight
TDa96/01168	41.0	33.0	8.0	28.2	24.3	3.9
TDa00060	32.0	19.0	13.0	21.3	14.1	7.2
TDa1166	27.0	21.0	6.0	18.0	13.0	5.0
Abanaoyibo	31.0	20.0	11.0	23.1	18.0	4.70
02/00151	22.0	17.0	5.0	18.1	12.5	5.6
Bufu	21.0	15.0	6.0	17.4	13.2	4.2
UM/680	27.0	12.0	15.0	24.6	20.00	4.60
Sakata	38.0	25.0	13.0	25.5	21.30	4.20
Gborogboro	28.0	19.0	9.0	19.5	13.70	5.60
TDa02/00019	20.0	18.0	2.0	17.0	16.50	0.50
98/1164	23.0	17.0	6.0	18.8	16.00	2.80
TDa/00194	55.0	34.0	21.0	42.3	34.00	8.30
Mean	26.25	20.8	9.6	22.82	18.05	4.72
Std error	11.64	9.83	5.55	12.65	13.74	9.93
Sig. level	P<0.01	P<0.05	P<0.01	P<0.05	P<0.05	P<0.05

Table 2: Flowering intensity, Flowering pattern and Sex of the yam plant (D. alata)

Genotypes	No of nodes	No of male flowers	No of female flowers	Percentage flowering intensity (male)	Percentage flowering intensity (female)	Presence of flower	Score for Flowering intensity (male)	Score for flowering intensity (female)	Sex of yam plant
TDa/96/01168	195.0	164.0	0.0	84.1	0.0	2	4	0	3
TDa00060	207.0	173.5	0.0	83.8	0.0	2	4	0	3
TDa1166	205.0	72.0	0.0	83.9	0.0	2	4	0	3
Abanaoyibo	211.0	122.2	0.0	57.9	0.0	2	3	0	3
02/00151	200.0	138.1	0.0	69.4	0.0	2	3	0	3
Bufu	217.0	97.6	0.0	45.0	0.0	2	2	0	3
UM/680	195.0	141.8	0.0	72.7	0.0	2	2	0	3
Sakata	216.0	0.0	202.6	0.0	93.7	2	3	2	4
Gborogboro	386.0	99.2	252.9	25.6	65.5	2	1	3	3
TDa02/00019	218.0	185.9	0.0	85.3	0.0	2	4	0	3
98/1164	216.0	0.0	24.1	0.0	11.2	2	0	1	3
TDa/00194	230.0	0.0	191.9	0.0	83.4	2	4	0	3

Note: Flowering intensity score
1 = (1-25%) low/sparse flowering
2= (26-50%) medium (moderate) flowerin
3 = (51-75%) high intensity flowering
4 = (76-100%) profuse flower

Sex of yam plant
1 = absence of flower
2 = presence of either male or female flower
3 = male yam plant
4 = female yam plant
5 = monoecions male flower > female flower
6 = monoecious female flower >male flower

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ASSESSMENT OF THE YIELD AND YIELD COMPONENTS OF SOME SWEETPOTATO GENOTYPES AS INFLUENCED BY DIFFERENT LEVELS OF ORGANIC AND ORGANIC FERTILIZER

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ABSTRACT
Eight Sweetpotato (*Ipomoea batatas L. Lam) genotypes were assessed on ten different rates of fertilizers at the experimental station of the National Root Crops Research Institute Umudike in Abia State, Nigeria in 2013 and 2014 cropping seasons to generate information on the of yield and yield components of sweetpotato as influence by organic and inorganic fertilizer so as to select the best nutrient formulation for sweetpotato root yield. The experimental design was split randomized complete block design with three replications. The treatment consisted of three levels of NPK fertilizer rates (100kg, 200kg and 300kg), three levels poultry manure rates (10t/ha, 20t/ha and 30t/ha) and three level combinations of poultry manure and NPK fertilizer at; (5t/ha +50kg/ha, 10t/ha+100kg/ha and 15t/ha+150kg/ha). Data were collected on: Vine length at 8WAP, Number of leaves at 8 WAP, Biomass weight at 12 WAP, Number of saleable roots and saleable root weight. Data collected were subjected to analysis of variance. The result revealed that Poultry manure and Fertilizer rates evaluated were not significant (P>0.05) at all levels of application in all the characters assessed, which showed that those levels of poultry manure and fertilizer rate could be used in root yield production in sweetpotato. However, the results indicated that two genotypes UMUSPO/1 and TIS/87/0087 responded significantly (P<0.01) to the combination of 15t/ha PM and 150kg /ha NPK I5:I5:I5 fertilizer and could be used to enhance the performance of the two genotypes.*

Keywords: Sweetpotato, NPK fertilizer rates Poultry manure, yield and yield components.

INTRODUCTION
Sweetpotato (*Ipomoea batatas L.*), is an herbaceous dicotyledonous plant with creeping perennial vines which is usually grown as an annual for their root tubers. It belongs to the family *Convolvulaceae* (Degrass, 2000) and the 45 genera and 1,000 species present in this family only *Ipomea batatas* is known to be of economic importance as food (Edmond, 1971). It remains a prominent food crop to many rural dwellers especially in Northern parts of the country (Edebiri *et al*., 2001). Nigeria is the third largest producer in the world with China leading, followed by Uganda (FAO, 2004). Despite the contribution of sweetpotato to food security in Nigeria, results showed there is poor yield of only 3 to 8t/ha in the farmers' field (Njoku *et al* 2001, Eke-Okoro 2010) and necessitates the use of fertilizer to enhance yield. The exact dosage of fertilizer for each genotype should depend on the soil type, the environment and cultivars grown (Onwueme, 1988). Okonkwo *et al.,* (2009), showed soil fertility is the bedrock for bumper harvest, food security and economic empowerment of farmers. The shortage and high cost of inorganic fertilizers have limited their use for crop production among the peasant farmers in Nigeria (Tanimu *et al.,* (2007). Result has shown that for increase performance and yield of sweetpotato, NPK 15:15:15 at the rate of 300-400kg/ha is recommended (Nwinyi, 1987), but incidentally this NPK rate (300-400kg/ha) often may not be suitable to optimize crop yield throughout the agro ecologies of Nigeria. Sweetpotato responds well to farm yard manure or compost (Udoh *et al*., 2005). According to Enwezor *et al* (1988), 10t/ha are recommendation for all organic manure in soil of eastern Nigeria. Sweetpotato farmers generally would not apply fertilizers for two reasons first the response of sweetpotato cultivars to different fertilizers has not been clearly established. Secondly the crop is often not paying for the cost of the fertilizer. According to Nedunchezhiyan *et al.,* (2007), tuber size, number of tubers per plant and stand count are strongly related to tuber yield and these are highly affected by changes in environmental conditions. In view of the foregoing challenges, this research is initiated to come out with the best NPK fertilizer rates, and optimum poultry manure/combination of both which will enhance healthy crop growth and thereby translating into higher root yield of sweetpotato.

MATERIALS AND METHODS
Vine Length: The result of the influence of different levels of compound fertilizer NPK 15:15:15 , levels of poultry manure and combination of each levels of the compound fertilizers and each levels of poultry manure on the yield and selected yield components of sweetpotato genotypes are presented in table 1 The result for the combined yield data for the two years showed that at 0t/ha of PM/NPK gave 49.8cm vine length while the highest vine length of 56.7cm was obtained in the combination of 15t/ha of PM + 150kg/ha of NPK 15:15:15. This shows that a combination of 15 /ha of PM + 150kg/ha of NPK 15:15:15 will give considerable vine length for sweetpotato yield. This is because the longer the vine length, the more the production of leaves which is the seat

of photosynthesis which is sent to sink for more tuberous root formation and root number. However, there was high significant (P<0.01) differences on the effect of fertilizer and poultry manure (PM) application on the various genotypes.. The combined mean result for the two years indicated that Ex-Onyunga gave the least vine length at 0t/ha of PM and NPK 15:15:15 fertilizer with vine length of 24.8cm while TIS87/0087 responded very well to 15t/ha PM +150kg/ha NPK 15:15:15 fertilizer which gave combined mean vine length of 84.9cm. This shows that 15t/ha pm +150kg/ha NPK 15:15:15 fertilizer could be used to increase the vine length on TIS/87/0087 for increase in the root yield of the crop.

Number of leaves: It was observed that there was no significant (P>0.05) differences in the number of leaves at 8 WAP with the various levels of NPK 15:15:15, poultry manure and their combination rates. The combined result for the two years showed that at 0t/ha of PM/NPK low mean number of leaves of 36.2 leaves was obtained while highest mean number of leaves was obtained with 10t/ha PM + 200kg/ha NPK 15:15:15 compound fertilizer. This could be used to increase leave number which could increase the leave area for high photosynthesis for which could lead to large tuberous root formation and high number of saleable sweetpotato roots. Sweetpotato genotypes responded significant (P<0.01) differently on the application rate of PM and fertilizer. The genotype TIS/87/0087 responded very well at the application of 10t/ha pm +100kg/ha NPK 15:15:15 fertilizer and 200kg/ha NPK 15:15:15 fertilizer with the combined mean leave number of 53.9 leaves more than other sweetpotato genotpyes.

Biomass: The biomass (root and above ground vegetative) is the biological yield of the sweetpotato crop. The result in Table 1 indicated high significant (P<0.01) differences in the biomass yield of the sweetpotato genotypes.. The combined results for the two years indicated that mean weight of biomass at 12WAP with 0t/ha PM/NPK was 11.4kg while the highest biomass weight at 12WAP was 17.77kg/ha at the application of 15t/ha PM +150kg NPK 15:15:15 compound fertilizer. This showed that 15t/ha PM +150kg NPK 15:15:15 combination was the best level for biomass production in sweetpotato.

The genotype UMUSPO/1 had the highest biomass yield at the application of 15t/ha PM and 150kg/ha NPK 15:15:15 fertilizer which gave 31.41kg and 16.43kg in 2013 and 2014 respectively with combined mean year of 23.9kg biomass. The study observed that there was high significant (P<0.01) differences in the weight of biomass produced among the sweetpotato genotypes and significant differences in the biomass produced by the individual sweetpotato genotypes evaluated (Table 1).

Number of saleable roots:. It was observed that the combined low mean number of root of 11.7 from NRSP/05/3D was obtained at 0t/ha PM/NPK fertilizer while the highest combined mean number of roots of 34.5 was obtained from UMUSPO/1 at the application of 20t/ha PM. Although, there was non-significant (P>0.05) effect of the various levels of application rate and their combination on the number of saleable roots, this indicated that any level of PM and NPK evaluated could be used in the production of number of saleable roots. However, the genotype UMUSPO/1 was significantly outstanding as the genotype that produced more number of roots among the sweetpotato genotypes evaluated.

Saleable root weight: The combined application rate of 15t/ha pm +150kg/ha NPK 15:15:15 gave the highest mean combined mean weight of 4.6t/ha of saleable root yield. This showed that at combination rate of 15t/ha PM +150kg/ha NPK 15:15:15 will give remarkable yield increase of saleable root weight although the non- significant influence of the poultry manure and fertilizer rate indicated that any application of fertilizer rate or combination of PM and fertilizer could be used to achieve considerable increase in saleable root weight in sweetpotato.

However, there were significant differences of the effect of the fertilizer rate and the poultry manure combination on the sweetpotato genotypes evaluated. The 0t/ha of PM and NPK 15:15:15 fertilizer drastically reduced the yield of NRSP/05/3D at a combined mean yield of 2.2t/ha while the yield of TIS 87/0087 was improved with the combined application of 15t/ha PM +150kg/ha of NPK 15:15:15 which gave combined mean yield of 6.8t/ha. This showed that while there was no significant effect of the combination of 15t/ha pm+150kg/ha NPK 15:15:15 on sweetpotaqto weight of the genotype TIS/87/0087.

CONCLUSION

As was found in the study, the different levels of poultry manure and NPK 15:15:15 fertilizer rates had no significant (P>0.05) effect on the yield components of the sweetpotato genotypes except on the biomass weight whereas individual sweetpotato genotypes were significantly (P<0.01) influenced by the application of various levels and rates of poultry manure and NPK 15:15:15 fertilizer evaluated. The result indicated that two genotypes TIS/87/0087 and UMUSPO/1 were significantly influence by the combined application of 15t/ha pm +150kg/ha NPK 15:15:15 fertilizer on the following combed mean year traits: 84.9cm vine length, 53.9 number of leaves at 8WAP and 6.8t/ha of saleable root weight while UMUSPO/1 produced combined mean year biomass weight of 23.9kg/ha and 34.5 mean number of saleable roots at the influence of 15t/ha pm +150kg/ha NPK 15:15:15 fertilizer rate.

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Table 1: Main effects of fertilizer and genotypes on vine lengths (cm) of some sweetpotato genotypes at 4and 8 WAP in 2013 and 2014 cropping seasons

***= very highly significant at 0.1% **= highly significant at 1% *=significant at 5% ns=not significant

Treatments	**Vine length 8WAP**	**Vine len 8WAP**	**Total Vine len**	**Number of leaves 8 WAP**	**Number lev at 8 WAP**	**Total Number**	**Biomass at 12 WAP**	**Biom at 12 WAP**	**Total Biomass**	**Number saleable root**	**Number sal root**	**Total Number**	**Yield saleable root**	Yield sal Root	**Total Yield saleable**
Fertilizer Rates	**2013**	**2014**		**2013**	**2014**		**2013**	**2014**		**2013**	**2014**		**2013**	2014	
0 t/ha PM	43.62	55.89	49.8	31.33	41.01	36.17	13.87	9.02	11.5	14.25	21.54	17.92	3.02	3.42	3.22
100kg/ha NPK	45.24	59.18	52.21	34.69	45.15	39.92	16.16	9.12	12.64	14.92	23.29	19.11	3.13	3.96	3.6
10 t/ha PM	45.90	56.24	52.8	33.96	46.48	40.7	21.05	10.14	15.7	18.71	24.96	21.84	4.42	4.37	4.5
10 t/ha PM + 100kg/ha NPK	47.62	59.61	53.62	35.21	48.75	41.98	17.74	10.44	14.09	17.25	26.46	21.92	4.07	4.76	4.42
15 t/ha PM + 150kg/ha NPK	52.55	60.83	56.7	38.45	49.93	44.19	23.60	11.76	17.7	17.25	23.96	20.61	4.64	4.48	4.6
200kg/ha NPK	49.90	59.70	54.8	36.04	47.91	41.97	18.73	10.26	14.51	16.58	23.79	20.21	3.77	4.19	3.98
20 t/ha PM	45.85	56.16	51.01	33.49	45.49	39.49	20.29	11.74	16.02	20.29	25.21	22.8	4.28	4.26	4.27
300kg/ha NPK	43.49	55.62	49.7	34.99	42.04	38.52	20.05	9.33	14.69	16.42	23.79	20.11	3.55	4.48	4.02
30t/ha PM	45.21	58.42	51.82	30.00	48.38	39.19	21.55	11.43	16.5	18.33	24.67	21.5	4.15	4.80	4.6
5 t/ha PM + 50kg/ha NPK	46.98	58.42	52.7	33.46	47.51	40.51	20.44	9.08	14.8	20.46	24.50	22.48	3.95	4.12	4.04
Mean	46.64	52.21	49.43	34.21	46.31	40.3	19.35	10.23	14.8	15.72	24.22	19.97	3.98	4.24	4.11
LSD(P<0.05) Fertilizer (F)	Ns	Ns		Ns	Ns		15.11***	11.49**		ns	Ns		Ns	Ns	
Genotype															
NRSP/05/3D	60.22	64.29	62.4	44.03	51.61	47.82	23.53	10.91	17.22	12.27	11.17	11.72	2.74	1.68	2.21
Centinnal	36.12	42.02	39.1	25.96	43.72	69.68	16.01	13.16	14.8	21.33	34.17	27.8	2.23	3.16	2.69
Ex-Igbariam	64.18	76.94	70.56	46.37	50.42	48.41	25.36	11.97	18.8	17.03	17.77	17.4	3.24	2.60	2.92
Ex-Onyunga	32.22	17.42	49.64	29.93	36.66	66.59	17.00	1.09	9.1	10.93	7.23	9.1	0.55	0.31	0.43
TIS8164	44.36	53.84	49.1	37.89	41.11	39.5	20.9	13.62	17.3	21.20	27.40	24.3	6.42	5.82	6.12
TIS870087	71.82	97.89	84.9	42.10	65.70	53.9	17.88	13. 58	15.73	20.60	24.63	22.62	7.67	5.97	6.82
UMUSPO/3	8.22	64.48	36.4	23.93	35.47	29.7	2.66	1.13	1.89	12.77	26.93	19.9	1.21	3.87	2.54
UMUSPO/1	36.01	47.29	41.7	31.93	57.91	44.92	31.41	16.43	23.92	25.93	43.03	34.5	7.10	10.86	8.98
Mean	44.14	58.41	51.3	35.32	47.83	41.65	19.35	10.24	14.9	15.23	24.04	19.61	3.92	4.29	4.11
LSD(P<0.05) Genotype (G)	14.12**	28.53***		9.62**	16.64***		13.51***	10.28***		6.88***	8.38***		2.20***	1.93***	
(G XF)	Ns	Ns		ns	ns		***	Ns		ns	Ns		Ns	Ns	

EVALUATION OF POST-EMERGENCE HERBICIDES FOR WEED CONTROL IN GINGER PRODUCTION AT UMUDIKE, SOUTH-EASTERN NIGERIA

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ABSTRACT
The experiment were conducted in 2014 cropping season at the Research farm of National Root crops Research Institute, Umudike, to evaluate selected herbicides for weed control in ginger production. The soil was sandy loam. The weed species found in the experimental site before clearing the field were broad leave weeds, grasses and sedges. The plot size was 3 mx 2m. The treatment consisted of 9 treatments, 2 post-emergence herbicides applied at 3 rates each: fluazifopbutyl at 0.5,0.8 and 1.0 kg a.i /ha, paraquat-0.3, 0.75 and 0.8 kg a.i/ha, primextra gold + paraquat(1.25+0.4) kg a.i /ha, weeded at 4+ 6 WAP and Unweeded. The manual weeding at 4+6 WAP gave the highest rhizome number/ha. The crop phytotoxicity rating at 8 and 12 WAP was minimal (<10%) have no serious injury to the crop. Application of post-emergence (paraquat) at rate 0.8 kg a.i/ha gave the highest ginger rhizome yield (13.85 t/ha). At 16WAP, paraquat 0.8 kg a.i /ha, sustained an excellent weed control.
Keywords: post- emergence, Ginger and Economics.

INTRODUCTION
Ginger is a monocotyledonous herbaceous perennial plant; its flavouring type is classified as *Zingiber officinale* which belongs to the order; suitaminae and family *Zingiberaceae*. It is a tropical herb extensively grown for its pungent aroma. It is an underground stem or rhizome which is an export crop, value for its powder; oil and oleoresin (NEPC, 1999). Ginger is one of the world's most popular and useful plants, being used for centuries as species for flavouring food and as a medicinal plant.Advance research has proved that ginger could be used to cure certain ailments.Chen et al (2007) reported that ginger compounds are active against a form of diarrhea. The crop is believed to have originated from the southern part of China, but now grown in almost all parts of tropical and sub-tropical world. The objectives is to screen selected herbicides for weed control in ginger production and to determine the effectiveness of the herbicide for weed control in large scale ginger production.

MATERIALS AND METHODS
The experiment was conducted in 2014 at the research farm of the National Root Crops Research Institute (NRCRI), Umudike (05º, 29N, 07, 31̀E and 122 M above sea level). The soil was sandy loam. The weed species found in the experimental site before clearing the field were broad leaves weeds, grasses and sedges. The plot size was 3m x 2m. The land was plough, harrowed and a well prepared bed was made with a planting distance of 20 cm x 20 cm of 20 gm sett size of UGI (yellow) ginger, given a total plant population of 250,000 plants/ha. The treatment consisted of 9 treatments, 2 post-emergence herbicides, applied at 3 rates each, viz: fluazifopbutyl at 0.3, 0.8 and 1.0 kg ai/ha, paraquat 0.3, 0.75 and 0.8 kgai/ha, mixture of primextra + paraquat (1.25 + 0.4) kg ai/ha, weeded at 4 + 6 WAP and unweeded check. Each treatment was replicated three times using a randomized complete block design.
Compound fertilizer (15:15:15 NPK) was applied to all the plots at the rate 400 kg at 4-6 weeks after planting. Plots were visually score for weed control by two independent assessors on a rating scale of 0-10 with 0, representing no weed control and 10-complete weed control, 7.5 was regarded as an acceptable level of weed control. Herbicides were applied at spray pressure of 2.1 bar. Overall volume was 250 litres/ha. Rhizome yields were measured at harvest as well as economic assessment of the weed control treatment using labour, productivity index, available yield index as well as return per naira investment model (Ezedinma *et al.,* 2006).

RESULTS AND DISCUSSION
Weed control
The effect of weed control treatments on weed control at 8, 12 and 16 WAP, phytotoxicity rating at 8 and 12 WAP, weed weight in 2014 are presented in Table 1. The results showed that application of paraquat, 0.3, 0.75, 0.8 kg ai/ha and Atrazine/metolachlor + paraquat (1.25 + 0.4) kg ai/ha, gave an excellent weed control at 8 WAP.

Weed control was excellent at 12 WAP with treatments containing paraquat 0.8 kg ai/ha and Atrazine/metolachlor (1.25 + 0.3) kgai/ha.

At 16 WAP, paraquat 0.8 kgai/ha sustained an excellent weed control, while Atrazine/metolachlor + paraquat (1.25 + 0.4) kgai/ha, paraquat 0.3 and 0.75 kg ai/ha was satisfactory at 16 WAP, when compared with fluazitopbutyl rates.

The crop phytotoxicity rating at 8 and 12 WAP was minimal (≤10%) have no serious injury to the crop. Unweeded control gave the highest weed weight (3.67) kg/ha, followed by fluazifopbutyl at rate 0.8 kgai/ha (1.07) kg/ha.

Ginger Rhizome Yield

Application of post emergence (paraquat) at rate 0.8 kgai/ha gave the best ginger rhizome yield (13.85 t/ha) in 2014 (Table 2). This was followed by manual weeding at 4 + 6 WAP (13.82 t/ha) and plots treated with Atrazine/metolachlor at rate 1.25 to 4) kgai/ha (11.44 t/ha) and paraquat 0.75 kg ai/ha (10.22). But there were statistically different to that of Atrazine/metolachlor at (1.25 + 0.4) kg ai/ha. Unweeded control treatment gave the least ginger rhizome yields (2.89 t/ha).

Manual weeding at 4 + 6 WAP gave the highest rhizome number/ha (12667/ha), followed by fluazifopbutyl 0.8 kg ai/ha (11967/ha). Paraquat 0.3 kgai/ha gave the least rhizome number/ha (3533/ha). Manual weeding gave the highest surviving plant count (93.33/plot), followed by fluazifopbutyl 0.8 ai/ha (87.67/plot). Paraquat 0.3 kg ai/ha gave the least surviving plant count (34.67/plot). The high yield recorded on the herbicides treated plots might be as a result of weed control in the crop after the expiration of the herbicides. Also good land preparation.

The economic analysis of the weed control treatment presented in Table 3, showed that paraqaut 0.8 kg ai/ha out yielded the other treatments. This was followed by the weeded plots and the mixture of Atrazine/metolachlor (1.125 + 0.4)kg ai/ha. Paraquat 0.8 kg ai/ha gave monetary return of N2,058.860 when compare with manual weeding N2,042.100. In most areas availability of labour constitutes a threat to productivity, leaving the option of using herbicides

CONCLUSION

Application of paraquat at 0.8 kg a.i/ha gave the highest rhizome yield (t/ha) and gave the highest income per naira .

Table 1: Effect of weed control treatments on weed control at 8, 12 and 16 WAP, phytotoxicity rating at 8 and 12 WAP, weed weight in 2014.

		Weed control			Phytotoxicity		
				WAP			
Treatments	**Rate kg ai/ha**	**8**	**12**	**16**	**8**	**12**	**Weed weight/plot**
Fluazifipbutyl	0.5	4.1^{b}	5.1cd	4.0^{d}	0.3ab	0.0	0.83^{b}
Fluazifopbutyl	0.8	5.2^{b}	5.7^{bcd}	5.6^{c}	0.6^{ab}	0.0^{c}	1.07^{b}
Fluazifopbutyl	1.0	4.4^{b}	3.2^{de}	3.7^{d}	0.3^{bc}	0.0^{c}	0.93^{b}
Paraquat	0.3	8.7^{a}	7.9^{abc}	7.2^{b}	1.3^{a}	0.3^{bc}	0.50^{b}
Paraqiat	0.75	8.5^{a}	6.3^{bc}	7.2^{b}	1.0^{ab}	1.0^{a}	0.23^{b}
Atrazine/Metolachlor + paraquat	1.25 + 0.4	9.3^{a}	8.6^{ab}	8.4^{ab}	1.0^{ab}	0.0^{c}	0.10^{b}
Weeded	4 + 6 WAP	10^{a}	10.0^{a}	9.2^{a}	0.0^{b}	0.0^{c}	0.10^{b}
Unweeded	-	2.4^{c}	2.0^{e}	1.7^{e}	0.0^{b}	0.0^{c}	3.67^{a}

Means followed by the same letter(s) within a column are not significant at P<0.5 (DMRT)

Table 2: Effect of weed control treatments on ginger rhizome yield t/ha, rhizome number/ha and stand count/plot in 2014

	Rate kg ai/ha	Rhizome yield t/ha	Rhizome no/ha	Stand count/plot
Fluazifipbutyl	0.5	7.76[bcd]	10435[a]	70.33[abc]
Fluazifopbutyl	0.8	4.34[d]	11967[a]	87.67[ab]
Fluazifopbutyl	1.0	5.78[cd]	7200[bc]	49.00[cd]
Paraquat	0.3	4.15[d]	3533[d]	34.67[cd]
Paraqiat	0.75	10.22[abc]	5800[cd]	39.67[cd]
Paraquat	0.8	13.85[a]	4300[cd]	41.00[cd]
Atrazine/Metolachlor + paraquat	1.25 + 0.4	11.44[ab]	7333[bc]	59.33[bcd]
Weeded	4 + 6 WAP	13.82[a]	12667[bc]	93.33[a]
Unweeded	-	2.89[d]	9900[ab]	67.67[abc]

Means followed by the same letter(s) within a column are not significant at P<0.5 (DMRT)

Table 3: Preliminary economic analysis of the effects of different post emergence herbicides application on yield of ginger in the rainforest agroecology of Nigeria

Treatments (Rates)	Cost/ha (₦)	Rhizome yield (tons/ha)	Value of output (₦)	Net income (₦)
Fluazifopbutyl (fusillade) **0.5**	17,500=	7.76	1,164,000=	1,146,500=
Fluazifopbutyl (fusillade) **0.8**	22,000=	4.34	651,000=	629,000=
Fluazifopbutyl (fusilade) **1.0**	25,000=	5.78	867,000=	842,000=
Paraquat **0.3**	13,240=	4.15	622,500=	609,260=
Paraquat **0.75**	18,100=	10,22	1,533,000=	1,514,900=
Paraquat **0.80**	18,640=	13.85	2,077,500=	2,058,860=
Atrazine (Metalachlor) + paraquat **1.12 + 0.4**	27,820=	11.44	1,716,000=	1,688,180=
Weeded (4 +6 WAP)	30,900=	13.82	2,073,000=	2,042,100=
Unweeded		2.89	433,500=	433,500=

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INCIDENCE OF CASSAVA MOSAIC DISEASE (CMD) IN SOUTH-EAST AND SOUTH-SOUTH NIGERIA

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ABSTRACT
We evaluated the incidence of cassava mosaic diseases (CMD) across the eleven states in the South-South and South–East Nigeria. There were varying degrees of incidence across the fields and states, ranging from 19.8 – 61.8%. The least and highest incidence were observed in Delta and Ebonyi state, respectively. The aim is to establish low disease pressure sites for the multiplication and generation of virus-free planting materials.
Keywords: Cassava mosaic, disease, Southeast, South-South Nigeria

INTRODUCTION
Cassava mosaic disease (CMD) is the most economically important viral disease of cassava in Sub-Saharan Africa (Legg et al., 2006). It is caused by cassava infecting begomoviruses (CMBs). The disease is wide spread in many cassava-growing countries of the region (Fauquet and Stanley, 2003; Sseruwagi et al., 2005). The disease has been shown to be common in subsistence agriculture with crop losses between 19 – 27 metric tonnes throughout the Sub –Saharan Africa (Legg and Thresh, 2004). It is estimated that over US$1.5 billion per year is lost due to CMD (Thresh et al., 1997). The affected plants are stunted with obvious foliar symptoms and produce no or significantly diminished tuberous root yield (Otim-Nape et al., 2000). Therefore for effective control and management, there is the need for routine surveillance and monitoring on the spread and distribution of the disease.

MATERIALS AND METHODS
A total 250 locations in the 11 states of south-east and south-south Nigeria were purposely sampled in 2015. The states were (Abia, Anambra, Imo, Enugu, Ebonyi (south-east) and Bayelsa, Cross River, Delta, Edo and Rivers (south-south) all in the humid forest agro-ecology.
The incidence of virus diseases on leaves of cassava plants were assessed by walking in an "X" (diagonal) transect manner in the field. Young leaves from thirty plants per field (15 plants per diagonal) were assessed for disease symptoms in an alternating manner by walking along the diagonal. Disease severity was scored on a scale of 1-5 (1 = no visible symptom and 5 = Severe mosaic, leaf distortion and severe stunting) for the presence or absence of virus disease symptoms and severity.

RESULTS AND DISCUSSION
A total of 7471 plants in 250 locations were assessed for virus incidence, of which 2877 (38.5%) were affected with varying degree of virus infection. Moderate mosaic symptom (score 3) contributed the highest (61.5%) infection (Table 1). The CMD incidence across the states ranged from 19.8 to 61.8%. The least mean incidence was recorded in Delta state while the highest was in Ebony state (Fig. 1). Four states (Anambra, Cross River, Ebonyi and Enugu had virus incidences of more than 50% representing 35.6% of the total sample location (Table 1). The implication of this is that, out of every ten samples in each of these locations, five are infected with varying degree of virus symptom. The mean symptom severity score ranged from 1.16 to 2.29. The high virus incidence observed in the fields is of noteworthy as cassava is a vegetatively propagation crop. The possibility of 100% infection is likely in situation where farmers use these infected plants are stakes for propagation. Although CMD is wide spread in all cassava producing area (Fauquet and Stanley, 2003), 23 of the locations were free from virus symptoms. Most likely, farmers in these areas are either planting resistant varieties or adopting the positive selection method. Apart from planting resistant varieties as this was the case in Delta state with the lowest virus incidence, encouraging farmers to practice on-farm positive selection of healthy plants and effective control of the vector whitefly, *Bemisia tabacci* will have the desired impact in the control of this disease.

CONCLUSION
The differences observed in the incidence and severity of CMD across the states will provide scope for generating virus-free planting material and also identify low disease pressure sites for clean seed multiplication.

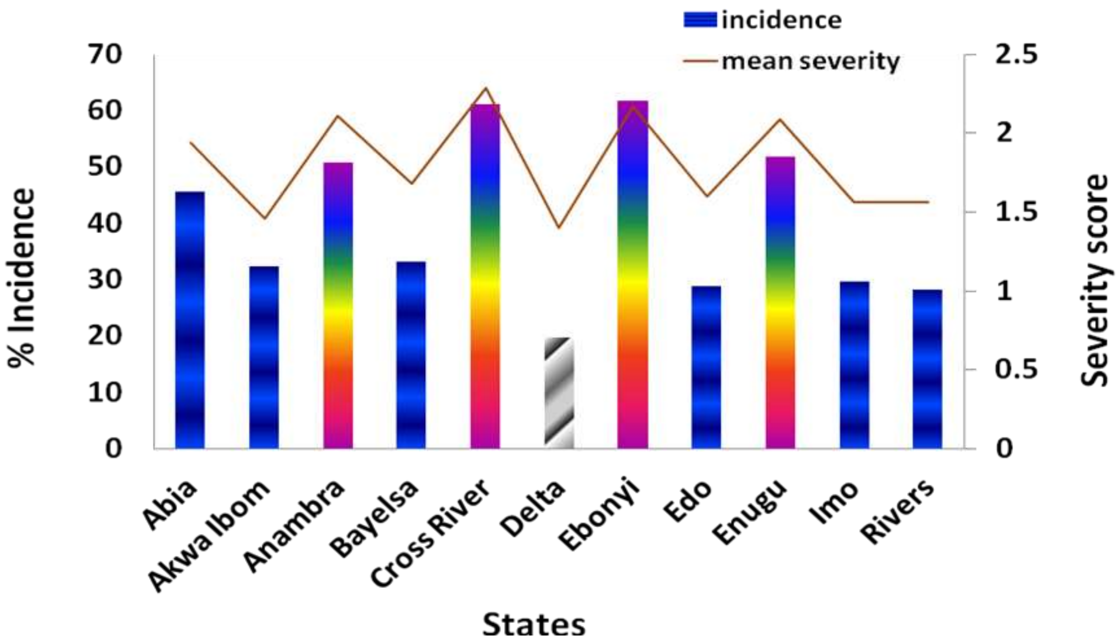

Fig. 1. Incidence and symptom severity in the different states

Table 1. Incidence of virus disease in the south-south and south-east states of Nigeria

States	No of locations	No of plant assessed	Incidence (%)	Severity score					Mean Severity
				1	2	3	4	5	
Abia	16	472	215 (45.6)	257	56	93	60	6	1.94
Akwa Ibom	21	630	204 (32.4)	426	130	64	10	0	1.46
Anambra	32	960	487 (50.7)	473	43	321	113	10	2.11
Bayelsa	10	300	100 (33.3)	200	9	80	10	1	1.68
Cross River	25	750	459 (61.2)	291	64	296	85	14	2.29
Delta	41	1209	239 (19.8)	970	41	159	33	6	1.4
Ebonyi	13	390	241 (61.8)	149	53	160	28	0	2.17
Edo	30	900	260 (28.9)	640	40	164	46	10	1.16
Enugu	19	570	295(51.6)	275	44	181	63	7	2.09
Imo	27	810	241(29.8)	569	56	156	28	1	1.56
Rivers	16	480	136 (28.3)	344	23	97	12	4	1.56
Total	250	7471	2877 (38.5)	4594 (61.5)	559 (7.5)	1771 (23.7)	488 (6.5)	59 (0.8)	1.77

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PLANTING DATE, VARIETY AND SEED PRODUCTION OF THREE YELLOW CASSAVA (MANIHOT ESCLENTA CRANTZ) VARIETIES

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ABSTRACT
Botanical seed production of three yellow cassava varieties was assessed at three different planting dates. On set of rain (Mid May) Mid July and Mid September on a three by three split plot experiment in 2011 and 2012. Results from the analysis of variance (ANOVA) showed that variety and planting date significantly affected the growth habit and seed production of the cassava varieties used in the experiment. Cassava batch planted in Mid May (earliest) had higher survival rate (89.89, 74.56 and 55.56) maintained better physiological features which in turn yielded significantly higher seeds (785.4, 165.9 and98.0) and gave heavier seed weight (0.11,0.02 and0.01kg) than others. Umucass 37 (variety2) out yielded the other varieties in seed production (461.7 and 762.4) respectively. Although variety1 (Uumcass36) had heavier weight. This has shown that early planting of cassava, varieties not withstanding is the key to optimum productivity in cassava.
Keywords: Cassava, planting date, physiological features and gestation seed,

INTRODUCTION
Nigeria is the highest producer of cassava in the world. It accounts for 55% of 55million metric tonnes global total production in 2013(FAOSTA 2013).Cassava production in Nigeria is mostly done by small house hood farmers on small to large scale family firms located in a wide range of ecological zones between latitudes 30^0N and 30^0S (EL-Sharkawu 1993, 2004), particularly in the humid tropics where its production is favored by the climatic and edaptic features. This wide range of ecological zones is characterized by varied micro climatic factors such as temperature, rainfall, solar radiation and relative humidity, the mean of which gives the climatic condition of a given area at a given time acting synergistically to form the two predominate tropical seasons of the year- the rainy season and the dry season. These two predominate seasons on the other hands determines the planting time of the year. The rainy season is characterized by long period of rains (6 months) and thereby making available adequate moisture for cassava development, moderate relative humidity, moderate temperature, moderate solar intensity and good edaphic conditions which can promote high photosynthetic activities, sustains good crop growth and maintains high yield (Cock 1983, Okogbenin *et al.,* 2003). Although cassava is produced all the year round, higher yield levels are obtained with a longer moisture cycle or with conservation by mulching (IITA, 1982). Generally cassava is propagated by stem and has lost or reduced its flowering abilities in some varieties, yet flowering and botanical seed production are very important in the improvement of the low yielding and highly susceptible land cassava races in use presently. Although flowering and botanical seed production of cassava depends on genotype, yet the potential yield of seeds is highly influenced by the interaction of photosynthetic abilities, growth habit, storage capacity, climatic conditions and time of planting. (Okeke.1981; Ekanayake, and Ginthinguri, 2000, Ceballos *et al*., 2004; Olasanmi *et al*.,2014). There is little or limited information on this subject matter hence this work was design to assess the effect of planting period on the survival rate and seed production of three newly bred pro-vitamin A cassava varieties.

MATERIALS AND METHODS
The experiment was carried out using three yellow fleshed pro- vitamin A cassava genotypes Umucass36 for vareity1, Umucass37 for variety3 and Umucass38 for variety2(where). The investigation was conducted for two consecutive years (2011 and 2012) at National Root Corps Research Institute, Umudike, located at $5^0$29`N and long: $07^0$33`E about 122m or 400ft above sea level in humid rainforest agro ecological zone of Nigeria.
A split –plot design using 3 cassava varieties and 3 planting dates was used and replicated 3 times at eastern farm. The three planting dates used were mid-May representing the early planting, mid-July and mid- September of the two years. Per and post--emergence herbicides were applied using pre-mextra and round up fort at the rate of 1 bottle per hectare respectively immediately after planting followed by 2 other hand weeding. NKP fertilizer 15;15;15 was applied at the rate of 600kg/ha. Fruits were harvested sequentially, sun dried for seeds to shatter, separated and stored in cool place.
Data was collected on survival rate and the number of seeds obtained from each planting period and variety. They were analyzed using SAS version9.2

RESULTS AND DISCUSSION
Table 1 shows the mean survival rate of the planted materials and their seed production.Umucass36 had a higher survival rate (81.11 and 52.77) in both years then the other two varieties and is significantly different

fromUmucass37 and 38 at ($p<0.05$) . Umucass38 significantly out yielded ($p<0.001$) Umucass36 Umucass37 in both years (461.7 and762.4) in the number of seeds produced, although the differences between Umuass36 and Umuass38 is not significant. Umucass36 maintained higher seed weight than the other two varieties (0.070and1.80). Although there was no significant difference (Umuass36 and Umuass38). But both were significantly difference from Umucass37.Time of planting significantly influenced all the parameters considered. The cassava batch planted early had higher survival rate (89.89), gave greater seed number (785.4) and maintained heaver seed weight (0.11) than others (table 2). This result is in agreement with Olasanmi *et al*., (2014) and Byrne et al (1982)

CONCLUSION

In conclusion, to obtain the potential yield of cassava both in tuber and seed production, time of planting cannot be over emphasized.

Table 1: Mean survival and seed production of 3(three) cassava variety

	First year			second year		
Variety	Mean survival	No of seeds per Ha	Wt. of seeds per Ha	Mean survival cm	No of seed per Ha	Wt. of seed (gram)
V1	81.11[a]	457.2[a]	0.070 [a]	52.77[a]	693.2[a]	1.80[a]
V2	62.44[b]	461.7[a]	0.049[a]	45.44[b]	762.4[a]	0.08[a]
V3	75.44[b]	130.4[b]	0.0267[b]	45.14[b]	294.8[b]	0.138[a]
LSD	14.26	220.94	0.044	20.76	317.66	1.71

Table 2: planting date mean survival rate and seed production of yellow cassava varieties

	First year			second year		
Variety	Mean survival	No of seeds per Ha	Wt of seeds per Ha	Mean survival cm	No of seed	Wt. of seed (gram)
PD1	89.89[a]	785.4[a]	0.11[a]	64.44[a]	117.0[a]	1.147[a]
PD2	74.56[b]	165.9[a]	0.02[b]	55.44[b]	391.7[b]	0.07[a]
PD3	55.56[c]	98.0[b]	0.01[b]	23.44[c]	187.8[b]	0.09 [a]
LSD	14.26	220.94	0.00	24.38	317.20	1.71

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POTENTIAL OF POULTRY LITTER COMPOST AS BIO-NEMATICIDES AGAINST ROOT-KNOT NEMATODE ON CACAO

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ABSTRACT
Root-knot nematode, Meloidogyne incognita, is a primary nematode pest of cacao and contributes to retardation of seedling growth, sudden death, plant damage, and concomitant yield losses. Unfortunately, there is no nematicide currently approved for use on this pathogenic nematode. In this study, a series of laboratory bioassays was designed to test the inhibitory and suppressive effects of sterile water extracts of poultry litter compost (PLC) on M. incognita. In microwell assays, M. incognita egg hatch and J2 activity were inhibited by all tested compost extract concentrations (25%, 50%, 75% and 100% extract), with > 90% inhibition in 100% compost extract after 3 and 7 day incubation periods. The study shows the high potential of naturally occurring chemicals present in PLC that should be further investigated as bio-nematicides for their use in sustainable integrated management of RKN.
Keywords: *Theobroma cacao*, *Meloidogyne*, poultry litter compost extract, root-knot nematode

INTRODUCTION
Root-knot nematodes (*Meloidogyne* spp.; RKN) are economically the most important nematodes that attack cacao (*Theobroma cacao* L.) plants worldwide thereby contributing to retardation of seedling growth, plant damage, sudden death, and concomitant yield losses (Campos and Villain, 2005; Orisajo, 2009). Recommended practices for suppressing nematodes on cacao include planting of clean seedlings, avoiding areas where nematodes infest the soil (including under banana), use of nematicides, and development of resistant cultivars (Orisajo, 2009). However, resistant cultivars are not widely available in all cacao-growing areas, and available chemical nematicides have been banned on cacao, so alternative management strategies are needed (Orisajo, 2009, Orisajo and Afolami, 2009). Studies with poultry litter or poultry litter compost demonstrated that these amendments were beneficial for suppressing populations of *M. incognita on cacao*, *Hoplolaimus columbus*, and/or *Pratylenchus penetrans* on vegetable crops and cotton, and of *Meloidogyne mayaguensis* on guava (Orisajo and Afolami, 2009; Everts *et al.*, 2006; Gomes *et al*., 2010). This study aimed to determine whether poultry litter compost produces substances inhibitory to *M. incognita* egg hatch and J2 activity.

MATERIALS AND METHODS
Nematode cultures
Inoculum of *M. incognita* Race 1, originally isolated in MD, was prepared as in Meyer *et al*. (2008). The nematode was grown on pepper (*Capsicum annuum*) 'PA-136' in greenhouse pots containing loamy sand, and eggs for greenhouse and microwell assay experiments were obtained from the roots of 3-month-old plants. Roots were rinsed, immersed in 0.6% sodium hypochlorite for 1 min to release eggs from egg masses, and the eggs were collected by sugar centrifugation and rinsed in water. Eggs were stored overnight at 4° C for use the following day. For the Baermann funnel test, eggs were collected from a 4-month-old plant, placed into a hatching chamber overnight, and the J2 collected and used as inoculum. Eggs for susceptibility test and microwell assays were collected from 3-month-old greenhouse-grown pepper plants (as above) 'PA136' grown in the lab in 250 ml plastic beakers filled with sand. The egg masses were shaken by hand for 3 min in 0.6% sodium hypochlorite. Eggs were then collected and placed into a hatching chamber to collect surface- sterilized J2. The hatching chamber was kept in the incubator for 1-3 days at 4 °C.

Cocoa Susceptibility Test
Cocoa seeds (from Pound 7 cocoa variety) for susceptibility test were obtained from Costa Rica. We could not obtained cocoa seeds from Nigeria based on stringent quarantine regulations. Mucilage and seed coats were removed by the aid of scalpel, surface sterilized in 5% Sodium hypochlorite, rinsed in water and the seeds placed in sterile agar medium. Following the rooting of the cocoa seeds, the roots were cut, transferred to another agar medium and thereafter inoculated with root-knot nematodes (*M. incognita*) eggs two weeks later.

Poultry litter compost

Mature compost was produced in a 3.8-cu m static aerated pile from 3-wk old poultry litter collected from a chicken house after the chickens were removed. The compost pile self-heated to temperatures > 55ºC in the central core of the pile for 4 weeks, and thereafter the temperature declined gradually; at 9 weeks the pile was turned so that the exterior material was placed in the core and the core material was placed on the exterior. The pile reheated to > 50-55ºC for one week, and then gradually cooled to ambient temperature by 13 weeks. The pile was allowed to cure for an addition 3 weeks before the compost was air-dried and stored in covered containers. Composite samples were obtained and analyzed according to standard methods. In preparation for the experiments, the compost was soaked in water (1:1 compost:water, by volume) for 2-3 minutes and clumps were broken up. The compost was placed onto nested U.S. Standard sieves (0.85 mm pore diameter over 0.106 mm pore diameter), broken further with the bottom of a beaker, collected from the sieves, and then washed and collected twice more and air-dried.

Microwell assays

To prepare compost extract, 100 g compost was steeped for 10 min in 100 ml tap water with continual mixing to ensure that the compost pieces were broken up. The mixture was placed onto two layers of cheesecloth, squeezed through to collect the liquid, and the liquid was then centrifuged for 3 min (447 × *g*). The supernatant was collected and centrifuged twice for 5 min (1,188 × *g*). The resulting supernatant was diluted (1:4 in water) and then filtered twice through 0.2 µm sterile filters (Whatman, Clifton, NJ). This was considered the 100% compost extract treatment. Microwell assays were set up in 96-well polystyrene plates, similar to methods described by Meyer *et al*. (2008b). Eggs and previously hatched J2 were assayed in separate wells. Each well received 315 µl of compost extract or of sterile distilled water control, and 35 µl of an *M. incognita* egg suspension (containing ca. 50 eggs) or 35 µl of a hatched J2 suspension (containing ca. 30 J2). Treatments were 0%, 25%, 50%, 75% and 100% compost extract in sterile distilled water (volume/volume). A plastic adhesive sheet (SealPlate®; EXCEL Scientific, Inc., CA) was placed over each plate to prevent evaporation and the plates were incubated at 26ºC. Five wells were used per treatment in each trial, and each experiment was conducted twice. The total was therefore n = 10 for microwell assays. For egg assays, total numbers of hatched J2 and of active vs. inactive J2 were counted 3 and 7 days after immersion of the eggs in the treatments. For assays of previously hatched J2, counts of active vs. inactive were made 48 hours after immersion of the J2 in the treatments.

Baermann funnel tests

Enriched loamy sand soil (16:9 sand : compost that had been steamed and air-dried; composition 82.9% sand, 5.3% silt, 11.8% clay; pH 7.3; 0.8% organic matter) and poultry litter compost (described above) were placed into Baermann funnels, with a total of 50 g per funnel. Six treatments were tested: 0%, 25%, 50%, 75% and 100% compost to soil (by weight), and an additional treatment of 25 g compost layered over 25 g soil. There were five funnels per treatment and the experiment was not repeated. Each funnel received ca. 1,500 J2, and J2 were collected from the funnels three days later.

Statistical Analysis

Data analyzed for the egg assays in microwell plates were total eggs hatched (based on J2 counts), and percent active J2 on Day 3 and Day 7 after egg immersion. For the assays of previously hatched J2, analysis was conducted on percent active J2 at 48 h. The replicate observed number of eggs or percent active J2 were regressed onto percent poultry litter compost extract using SAS PROC GLIMMIX to fit generalized linear regression models or PROC NLMIXED to fit generalized non-linear regression models. Total eggs hatched, for both 3 and 7 days after immersion, was modeled using a negative binomial distribution and regressed onto a sigmoidal, non-linear function of percent poultry litter compost extract. Percent active J2 from hatched eggs, for both 3 and 7 days after immersion, and percent active J2 of observed J2, were modeled using a binomial distribution with Laplace optimization and regressed onto a logit (link) function of percent poultry litter compost extract.

RESULTS AND DISCUSSION

The compost used in the experiments had the following composition: pH 8.0, soluble salts 30.7 mmhos/cm, solids 69.8%, moisture 30.2%, organic matter 37.6% (53.9% of dry weight), total nitrogen 3.18% (4.6%), organic nitrogen 3.07% (4.4%), ammonium nitrogen 0.1068% (0.1530%), carbon 18.6% (26.7%), C:N ratio 5.9, phosphorus (as P_2O_5) 4.75% (6.8%) and potassium (as K_2O) 4.35% (6.23%).

Cocoa Susceptibility Test

Root-knot nematode galls (abnormal swollen of roots) were formed on the cocoa roots two weeks after inoculation and later burst open with nematode juveniles seen in the roots under the microscope (Plate 1). This experiment revealed that Pound 7 cocoa was susceptible to root-knot nematode infection.

Microwell assays and Baermann funnel tests

The pH values of the compost extracts and water control ranged from 7.18 to 7.66. In the microwell assays at Days 3 and 7, egg hatch and J2 activity were suppressed by poultry litter compost extract, as indicated by the regression models (Figs. 1, 2). At Day 3, egg hatch was greatest in the 0% extract (water control), with a recorded mean egg hatch of 41.0. Egg hatch at Day 3 decreased significantly with increasing extract concentration (Fig. 1). After three days of immersion in the treatments, egg hatch was suppressed by 19.2% in the 25% compost extract and 52.7% in the 50% compost extract, compared to water controls. Hatch was lowest in the 75% and 100% compost extracts at Day 3; mean recorded egg hatch was 5.0 and 3.7, respectively. In the 100% compost extract, this was a decrease in egg hatch of more than 90% compared to water controls. By Day 7, more eggs had hatched in 0% extract (water controls) than in water controls on Day 3 (Fig. 1). The mean recorded egg hatch on Day 7 was 74.3 in the water controls. It should be noted that although equal amounts of egg suspension were pipetted into each well, 50 eggs per well was an estimate based on number of eggs per ml rather than an exact count. The total number of eggs per well was subsequently greater than 50. Although egg hatch at Day 7 decreased significantly with increasing extract concentration, the regression models indicated that total egg hatch numbers at Days 3 and 7 were statistically different from each other when eggs were immersed in 0% to 40% compost extract (Fig. 1). However, egg hatch numbers were similar between Days 3 and 7 when eggs were immersed in compost extract concentrations of 45% to 100%. At Day 7, mean recorded egg hatch in the 75% and 100% compost extracts was 6.9 and 5.0, respectively. Therefore, at Day 7, egg hatch was decreased by > 90% compared in the 75% and 100% compost extracts compared to water controls.

The percent of J2 that hatched from the treated eggs and remained active also decreased with increasing compost extract concentrations for Days 3 and 7 (Fig. 2). At Day 3, mean recorded values for active J2 in the 0% and 50% compost extracts were 96.1% and 91.2%, respectively. Also at Day 3, J2 activity was lower in 75% compost (29.6% of hatched J2 were active), and in 100% compost extract only 2.2% of hatched J2 were active. J2 activity was therefore decreased by 69.2% in the 75% compost extract and by 97.7% in 100% compost extract compared with the water controls at Day 3. At Day 7, the percentage of active J2 was generally lower than at Day 3. The regression models indicated that percent active J2 was statistically different between Days 3 and 7 in 0% to 85% compost extract, but statistically similar between Days 3 and 7 at 90% to 100% compost extract. For example, at Day 7, only 57.0% and 32.2% of J2 were recorded as active in 0% and 50% compost extract, respectively. However, at Day 7, 2.0% of the J2 were active in the 75% compost extract, and 4.4% of J2 were active in the 100% compost extracts. These were decreases in J2 activity of 96.5% and 92.3%, respectively, compared with water controls. The effects were not attributable to pH, as the pH of the extracts was normal. The deleterious results are similar to those from a previous study with extracts from poultry manure compost, which demonstrated that an exposure time of just 3 minutes increased the sensitivity of *M. incognita* and *H. schachtii* eggs to infection by *Verticillium chlamydosporium* (Pandey and Sikora, 2000). The authors concluded that secondary metabolites in the extract might act by affecting the egg shell or egg membrane. In the Baermann funnel tests, a mean of 556 J2 was recovered from each of the control funnels that contained only soil. No J2 were recovered from any other treatment. This study shows the high potential of naturally occurring chemicals present in PLC that should be further investigated as bio-nematicides for their use in sustainable integrated management of RKN.

Acknowledgements

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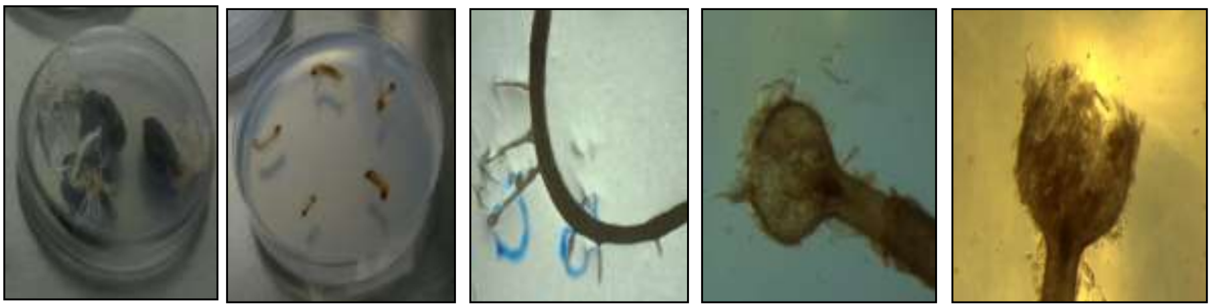

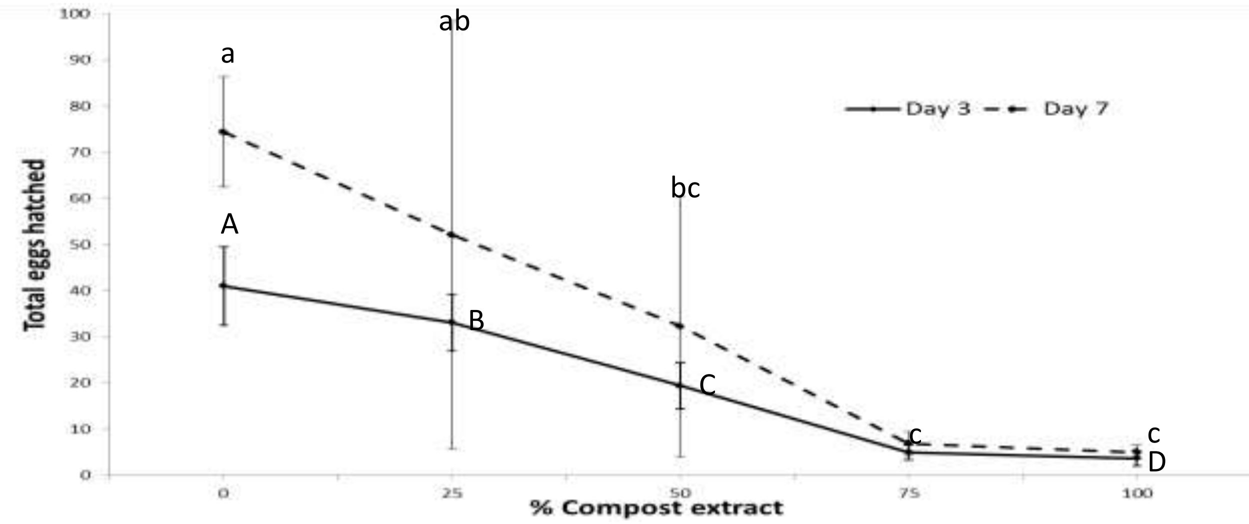

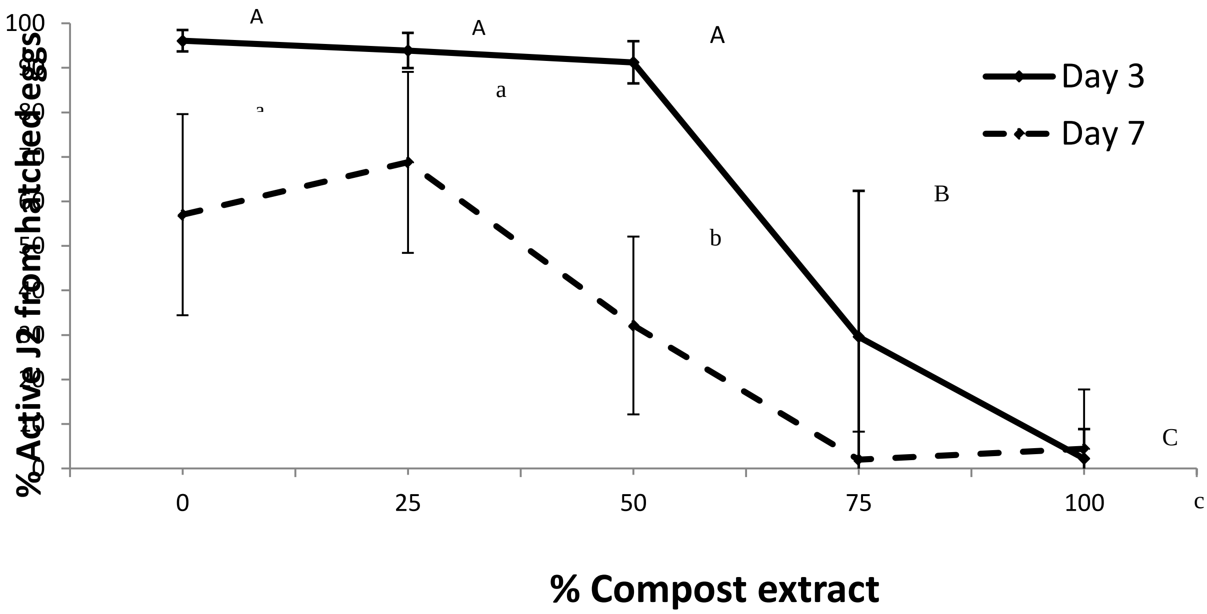

Fig. 2. The percentage of active *Meloidogyne incognita* second-stage juveniles (J2) that hatched in microwell assays within 3 and 7 days of egg immersion in poultry litter compost extract. Shown are the means of two trials with five replicates of each treatment per trial (n = 10). Values followed by the same letter are not significantly different ($P < 0.05$) according to Tukey's adjustment for multiple comparisons.

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GENERATION OF BOTANICAL WHITE YAM (*DIOSCOREA ROTUNDATA*) SEEDS THROUGH POLYCROSS IN THE RAINFED FOREST AGROECOLOGY OF UMUDIKE SOUTHEASTERN, NIGERIA

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ABSTRACT
The experiment was conducted at the Western experimental farm of National Root Crops Research Institute Umudike during the rainy season of 2015 with the objectives to generate 10,000 to 50,000 viable botanical seeds for the development of variability in yam plants . The parent stocks for the trial were 9 white fleshed varieties of female yam plants namely; Heabalo, Myango, Ame, Amola, Aloshi, Obiaoturugo, Adaka, Faketsa, Hembakwasi, Akuru and one yellow fleshed male yam plant variety Okpani. The varieties were randomly laid out in 3 replicated blocks. Each plot was 4 x 5m^2 with Inter and intra row spacing of 1m by 1m respectively giving a population density of 10,000 plants per hectare. Twenty plants per plot. The parent stocks were staked to enhance flowering and ease for pollination. The plots were kept weed-free by hand weeding throughout the lifespan of the crops. No application of fertilizer to prevent the plants growing too luxuriantly which may delay flowering. The crops were allowed to inter mate by natural pollination. Through this means insects such as Thrips were allowed to do the pollination. The following parameters were assessed namely: number of pistillate flowers, number of capsules per spike, number of seeds per capsule per spike, number of good seeds collected, number of undeveloped seeds, total number of seeds collected, percentage of good seeds per parent, weight of 100seeds collected per family. The result indicated that the objective of generating 10.000 to 50,000 botanical seeds was not realized as a result of number of factors which may include abiotic factors such as inadequate rain/irrigation during the fruiting period, biotic factor such as inability of the insects (Larothrips) to do its job of natural pollination and inherent genetic incompatibility among the varieties. Yam parents with number of good seeds higher than the grand mean will be selected for inclusion in the germplasm for hybrid seeds production.
Keywords: botanical seeds, yam plants, germplasm, flower spike

INTRODUCTION
Food crop improvement by conventional plant breeding without resorting to genetically modified organism technology is the goal in National Root Crops Research Institute, Umudike -Umuahia Abia State- Nigeria. The initial stage before embarking on yam plant genetic recombination is to ask farmers what they want in a variety by using a scientifically structured survey process. After analysing the farmers' responses, the key traits they want in their crops such as taste, colour, shape etc are then identified and yam parents carefully chosen are genetically recombined. Genetic recombination is one of the ways to create novelty in yam genotypes (Martin, 1982) and (Howarth et al., 2013). This could be done through open pollination or through controlled pollination {Akoroda, 1985).. In order to foster this work, 9 parents were constituted in the hybridization block and allowed to inter-mate with the objectives to generate 10,000 to 50,000 viable botanical seeds for the development of variability in yam plants.

MATERIALS AND METHODS
The experiment was conducted at the Western experimental farm of National Root Crops Research Institute Umudike during the rainy season of 2015. The parent stocks for this trial were 9 white fleshed varieties of female yam plants namely; Heabalo, Myango, Ame, Amola, Aloshi, Obiaoturugo, Adaka, Faketsa, Hembakwasi, Akuru and one yellow fleshed male yam plant variety Okpani. The varieties were randomly laid out in 3 replicated blocks. Each plot was 4 x 5m^2 with Inter and intra row spacing of 1m by 1m respectively giving a population density of 10,000 plants per hectare. Twenty plants per plot. The parent stocks were staked to enhance flowering and ease for pollination. The plots were kept weed-free by hand weeding throughout the lifespan of the crops. No application of fertilizer to prevent the plants growing too luxuriantly which may delay flowering. The crops were allowed to inter mate by natural pollination. Through this means insects such as *Thrips* were allowed to do the pollination. *Larothrips dentipes* is the major agent of pollination in a natural hybridization. The following parameters were assessed namely: number of pistillate flowers, number of capsules per spike, number of seeds per capsule per spike, number of good seeds collected, number of undeveloped seeds, total number of seeds collected, percentage of good seeds per parent, weight of 100seeds collected per family.

RESULTS AND DISCUSSION:
Number of female spikes: Significant variability exist in the number of female flower spikes produced by the yam parent stock. Out of a total of 1037 female flower spikes harvested, Obiaoturugo yielded 341 female flower

spikes, followed by Hembakwasi which yielded 174 female spikes while the least was 32 female spikes by Heabalo. However, Hembakwasi with 174 female spikes, Obiaoturugo with 341 and Feketsa with 163 female spikes yielded high number of female flower spikes above the grand mean of 115.2, and these 3 parents could be selected as parents for inclusion in the hybridization block for botanical seed generation either by controlled crosses or by polycross technique.

Number of capsules: The number of harvested capsules are presented in Table 1.The rsult identified high significant ($P<0.01$) variation in the number of capsules produced by the various yam plants. The number of capsules varied from 180 capsules (heabalo) to as high as 803 capsules (Akuru) with grand mean of 340.6 capsules. However, Akuru and Obiaoturugo produced more number of capsules (with 803 and 548 capsules respectively) more than the rest of the parents plants. For high capsule production, these parents should be selected for inclusion in the hybridization blocks.

Number of seeds per family: The high significant ($P<0.01$) variability that existed in the number of seeds per family indicated that out of 13292 seeds harvested from various families, Hembakwasi produced the highest number of seeds numbering 3060 seeds followed by Obiaoturugo with 2428 seeds while the least number of seeds was from Aloshi with 426 seeds. However, Hembakwasi and Obiaoturugo produced more seeds above the grand mean of 1476.9 seeds which represented 23.0% and 18.3% respectively of seeds collected from the parent stock. The least number of seeds harvested was 426.0 from Aloshi which represented 7.8% which was far below the grand mean. Number of seeds per capsule is very important in botanical seed generation. Parent stocks with number of seeds less than the grand mean should not be included in the hybridization block.

Number of quality good seeds: There was high significant ($P<0.01$) variation in the number of good seeds harvested. Number of good seeds harvested varied from 68 seeds for Aloshi representing 16.0% to 1600 seeds represented by 66.0% collected from Obiaoturugo. The grand mean of good quality seeds collected was 463.1. Parents with number of good seeds above the grand mean should be selected for inclusion into the germplasm for yam improvement. Low seed producing parents should only be included if they have special traits that the breeder is interested on for the improvement of the progenies (Table 1).

Seed set: The highest number of seed set was 3060 obtained from the family of Hembakwasi representing 23.0% of the total number of seeds collected. This was followed by Obiaoturugo with seed set of 2428 seeds representing 18.3% of total seeds collected. The least seed set was 426 seeds obtained from Aloshi representing 4.1% of the total seeds collected. Generally, total number of seeds collected was 13292 from 3065 capsules which were in a cluster of 137 flower spikes. Number of good seeds was 4168 representing 31.4% while 9124 were bad seeds representing 68.6%. The seeds were bad as a result of non -fill/under-development. Most of the capsules developed when the yam crop had completed its life circle and as such do not have the time to fully fill the seeds. Some capsules that were produced do not have enough soil moisture to complete its maturation. Therefore time of planting and irrigation facilities are necessary for botanical yam production. Another factor that may be attributed to low yield of good seeds may be biotic factors. The insects *Larothrips dentipes* that pollinate yam plants might not had do their job of pollination as a result of being few in number hence the high percent of undeveloped seeds and incompatibility among the varieties. According to Akoroda (1985), Thrips are relatively inefficient in achieving natural hybridization.

Seed weight: Hundred seeds were taken from each family and weighed, Hembakwasi and Obiaoturugo had the highest seed weights of 1.095 and 1.046 g respectively. This was followed by Amola with seed weight of 0.0990g while the least seed weight was obtained from Ame with 0.001g. Seed weight is a measure of high percentage of germinability and survivability of the crop into seedlings.

CONCLUSION

The objective of generating 10.000 to 50,000 botanical seeds was not realized as a result of number of factors which may include abiotic factors such as inadequate rain/irrigation during the fruiting period, biotic factor such as inability of the insects (*Larothrips*) to do its job of natural pollination and inherent genetic incompatibility among the varieties. These may have accounted for the low percentage in the number of good seeds collected. Yam parents with number of seeds higher than the grand mean will be selected for inclusion in the germplasm for hybrid seeds

production. However, in the next stage of evaluation, the 4168 good Seeds representing 31.4% of total seeds harvested will be evaluated, screened, and identified as genotypes to broaden the genetic base of the yam crop.

Table 1: Number of Spikes, Capsules, Seeds and Weights of seeds per family

Parents	No of flower spike /family	No. of capsules collected	No of seeds/ family	No. of good seeds /family	No of unfilled seeds/ family	Total number of seeds collected	% total seeds collected/family	% number of good seeds	weight of 100 seeds in g
Heabalo	32	180	1080	172	908	1080	8.1	16.0	0.003
Myango	65	262	972	243	729	972	7.3	25.0	0.001
Hembakwasi	174	210	3060	510	2550	3060	23.0	17.0	1.095
Ame	39	237	1422	355	1067	1422	10.6	25.0	0.001
Amola	76	273	1038	430	608	1038	7.8	25.0	0.990
Aloshi	52	271	426	68	358	426	3.2	16.0	0.002
Obiaoturugo	341	548	2428	1600	828	2428	18.3	66.0	1.046
Faketsa	163	281	1086	210	876	1086	8.2	19.3	0.732
Akuru	95	803	1780	580	1200	1780	13.4	33.6	0.042
Total	**1037**	**3065**	**13292**	**4168**	**9124**	**13292**	**99.9**	**31.4**	**3.912**
Mean	115.2	340.6	1476.9	463.1	1013.8	1476.9	11.1	3.49	0.43
LSD(0.05)	13.1	252.2	1211.4	501.7					
Sig. level	P<0.01	P<0.01	P<0.01	P<0.01					

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EVALUATION OF PRE- EMERGENCE HERBICIDE FORMULATION FOR THE MANAGEMENT OF WEEDS IN POTATO

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ABSTRACT
An experiment was carried out to evaluate a newly introduced pre-emergence herbicide in the management of weeds in potato production during 2011 cropping season. The herbicide was Pendilin with Pendimethalin 500gm/l. EC as active ingredient a pre - emergent herbicide formulated for the control of broad leaved weeds and grasses with a recommended application rates of 2.5-4.0 L./ha. The experiment was carried out at Potato Research Programme experimental field Kuru (09^0 44^1N $08^0$44E and altitude 1351m) during 2011 cropping season. Experimental design was Randomized Complete Block Design replicated three times. Potato variety used as test crop was Nicola a popular variety with the farmers. Result of the effect of the pre emergence herbicides on plant vigour, weed density, weed biomass and yield of potato was significant ($p<0.05$). Pendalin at the rate of 4 liter/ha and atrazine at the rate of 4 liters/ha gave weed densities of 2.11 and 2.67/0.25m^2 compared to the control with a density of 7.00/0.25m^2. Both fresh and dry weed biomass was significantly higher in the control (2.33 and 0.271kg/plot respectively). For the rates, result showed that application of the herbicides at high concentration significantly ($p<0.05$) suppressed the weeds than lower rates and the control irrespective of the herbicides. It is recommended that in addition to pre emergence herbicides, post emergence herbicides be use followed by at least one manual weeding for effective weed management in potato as from the 4-6 weeks after planting. Pendilin is therefore strongly recommended as a pre emergent herbicide to be use in potato production.
Keywords: Herbicide formulation, management, weeds, potato

INTRODUCTION
It has been established severally that weeds are a major problem in crop production generally. Weeds compete with the crops for space, light, moisture and soil nutrients. Weeds can also serve as alternative host for pests and diseases (Agpad, 1987). Weeds are also known to lower human efficiency and cause drudgery (Melifonwu, 1999). Akobundu, (1987) reported that weeds are the most underestimated pests in tropical agriculture that are often been associated with the drudgery that characterized peasant agriculture. Akobundu (1987) stated that weed results in 65% reduction in the yield of root and tuber crops and takes 25% of the total labour use in the production. Nwokocha (1987) had shown that yield reduction of about 50% is possible in potato production as a result of weeds infestation. All these calls for concerted effort at weed control in crop production.
Weeds can be managed either culturally, mechanically, biologically, chemically and through an integrated approach. There are two major ways is which weeds are controlled in Nigeria today, these are manual and chemical. The use of cover crops to suppress weed had also been shown to be effective (Chikoye *et al*., 2001) Manual weeding is capital intensive, time consuming and full of drudgery which had made it unattractive.
New improved agricultural inputs are getting into the market on a daily basis. Herbicides are essential in the management of weeds in potato production. Several herbicides and their rates had been screened and found effective in the control of weeds in potato and other crops production.
There are approximately 140 herbicides active ingredients (Vencill, 2002; Mallory-Smith and Retzinger, 2003). Most of these basic forms of herbicides are further refined and formulated, creating several hundred commercial products. It is natural to evaluate them viz a viz the existing ones in the management of weeds in potato production. The objectives of the study were; to evaluate the new herbicide formulation in the management of weeds in potato and to compare its efficacy viz a viz the existing ones being used in the management of weeds in potato. Lastly to determined the best rate for optimum weed control.

MATERIALS AND METHODS
An experiment was carried out to evaluate a newly introduced pre-emergence herbicide by an agrochemical company (African Agro) based in Kano state in the management of weeds in potato production. The herbicide brought was Pendilin with Pendimethalin 500gm/l. EC as active ingredient a pre - emergent herbicide formulated for the control of broad leaved weeds and grasses with a recommended application rates of 2.5-4.0 L./ha. The experiment was carried out at Potato Research Programme experimental field Kuru (09^0 44^1N $08^0$44E and altitude 1351m) during 2011 cropping season. Experimental design was Randomized Complete Block Design replicated three times. Potato variety used as test crop was Nicola a popular variety with the farmers. Potato was planted at a spacing of 30cm inter and 100cm intra row given a gross plot size of 24m^2. Fertilizer NPK was applied at

planting at the rate of 100kg/ha each of N, P_2O_5 and 40kg/ha K_2O as band application. Atrazine (ai =Atrazine 500SC) a pre-emergent herbicide with a recommended application rates of 2.5 – 4L. /ha was used as a check herbicide. The herbicides were applied after planting (0WAP) using a CP3 knapsack sprayer at the following rates; Pendilin applied at 4, 3.25 and 2.5 liter/ha, Atrazine applied at 4, 3.2 and 2.4 liters/ha and absolute control (No herbicide application). Weed biomass was taken using a quadrat of 0.5x0.5m (0.25m^2) at 6 weeks after planting (WAP). Thereafter the potatoes were weeded manually. Harvesting was done at 12WAP. Data collected were; plant establishment at four weeks after planting (4WAP), a score of weed density and plant vigour, fresh and dry weed biomass at 6WAP, final stand count and tuber yield at 12WAP. Data collected were subjected to analysis of variance and means separated by LSD at 5% level of probability,

RESULTS AND DISCUSSION

Results of the effect of the pre emergence herbicides on establishment count, weed density, plant vigour, weed biomass and yield of potato are presented in Table 1. The result revealed a significant ($p<0.05$) effect in all the parameters measured with exception to plant establishment. Higher rates of the herbicides led to vigorous growing plants as the result shows. Pendilin applied at the rate of 4 liters/ ha and atrazine (check) at 4 liters/ha gave the most vigorous growing plants compared to the absolute control. The effect of herbicides on weed density and biomass shows that they suppressed the weeds. Higher rates irrespective of the herbicides gave significantly low weed densities than the control. Pendalin at the rate of 4 liter/ha and atrazine at the rate of 4 liters/ha gave weed densities of 2.11 and 2.67/0.25m^2 compared to the control with a density of 7.00/0.25m$^{2.}$ Both fresh and dry weed biomass was significantly higher in the control (2.33 and 0.271kg/plot respectively)

Effect of pre – emergence herbicides and rates on fresh and dry biomass of weeds (kg) /0.25m^2 are presented in table 2. Result shows significant ($p<0.05$) effect in the herbicides and rates on fresh and dry weed biomass. Interaction between herbicides and rates was not significant ($p<0.05$). There was no significant difference in the fresh and dry weed biomass between the new herbicide pendalin (1.71kg and 0,155kg/0.25m^2) and the check herbicide atrazine (1.81 and 0.113/0.25m^2) in terms of weeds management though pendalin was numerically better. For the rates, result showed that application of the herbicides at high concentration significantly ($p<0.05$) suppressed the weeds than lower rates and the control irrespective of the herbicides

Herbicides had been known to control weeds if applied effectively without phytotoxic effect on the crops. The low weed densities and biomass mass can be attributed to the herbicides applied as the result shows. As the rate increases, the densities and biomass reduces. This has further been ascertained with higher weed density and biomass recorded in the control. Balthazar and Barium (1986) and Olofintoye (1997) reported that pendimethalin (pendilin) a pre emergent herbicide as for grass – weed control. Yield and yield attribute of the potatoes were also significantly affected. Result shows that there is a positive relationship between herbicides application and yield performance as seen on final stand count, tuber number and weight. Weeds have been known to interfere with normal crop growth and yield leading to low yield. This fact is corroborated by the findings of Akobundu, (1987) who stated that weeds are the most underestimated pests in tropical agriculture and can results in 65% reduction in the yield of root and tuber crops. Nwokocha (1987) had shown that yield reduction of about 50% is possible in potato production as a result of weeds infestation. This shows that weed management translate to high yield.

CONCLUSION

It has being established that weeds adversely affect potato production resulting in low yields. Result of the study revealed that the herbicide Pendilin applied at 4 liters/ha did suppressed weeds infestation in the first six weeks of potato production though not significantly different from the check herbicide (atrazine) applied at 4liters/ha. It is therefore deduced from the finding of this work that pendilin is a credible alternative to atrazine or any other pre emergence herbicide in potato production. For the desire result recommended rates of the herbicide be use for effective management of weeds in potato. It was observed that the potency of the herbicides is shot lived for the period of crop growth.

It is recommended that in addition to pre emergence herbicides, post emergence herbicides be use followed by at least one manual weeding for effective weed management in potato as from the 4-6 weeks after planting. Pendilin is therefore strongly recommended as a pre emergent herbicide to be use in potato production.

Table 1: Effect of pre emergence herbicides on some potato attributes, weed biomass and yield

Treatment	Est. Count (4WAP)	Plant Vigour Score	Weed Density Score	Fresh weed biomass	Dry weed biomass	Final Stand Count	Tuber No.	Tuber yield (kg/std)
Pen.(4L./ha)	36.00	2.33	2.11	1.23	0.096	16.67	6.10	6.00
Pen.(3.25L./ha)	38.00	1.67	3.89	1.87	0.119	15.33	6.07	5.67
Pen.(2.5L./ha)	37.33	1.44	5.00	2.03	0.124	9.67	4.39	3.33
Atraz. (4L./ha)	38.00	2.33	2.67	1.77	0.108	16.33	6.48	6.33
Atraz.(3.2L./ha)	38.33	1.67	5.45	1.83	0.174	15.33	4.93	4.67
Atraz.(2.4L./ha)	37.00	1.67	5.67	2.00	0.182	13.00	4.92	4.00
Control	37.67	1.00	7.00	2.33	0.271	12.00	4.88	1.67
Mean	**37.48**	**1.73**	**4.60**	**1.87**	**0.153**	**14.05**	**5.4**	**4.52**
LSD0.05	NS	0.74*	0.68*	0.58*	0.01*	5.49*	1.09*	1.92*

Weed Density Score (on a scale of 1-7) where; 1 = weeds free, 3 = slightly weedy, 5 = weedy and 7 = very weedy
Plant Vigour Score (on a scale 1-5) where; 1 = low vigour, 3 = moderately vigorous and 5 = highly vigorous
WAP = Weeks After Planting

Table 2: Effect of pre – emergence herbicides and rates on weeds biomass (kg) / 0.25m²

	Biomass of fresh weeds (kg) /0.25m²				Biomass of dry weeds (kg) /0.25m²			
Rate	**Pendilin**	**Atrazine**	**Control**	**Mean**	**Pendilin**	**Atrazine**	**Control**	**Mean**
1 (higher)	1.87	1.77	2.33	**1.80**	0.096	0.108	0.271	**0.158**
2(medium)	1.23	1.83	2.33	**1.99**	0.119	0.174	0.271	**0.188**
3 (lower)	2.03	2.00	2.33	**2.12**	0.124	0.182	0.271	**0.192**
Mean	**1.71**	**1.87**	**2.33**		**0.113**	**0.155**	**0.271**	**0.158**
	LSD(0.05)Herbicides = 0.38*				LSD(0.05)Herbicides = 0.093*			
	LSD(0.05)Rates = 0.15*				LSD(0.05)Rates = 0.031*			
	LSD (0.05) Herb. x Rates = 1.195 ns				LSD (0.05) Herb. x Rates = 0.123ns			

Where: Pendlin 1= 4L./ha, Pendlin 2= 3.25L./ha and Pendlin 3=2.5L./ha,
Atrazine 1= 4L./ha, Atrazine 2=3.2L./ha and Atrazine 3= 2.4L./ha Control (No herb. Application)

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SCREENING OF SOME COWPEA (*VIGNA UNGUICULATA* L.) GENOTYPES FOR RESISTANCE TO COWPEA MOTTLED VIRUS IN NORTHERN NIGERIA

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ABSTRACT
Potted experiment in screen house was conducted in the dry season of 2014/2015 in IITA Kano Station (11^{0}59'N, 8^0 35'E and Alt. 486.6m) to study the response of some cowpea genotypes to cowpea mottle virus disease on some growth attributes. Twelve cowpea varieties obtained from IITA Kano Station were sown in pots in three replications. Source of virus inoculums was a cowpea plant that had the disease symptom. During the study, the following parameters were observed on weekly basis from 4 weeks after sowing (4WAS): Plant height, number of leaves and Chlorophyll content of leaves, Virus disease severity, number of branches, leaf area and percent dry matter were captured at point of termination of the experiment. Results of the study showed 10 of the 12 cowpea varieties expressed varying degree of cowpea mottle virus symptoms. Remaining two varieties had no disease symptoms. Means of plant height, number of leaves and leaf chlorophyll content were significantly different (P< 0.05) across weeks and among varieties. Their correlation matrices with virus severity indicate negative association.
Keywords: cowpea genotypes, mottled virus, vegetative growth,

INTRODUCTION
Cowpea is an important annual food legume of the Tropics Africa with diverse uses. The young leaves, immature pods and peas are used as vegetables while several snacks and main meal dishes are prepared from the dry grain. The dry haulms and fodder are fed to ruminant livestock in the dry season when feeds are scarce. In addition, the grain is widely traded out of the production areas where it provides cheap and nutritious food for relatively poor urban communities. Cowpea also fixes atmospheric nitrogen through symbiosis with nodule bacterial (*Brayrhizoium* spp.) thus replenishing depleted soil nitrogen and improving soil structure.
Cowpea is well adapted to relatively hot dry environment of the Semi-arid Tropics. For that reason, the crop is considered as highly drought tolerant. In association with cereals and other grain legumes, cowpea contributes to the sustainability of cropping systems in marginal lands of the semiarid areas through fixation of nitrogen, ground cover and soil improvement from plant residues. These features particularly make cowpea an attractive crop for the subsistence farmers of Sub-Saharan Africa, where about 70% of the world's cowpea is grown but where the farmers still faces numerous problem in growing and harvesting the crop. Currently, the world's leading producing countries are Nigeria, Brazil and Niger. According to IITA (1999), Nigeria produces 0.9 MMT annually on a 4.0 million hectares most of which is in Kano, Sokoto and Borno States. Other producing countries in Africa are Beni, Botsuana, Bokinafatso, Cameroon, Kenya, Malawi, Mali and Togo (Singh and Emdem, 1979) Cowpea yields are known to be low in most parts of the tropics because of the numerous constraints associated with its production. Notabe among the production constrains is the insidious effect of viral diseases (Thottappilly and Rossel, 1985). According to Hampton et al. (1997), Cowpea crops are susceptible to more than 20 viral diseases.
The most important factors that constrain cowpea production in the West African sub-region are group of viruses that are mainly transmitted either through the seed or insect vectors. Seed borne cowpea viruses are spread within the field either by aphids or some species of beetle. The most effective control of cowpea viral diseases universally has been the development of improved genotypes with resistance to viral infection. Historically productiveness of cowpea breeder-geneticists describing almost every major virus provides opportunities to develop multiple resistance to diseases, insect pest parasitic weeds (Striga and Aledctra) and drought. Far reaching developments have occurred in plant virology since research started in IITA. Viral gene transfers are now viewed with increased understanding and maturity. General knowledge pertaining *Vigna unguiculata* genetics and germplasm has also expanded. The implementation of these resources has resulted in new improved cowpea cultivars with multiple resistance (Ndiaye et. Al., 1993; Singh et al . 1987; Kim et al. 1986; and Fery and Dukes 1995). Despite this advancement, conventional resistance breeding remains the most practicable measure for controlling cowpea diseases and hence the reason for this research.
The aim of this work is to study the response of some cowpea varieties to cowpea virus in Kano. The objective of this study is to investigate the response of 12 different cowpea varieties to virus inoculation and to assess the effect of virus severities at vegetative growth phase of the cowpea varieties.

MATERIALS AND METHOD

The experiment was conducted in IITA Kano Station screen house (Lat. 11^0 $_{59'N,\ l0ng.\ 8}$ ^{0}35'E and Alt. 486.6m (1595F) in the Sudan savannah agro-ecological of Nigeria. Treatment consisted of twelve cowpea lines that were collected from the International Institute of Tropical Agriculture (IITA) Kano Station, Nigeria. They are Danila, IT 90K-277-2, IT07K-292-10, IT07K-299-6, IT07KD-299-6, IT07K-318-33, IT89KD-391, IT98K-494-4, IT99K-216-24-2, IT99K-573-1-1, IT99K-7-22-2-2, IT98K-499-35

The experiment was laid in a Complete Randomized Design (CRD) and replicated three times. Other materials used for the experiment include river sand, top soil, farm yard manure, pestle plastic pots, mortar and pestle, distil water, filter paper, cotton wool, Leaf area machine, SPAD meter, Meter Balance, and drying oven, 250 ml glass beaker, glass funnel, and 1000 ml measuring cylinder. The necessary agronomic practices such as pot filling, sowing and thinning were observed before mechanicl inoculation of the virus. More so, insect control was done by spraying against Aphids cracivora using Mamdo (Imidodazole) at the rate of 2.0ml in 10.0 liters of water.

Plant measurement, counting of leaflets and measurement of leaf chlorophyll content, virus rating cum dry matter content were also observed. All data captured were subjected to statistical analysis using Statistical Analysis Software (SAS 9.3). Means were separated using Duncan multiple range test (DMRT).

RESULTS AND DISCUSSION

Effect of virus severity on plant height

The result of this investigation indicates that 10 out 12 cowpea varieties tested showed virus disease symptom that was identified as cowpea mottle virus. This could be interpreted as varieties that are lacking in genes that offer protection to virus disease. The two varieties (IT97K-499-35 and IT07K-299-6) that had no virus symptom even at 10 WAS imply resistance virus disease. This finding was similar to the report of Sunusi (2010) when he found no disease symptom on IT97K-499-35.

The decrease in the association between virus severity and plant height was as result of the insidious effect of the virus on the plants by inducing severe stunting in infected plants through shortening of internodes and apical necrosis. This fact is substantiated by the report of Pio-Ribeiro *et al.* (1978) that indicate CABMV and Cu cumber mosaic cucumovirus interacted synergistically to produce stunting in cowpea: a disease characterized by severe yields loss. Also, Niblett and Claflin (1978) and Uyemoto *et al*. (1981) demonstrated that maize dwarf mosaic virus (MCMV) induced necrosis disease that resulted in up to 91% yield loss and death of many plants especially when infection occurred early.

Effect of virus severity on number of leaves

The result of this study indicated that disease symptom was expressed on older leaves similar to the finding of Joseph, *et al.* (2011) when they observed highest disease severity (61.65%) in the old leaves compared to (22.97%) on flag leaves of o.Hyla. The lack of significant differences in the effect of virus on number of leaves was probably due to the early stages of plant development (vegetative). The slight decrease in the number of leaves of diseased infected plants is in agreement with the report of Kareem and Taiwo (2007) where they that CABMV alone and its combination with SBMV resulted in significant reduction in the number of IT86D-719 leaves.

Effect of virus severity on chlorophyll content of leaves

The chlorophyll content in the test plants ranged was within the range of what was reported by Joseph *et al.* (2007). Mean values of chlorophyll content that increased from 32.1 to 50.7 was probably due to the fact that plants were still in their vegetative phase of growth and the virus activity had not attained full blown disease status in the susceptible plants.

Effect of virus severity on number of branches

Branching in cowpea is a function of genetic and environmental influence. In this study, branching appeared to be controlled by a combination of factors such as change in day-length, low temperature and effect stage of growth of the plants. Since the plants had not started flowering at the time of termination of the experiment, only three of the varieties had developed branches.Plant growth in terms of increase in % DM was significant with low and negative level of association with virus severity. This supports the finding of Kollmann *et al.* (2007) that virus significantly reduced above-ground biomass of plants, stem biomass, and higher relative mass of leaves.

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POLYCULTURE CROPPING SYSTEM AMONG YAM FARMERS IN YORRO LOCAL GOVERNMENT AREA OF TARABA STATE, NIGERIA

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ABSTRACT
Rising rural population densities in Nigeria are profoundly affecting farming systems. Localized land pressures being experienced by many rural farmers required polyculture cropping system which this study is aimed to analyze among yam farmers in Yorro Local Government Area of Taraba State, Nigeria. Primary data used for the study was collected from a sample 142 farmers and were analyzed using descriptive and inferential statistics. Results revealed that respondents are small scale farmers characterized by large family size and are well experienced with a mean farming experience of 23 years. Majority (89%) practiced mixed cropping to avoid crop failure and scarcity of land. Production function analysis revealed that the coefficient of multiple determination (R^2) was 0.8451 and explained about 85% of the variations in the output of respondents. Farm size, labour and seed were statistically significant ($p<0.001$).
Keywords: Polyculture, yam, production function, Yorro, Nigeria

INTRODUCTION
Root and tuber crops are important in food security and income for 2.2 billion people in developing countries and crops comprise crop covering several genera. They are staple food crops, being the source of daily carbohydrate intake for the large populace of the world. Root and tuber crops refer to any growing plant storing edible materials in subterranean root, corm or tuber (Oke, 1990) and yam is a member of this important class of food. Yam is an important food crop especially in the yam zones of West Africa, comprising, Nigeria, Cameroon, Benin, Togo, Ghana and Cote divoire. This zone produces more than 90% of the total world production which is estimated at about 20 – 25 million tonnes per year (Sanusi and Salimonu, 2006). Nigeria is the main producer of yam in the world with 70% of the world output followed by Ghana, Cote d' Ivoire, Benin and Togo (International Institute for Tropical Agriculture, IITA, 2015). The crop yield depends on how and where the setts are planted, sizes of mounds, interplant spacing, provision of stakes for the resultant plants, yam species, and tuber sizes desired at harvest. Small-scale farmers in West and Central Africa often intercrop yams with cereals and vegetables (Dumont and Vernier, 2000).

Yam based crop mixture (YBCM) is one of the two common crop mixture systems practised in farming communities of Nigeria. YBCM composed of yam, maize and melon with yam as based crop. Yam, the based crop of YBCM, is an important food crop in Nigeria (Food and Agriculture Organization, FAO, 1999). The crops in YBCM are arable crops which are food crops planted and harvested at maturity within one production cycle or season. However, crop mixture is a viable strategy for spreading the risks of crop failure and labour demands for critical operations of sowing, weeding and harvesting (Eze *et al*., 2009). Yam-based system is a system in which yam production is the predominant rural activity among several other crops, livestock or off-farm production activities.The practice of intercropping is popular because of its advantages over sole cropping which include yield stability and security and higher profitability due to higher combined returns per unit area of land (Ezulike *et al*, 1993). The practice of inter cropping controls erosion and weeds and allows a more even distribution of farm labour than sole cropping and serves as enterprise combination which is a security against crop failure. The cropping combination is also agriculturally compatible (Ibeawuchi, 2004). In 2010, the world harvested 48.7 million tonnes of yam, 95 percent of which was produced in Africa. The biggest yam harvest, globally was in 2008 when world produced 54 million metric tonnes of yam, with Nigeria producing an annual average of 35.017 metric tonnes (FAO, 2011). Rising rural population densities in Nigeria are profoundly affecting farming systems and indeed the overall trajectory of economic systems in ways that are underappreciated in current discourse. Population pressure is linked in one way or another to the shrinking size of most smallholder farms over time; more continuous cultivation of fields, contributing to land degradation and unsustainable forms of agricultural intensification; the rise of land rental and purchase markets and changes in land allocation institutions, all of which are rapidly altering farm structure; and the challenges that Nigeria is currently experiencing in achieving broad-based and inclusive forms of farm income growth. The extent, distribution and exploitation of land are factors that have long been identified as fundamental influences on agricultural development paths and poverty reduction (Maikasuwa and Ala, 2013). Nigeria is typically characterized as land abundant, with the implication that land endowments pose no serious constraint for agricultural development, but our starting point for studying the impacts of population density is the recognition of Nigeria's spatially heterogeneous distributions of rural populations, giving rise to acute localized land pressures being experienced by many rural farmers. The broad objective of the study is to analyze polyculture cropping system among farming farmers in Yorro Local Government Area of Taraba State, Nigeria.The specific objectives were to describe the socio-economic characteristics of yam farmers; identify the various crops in the yam- based intercropping and examine factors influencing output of crops among respondents in study area.

METHODOLOGY

The Study Area: The study was conducted in Yorro Local Government Area of Taraba State, Nigeria. The local Government Area lies between latitude 8.17˚N and 9.7˚N and longitude 11˚ 66˚E and 11˚ 46˚E of Greenwich meridian. The Local Government lies to the North-eastern part of Taraba state, bordered by Zing Local Government to east, Lau Local Government to the North, Jalingo and Ardo-Kola Local Government to the West and Bali Local Government to the South. The Local government has a land area of 21,200 km^2 with a projected population of 60,894 people. The local government has tropical climate marked by dry and rainy seasons. The rainy season starts in April and ends in October. The wettest months are August and September The mean annual rainfall ranges from 800 mm to 1000 mm and the mean daily temperature ranges between 18.8˚ C and 34.4˚C. The dominant soil types in the local government are ferruginous sandy loamy soil. The main vegetation cover of the Local Government is made up of scattered trees, while the topography is essential marked with mountainous land traversed by small streams between them (Taraba State Agricultural Development Progamme,TADP Diary, 2012).

Source of Data: Primary data was used for the study and was collected using structured questionnaire administered to the respondents to collect the desired information.

Sampling Size/Sampling Technique: The population for this study were yam farmers in Yorro Local Government Area of Taraba State. A sample size of two hundred and fifty (250) Yam farmers was considered from the eight (8) farming villages, where one hundred and fifty (150) farmers were selected using proportionate and random sampling technique .

Method of Data Analysis: Descriptive and inferential statistics were used. The descriptive statistics was used to achieve objectives i, ii, iii and v. Inferential statistics (multiple regression) was used to achieve objective iv of the study.Multiple regression analysis was used to determine the factors influencing output of crops of yam-based farming system among respondents. Four functional forms (Linear, Semi log, Exponential, Double log) were tried where Double log gave thebest fit and is expressed as:

$$Y = \beta 0 + Log\beta 1X1 + Log\beta 2X2 + Log\beta 3X3 + Log\beta 4X4 + Log\beta 5X5 + Log\beta 6X6 + \varepsilon$$

Where Y = Output of the ith farmer in grain equivalent X_1 = Farm size (hectares) X_2 = Labour(Mandays) X_3 = Hired labour(mandays) X_4 = Fertilizer(kilogramme) X_5 = Seed(grain equivalent) X_6 = Herbicides(litres) and ε = error term

RESULTS AND DISCUSSION

Respondents' Socio-economics

Summary statistics of respondents socio-economic variables as contained in Table 2 revealed that the minimum age of 18 years with a maximum of 78. Mean age was 46 years. There were variations in the ages of respondents as revealed by standard deviation. Farmers are relatively older and may portend danger to food production in the study area. The finding is in line with the works of Migap and Audu(2012) and Donye *et al.*(2012) that yam production was carried out by the elderly farmers. Government should entensify efforts in the provision of infrastructure in rural areas to attract young people and encourage food production. Furthermore, yam based farming was small scale as evidenced by mean farm size of 2.7 hectares, respondents have large family sizes with a mean family size of 9 people.

Respondents' Cropping pattern and Reasons for Intercropping

Mixed yam production was predominant in the study area (Table 2). Reasons for intercropping may not be far - fetched; fear of crop failure, scarcity of land, rising population and conversion of arable land for construction. Another reason is that the study area is in a moutainous area imposing the necessity for polycultural farming systems. Furthermore analysis in Table 3 showed that Mixing yam with groundnut, sorhgum, millet and cowpea were major cropping combination.

Table 1: Summary statistics of selected socio-economic variables of Respondents

Variable	Minimum	Maximum	Mean	Standard deviation
Age	18	78	46	13.928
Farm experience	12	47	23	13.771
Farm size	0.5	6	2.7	1.301
Family size	1	22	9	4.801

Source: Field survey 2016

Table 2: Cropping Pattern of the Respondents

Cropping pattern	Frequency	Percentage
Sole Yam production	16	11.27
Mixed Yam Production	126	88.73
Total	142	100

Source: Field Survey 2016

Table 3: Cropping Combination of the Respondents

Cropping combination	Frequency	Percentage
Yam + Maize	80	13.40
Yam + Sorghum	110	18.43
Yam + Millet	105	17.58
Yam + Cowpea	97	16.25
Yam + Cassava	85	14.24
Yam + Ground nut	120	20.10
Total	**597***	**100.00**

Source: Field Survey 2016

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME IV:

GENDER MAINSTREAMING IN AGRICULTURE

ORGANIZING RURALWOMEN FARMER FOR EFFECTIVE UTILIZATION OF AGRICULTURAL EXTENSION ACTIVITIES IN UMUAHIA NORTH LGA OF ABIA STATE

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ABSTRACT
The aim of the work was to organize rural farm women to benefit from agricultural extension activities in Umuahia agricultural zone of Abia State, Nigeria. 120 farm women were sampled. There Mean age was 47 years old. 56.67% of the respondents were married. The result revealed that a high proportion of women farmers in the area (75.84%) had completed one form of formal education or the other. The mean household size of the respondents was 7 persons per household. The results of the Likert analysis of the data collected revealed a wide range of agricultural extension activities which the rural women farmers have participated/benefited from in the past. Such agricultural activities included: introduction of new herbicides and pesticides/uses ($\bar{X}$=3.04), better crop rotation practices and fertilizer application ($\bar{X}$=2.87), types of soil and best soil type for planting ($\bar{X}$=2.80) introduction of new seedlings ($\bar{X}$=3.18), crop disease treatment and control ($\bar{X}$=3.27) new methods of crop preservation ($\bar{X}$=3.01). 57.5% of the respondent found extension activities very effective. The findings further revealed that the major organs used in accessing agricultural information by the rural women farmers' in Umuahia zone are posters, radio and television. The result revealed Lack of rural electrification/constant power interruption in communities that have electricity supply and Lack of money to purchase newsletters, leaflets on agricultural information as the major constraints facing rural farm women in accessing agricultural information. It is therefore recommended that the existing women groups in the village should be organized and strengthened to increase women's access to extension services, credit facilities, agricultural inputs and even marketing services
Keywords: Rural Women, Effective Utilization, Extension,

INTRODUCTION

Rural farmers are meant to know and also adopt agricultural innovations relevant to their situations. It is the duty of institutional and government organs (the Agricultural Extension and Research Liaison Services-AERLS, the extension services of the Agricultural Development Project-ADPs, Ministries of Agriculture at both state and federal levels, Media Forum for Agriculture, Cooperative Extension Centres-CEC of universities etc) to ensure that towns and villages in Nigeria have easy access to agricultural information for enhancement of crop productivity and better animal husbandry practice.

The poverty among rural farm women in agriculture are attributable to the following: no access to innovative information, low productivity, poor agricultural produce prices, hence poor farm income, inadequate infrastructure, limited access to credit and other improved farm inputs and land (Ojowu *et al.*, 2007). This is not surprising as women comprise the majority of the world's poor in both urban and rural sectors and the majority of those working in the informal sector (Spiedoch, 2007). Most of innovations do not reach the rural farm women and this has been attributed to lack of effective agricultural information dissemination machinery (Yahaya, 2002). Rural farm women are engaged in several on- farm, off farm and domestic activities, many of them thus become apathetic to attend farmers' union and cooperative meetings through which they could have access to vital agricultural information.

There is need therefore to organise rural farm women in agriculture to effectively benefit from extension. Extension facilitates the access of farmers, their organizational and other market actors to knowledge, information and technologies; facilitates their interaction with partners in research, education, agric-business and other relevant institutes and assists them to develop their own technical, organizational and managerial skills and practices (Christoplos, 2010). According to Anderson and Feder (2010), agricultural extension intends not only to increase productivity and income, but also to organise the rural farm women for effective utilization of agricultural extension activities.

The study was set out to organise rural farm women to benefit from agricultural extension activities in Umuahia agricultural zone of Abia State. Other objectives were to **;** describe socio-economic characteristics of the rural farm women in the study, find out the proportion of these women in co-operative societies, ascertain extension activities that rural farm women have participated/benefited from in the study area, ascertain organs employed in accessing agricultural extension information, innovation or technologies by rural farm women in the study area, identify constraints encountered by the rural farmer women in accessing agricultural information from the study area.

MATERIALS AND METHODS

The study was carried out in Umuahia agricultural zone of Abia State. A multi- stage random sampling technique was adopted.

Two local government areas (Ikwuano and Umuahia North) were randomly selected from the zones; three communities were selected from each of the local government areas; twenty (20) farm women were randomly selected from each of the communities. This gave a total sample size of 120 respondents. The extension agent(s) covering the study area were purposively sampled to elicit information on extension activities in the area. The study employed primary and secondary sources for data collection. Primary data were collected using a well structured questionnaire. The secondary sources of data included text books, journals, internet, conference proceedings, published and unpublished literatures among others. Data generated for this study were analysed using descriptive statistics such as frequency distribution, percentage, mean, and likert-type scales.

RESULTS AND DISCUSSION

Findings from the study revealed that majority (38.33%) of women farmers were within the age bracket of 40-49 years old. Mean age of the farmers was approximately 47 years old. It is evident from the results that most of the respondents were married (5According o the result, a high proportion of women farmers (75.84%) had completed one form of formal education or the other. The mean household size of the women was 7 persons per household. About 67.5% of the farmers had household size of about 4-9 persons per household. Response on farming experience revealed that 89.17% of women farmers have above 5 years of farming experience. This implies that most of the women have been in farming profession for quite some time and are not novice in farming activities. The results further revealed that most of the respondents are small scale cassava farmers as most of them (44.17%) have farm sizes less than 3 hectares and that most (69.3%) of the women had no access to extension services. Monthly, majority (45.83%) have income level ranging between N20, 000 to N40, 000 while only 9.17% have above N60, 000 income levels. By implication, some of the farmers' financial commitment may not be met. Only 35% belonged to a cooperative society while about 65% do not belong to any cooperative. Analysis of the farming enterprise as practiced by the farmers revealed that all the farmers participate in food crop (100%) production, 31.7% produce tree crops and food crops as well, 52% are into livestock production and food crops production while 30% produces both food crops, tree crops and livestock as well.

The results of the Likert analysis of the data collected from the respondents according to Table 4.12 showed a wide range of agricultural extension activities which these rural women farmers have participated/benefited from in the past. Such agricultural activities include: introduction of new herbicides and pesticides/uses with a mean score of 3.0.4 ($\bar{X}$=3.04), better crop rotation practices and fertilizer application ($\bar{X}$=2.87), types of soil and best soil type for planting ($\bar{X}$=2.80) introduction of new seedlings ($\bar{X}$=3.18), crop disease treatment and control ($\bar{X}$ =3.27) new methods of crop preservation ($\bar{X}$=3.01).

The distribution of respondents according to their perception on the effectiveness of extension activities showed that 57.5% of the respondent found extension activities very effective. This could be as a result of the increase in output of farmers. 31.7% also indicated that extension activities are effective.

The major organs used in accessing agricultural information by the rural women in Umuahia agricultural zone included posters, radio, television, leaflets and through extension workers.

The result also indicated that respondents have no access to agricultural information through the community library (82.5%), Newsletters (80%) and extension agents (72%), while On the other hand, respondents agreed to have access to agricultural information through posters (70%), exhibition (79%), and leaflets (69%). Lack of rural electrification/constant power interruption in communities that have electricity supply and Lack of money to purchase newsletters and leaflets (poverty) were the major constraints facing rural farm women in access agricultural information in the area.

CONCLUSION

Cooperative groups are **o**rganized for the promotion of special interest or meet certain needs that cannot be achieved by the individual's effort. They contribute to the dissemination of new ideas, practices and products as well as in sourcing for loan and farm inputs. The existing women's group in the village should be organized and strengthened to increase women's access to extension services, credit facilities, agricultural inputs and even marketing services.

Table 1: Distribution of respondents by socio-economic status.

Age (years)	Frequency	Percentage
20 - 29	11	9.17
30 – 39	17	14.17
40 – 49	46	38.33
50 – 59	27	22.50
60 - 69	19	15.83
Total	120	100
Mean		46.7
Marital Status		
Single	7	5.83
Married	68	56.67
Divorced	14	11.67
Widowed	31	25.83
Total	120	100
Educational level		
No formal education	29	24.16
Adult literacy	12	10.0
Primary education	30	25.0
Secondary education	38	31.67
Tertiary education	11	9.17
Total	120	100
Household size		
1-3	18	15
4-6	32	26.7
7-9	49	40.8
10-12	13	10.8
13-15	8	6.7
Total	**120**	**100**
Mean		**7.0**
Farm size (ha)		
Less than 3	53	44.17
3 – 5	29	24.17
6 – 8	13	10.83
9 – 11	13	10.83
12 – 15	9	07.50
Above 15	3	02.50
Total	**120**	**100**
Monthly Income level (N)		
Less than 20000	32	26.67
20000 – 40000	55	45.83
41000 – 60000	22	18.33
Above 60000	11	9.17
Access to Extension		
No access	82	68.3
Access	28	23.3
Total	**120**	**100**
Membership of cooperative society	78	65%
No		
Yes	42	35%
Total	**120**	**100.0%**
Farming enterprise		
Food crops	120	100
Tree crops	38	31.7
Livestock	52	43.3
All of the above	30	25

Source: *Field survey data, 2015*

Table 2: Extension activities from which rural farm women have participated/ benefited

Statements	SA	A	U	D	Mean score
Introduction of new herbicides and pesticides/uses.	35(29.2)	60(50.0)	19(15.8)	6(5)	3.04
Better crop rotation practices and fertilizer application.	21(17.5)	68(56.7)	25(20.8)	6(5.0)	2.87
Types of soil and the best soil type for planting.	26(21.7)	56(46.7)	26(21.7)	12(10)	2.80
Introduction of improved seedlings	35(29.2)	68(56.7)	10(8.3)	7(5.8)	3.18
Crop disease treatment and control.	60(50.0)	41(34.2)	10(8.3)	9(7.5)	3.27
Livestock disease treatment and control.	28(23.3)	32(26.7)	12(10)	48(40)	2.33
Use of artificial insemination (AI) on local sheep and goats.	8(6.7)	19(15.8)	37(30.8)	56(46.7)	1.84
New methods of crop preservation.	36(30.0)	60(50.0)	15(12.5)	9(7.5)	3.01
erall mean					2.79
Number of responses					120

Source: *Field survey data, 2015*

Table 4.4: Frequency Distribution of Respondents on Organs employed in accessing agricultural extension information, innovation or technologies

Organs used in accessing agricultural information	Agreed	Disagree
Community library	21 (17.5%)	99 (%82.5)
Newsletters	40 (33.3%)	80 (%66.7)
Posters	70 (58.3%)	50 (%41.7)
Exhibitions	79 (65.8%)	41 (%34.2)
Leaflets	69 (57.5%)	51 (%42.5)
Radio	112 (93.3%)	8 (%6.7)
Television	98 (81.7%)	22 (%18.3)
Extension workers	48 (40%)	72 %60)

Source: *Field survey data, 2015*

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DIVISION OF LABOUR IN COWPEA PRODUCTION IN KANO STATE: IMPLICATION FOR GENDER PLANNING

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ABSTRACT
The study examines the role play by both female and male gender in the production of cowpea in the state. Three local governments were randomly selected from each geological zone of the state. Data were collected from 119 respondents through structured questionnaire and the analysis was done using frequency and percentage. The analyzed results show that majority of the respondents are in their active years (73%), almost 81% are literate while majority of them acquired farmland through common ownership and Inheritance (47%). The study showed that the females are actively involved in direct field production activities such as planting, harvesting, threshing, while post harvest handling such as storage and processing are majorly a female gender role. In order to improve their economic condition effort should be made by all stake holders in the field of agriculture to provide necessary assistance towards facilitating the roles generally played by the female producers.
Keywords: Female Cowpea Farmers, Gender role, Post-harvest handling, Economic improvement

INTRODUCTION
Gender as a concept is used in social sciences to define the roles and activities of men and women. These roles are socially defined by the traditions and a belief of a particular culture.Gender is therefore not synonymous with sexual differences which are based only on biological characteristics. Gender analysis is a tool for understanding and learning more about the activities of male and female in the society, the opportunities and problems they face in performing their activities. The subject of gender, according to Olawoye (2001) concentrates attention on the obligations, privileges and duties assigned to men and women in society and the relationships between them. In the African society, there are tasks meant for men and those meant for women. Gender division of labour is best understood in learning about socio-cultural differences. Gender analysis therefore is not necessarily about developing programs for women, which is the common assumption of the people in the society. It is focused on the relations of both men and women to the social and economic structure of the society. Most farmers in Nigeria operate on the subsistence and smallholder level in an extensive agricultural system; therefore, in the country's food security lies in their hands. Men and women perform different roles in agricultural production. These roles vary from place to place depending on the tribe, culture, religion and geographical location. Women in Africa (including Nigeria) generally play an important role in small-scale traditional agricultural production (Afolabi,2008). Rural women have taken over the production and processing of arable crops and are responsible for as much as 80% of the staple food items.

As reported by Odebode, (2012) an estimates of women's contribution to the production of food crops range from 30% in the Sudan to 80% in the Congo contributing substantially to national agricultural production and food security. Women farmers are the principal labour force on small holder farms and perform the largest share in land preparation, weeding, transporting, processing and marketing of agricultural products. Women therefore contribute greatly to agricultural production in Nigeria as take the lead in most agricultural activities. They make up to 60-80 percent of the labour force. Therefore the significant role they play in meeting the challenges of agricultural production and development are quite dominant and prominent.

Despite their great contributions to agriculture, various findings have reported that women farmers generally, and particularly in Nigeria, lack access to adequate productive resources such as land, credit, agricultural inputs, education, extension services, and appropriate technology, due to various socio-economic factors (Rahman, 2008). According to Ajani (2008), religion in the northern part of Nigeria plays a large role in the division of labor. Among Muslim Hausa-Fulani's community in particular, seclusion norms dictate that women are less involved in outside-the-compound farming tasks (other than harvesting of certain crops by widows or women who have reached menopause).In the northern part of the country a research on involvement of both women and men rice production showed that married women are constrained in their production by their multiple roles and cultural practices which prevented them from direct field production activities. (Ayoola *et al.*, 2011).Generally, Married women of childbearing age do not undertake field work in Kano State; however, they are involved in many other aspects of production. Depending on how strongly seclusion is practiced within an area or a household. Girls, unmarried women (e.g., widows, divorcees), and menopausal women might participate in field work, particularly

in the less physically demanding activities such as planting or harvesting and other activities such as weeding, harvesting, and post-harvest processing are frequently female activities.
Thus, gender has become a critical cross-cutting factor in innovation process to promote equity and enhance the relative access of female and male farmers to necessary resources in programmes targeted at promoting household food security and poverty reduction.
Gender roles in the production of cowpea in the Northern part of Nigeria have not been adequately provided for by research and documentation. It is therefore necessary to assess the existing gender roles in cowpea food chain especially that of the females as well as those factors responsible for any noticeable change thereby enhancing proper planning for the females' producers.

METHODOLOGY

The study was conducted in Kano state of Nigeria. The State is made up of 44 Local Government areas (LGAs) divided into three (3) ecological zones. It is located in the Northern part of the Country and well known for cowpea production. The study population consists of female cowpea farmers. Three Local Government Areas (Gezawa, Ungogo and Kumbotso) were randomly selected from each of the three ecological zones in the state. A total population of six hundred (600) female farmers actively involved in cowpea production was located in the study areas. Forty (40) female cowpea producers were randomly selected in each ecological zone using a sampling fraction of 0.15.About 99 percent of structured questionnaires (119) were finally used for the analysis using descriptive statistics

RESULTS AND DISCUSSION

Table 1 show that Majority 61.4% are between 31-40years of age, while about 6% are 50 years and above. This implies that most of the female cowpea producers are in their productive age. Almost 75% of the respondents are married and twenty –one percent (21%) are widows. a very large proportion has no formal education (almost 81%) with only about seventeen percent (17%) have been exposed to primary education. with a negligible percentage of 2.5% having secondary education. In terms of family size, about 45% have a family size of 6-10 members while almost 35% have an household size of 1-5.The most significant mode of land acquisition is through common ownership and Inheritance (47.1%). Most of the respondent (44%) has 3-5yrs farming experience, while about 38% have 6-8yrs of farming experience.
The above socio-economic characteristics revealed that the respondent consists of a large proportion of women in their productive age, most of whom are married, illiterate and possessing a relatively large family size to support. They can be referred to experienced small scale farmers with access to land based on Inheritance and common Ownership while few of them purchase land for farming.
Table II above reveals that the greater percentage of male involvement is recorded in Bush clearing (46.9%), Stumping (58.8%) and weeding (51.3%),but stumping and weeding are majorly dominated by the male gender with significant contribution by both gender; was reported by the female cowpea producers. More than half of the respondent (51.3%) reported that Tilling is carried out by the female farmers and employed male labourers, while planting (49.6%) can be categorizes as a female job. fertilizer application (58.0%) are carried out by both gender while more than half (52.9%) of the respondents claimed that harvesting is majorly done by the female gender. Post Harvest activities which are Threshing (90.8%), Storage (67.2%) and Processing (66.4%) are performed by the female gender while Marketing (56.3%) can be referred to as a post harvest task handled by both gender in the State.
From the table III, about 98%, 67%, and 63% of the female farmers are involved in the task stated above as a result of quest for financial dependence, changing economic conditions and culture flexibility respectively. Also, almost 41% and 43% of them perform the tasks due to a large size of dependants to cater for and children education. The lower percentage recorded in the latter compared to the former might be attributable to the fact that majority are married and probably receive assistance from the head of their household concerning family members and children's education.

CONCLUSIONS AND RECOMMENDATION

Attempt has been made to examine the division of labour in cowpea production and post harvest handling in Kano state with an emphasis on the roles played by the women folk in the process. The sampled population can be referred to as small scale farmers, who are in their productive age and with a very low level of formal education. Their major access to farmland is through joint ownership and Inheritance, these is in consonant with the work of Lowenberg-DeBoer.J.and Germaine (2008) who posited that women in the north experience a restricted access to farmland while most of them can only boost of Quranic education. A considerable proportion of them have a relatively large number of families to support.
Stumping and bush clearing are dominated by the males; this might be as a result of the labour intensity of the operation. Both men and women were also found to be actively involved in the marketing of the cowpea in the

study area. It was discovered that majority of the female producers are actively involved in field activities such as planting, fertilizer application and harvesting while storage and processing are majorly carried out by the females. This is in contrast with some finding which says women in the northern part of the country are constrained by religion to participate in field activities.

Almost 98 percent of the female were involved in some of the task reported because of quest for financial freedom, indicating a great dependency of the females on their household head for finance. A considerable percentage: 67.2% are also involved due to changes in economic condition while 63% claimed culture flexibility for the division of labour involved in.

Having discovered the active role of the female gender in cowpea chain, all stake holders involved in the planning of rural development should target the female producers. The area of target should include provision of input materials such as high breed seedlings, fertilizers as well as the technical assistance on improved planting and application techniques. In order to ensure the economic development and status of these small scale farmers in terms of post harvest handling, improved storage facilities should be made available by the government and non governmental agencies for food sustainability and enhanced economic well being. The above will increase their participation in the society, and constitute to an overall improved rural economy and development.

Table 1: Socio-economic characteristics of Respondents

Characteristics	Frequency	Percentages (%)
Age		
20-30yrs	16	13.4
31-40yrs	73	61.4
41-50yrs	23	19.3
50+	7	5.9
Marital Status		
Single	1	8
Married	89	74.8
Divorced	4	3.4
Widow	25	21.0
Household size		
1-5	41	34.5
6-10	53	44.5
10+	25	21.0
Educational Level		
No formal education/Quranic education	96	80.7
Primary Education	20	16.8
Secondary Education	3	2.5
Farming Experience		
3-5yrs	52	43.7
6years and above	67	56.3
Farm Size		
0.1-1acre	48	40.3
1.1-2.0acre	64	53.8
2+	7	5.9
Land Acquisition		
Rent/lease	6	5.0
Inheritance	22	18.5
Purchase	37	31.1
Common ownership &Inheritance	54	45.4

Source: Field Survey 2010

Table II: Gender role in Production Process and Post Harvest Handling

Production Process	**Female Freq %**	**Male Freq %**	**Both Freq %**
Bush clearing	17 (14.3)	59 (49.6)	43 (36.1)
Stumping	1 (.8)	70 (58.8)	48 (40.4)
Tilling	2 (1.7)	56 (47.1)	61 (51.2)
Planting	54 (45.4)	6 (5.0)	9 (49.6)
Fertilizer Application	46 (38.6)	4 (3.4)	69 (58.0)
Weeding	9 (7.6)	61 (51.3)	49 (41.1)
Harvesting	63 (52.9)	9 (7.6)	47 (39.5)
Post harvest handling Female	**Male Freq %**	**Both Freq %**	**Freq %**
Threshing	108 (90.8)	3 (2.5)	8 (6.7)
Storage	80 (67.2)	15 (12.6)	24 (20.2)
Marketing	34 (28.6)	18 (15.1)	67 (56.3)
Processing	79 (66.4)	21(17.6)	19(16.0)

Source: Field Survey 2010

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FACTORS AFFECTING F EMALE FARMERS IN THE PRODUCTION OF AFRICAN EGGPLANT IN ABIA STATE (*Solanium gilo*) IN ABIA STATE, NIGERIA

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ABSTRACT
The study examined the factors affecting female farmers in the production of African eggplant (Solanium gilo) in Abia State. Recent studies have shown a lot of involvement of women in agricultural production in the state. The sampling technique used was multi-stage random sampling procedure. Structured questionnaire was also employed to obtain necessary data required. A total of 12 circles of 10 female farmers each (120 female farmers) were randomly selected and interviewed with structured questionnaire. The study revealed that, out of fourteen independent variables estimated with Tobit model, two variables (year of experience and planting materials) were significant at 5% level while two others (quantity of fertilizers and pesticides) were positively significant at 1% level. The study recommends formulation of policies aimed at timely provision of farm inputs such as improved seeds, fertilizers and agro-chemicals to female farmers to ensure sustainability in the production of African eggplant.
Keywords: Factors, Female Farmers, African eggplant, Production.

INTRODUCTION

Nigeria is blessed with abundant resources which include land, labour and natural resources suitable for agricultural production. At present, she has a total population of over 140,001,542 million people made up of 71,709,853 males and 68,291,683 females (NPC, 2006). Agricultural production engages about 80% of the Nigerian population especially women who spend more than two-third of their time on food production activities. They do most of the work in the areas of primary production, processing, storage, marketing and transportation of crops from the farms to the homes (Ironkwe *et al*, 2007). Women physically produce 70-80% of domestic food crops, hence helping to ensure family and national food security in Nigeria.

In Nigeria, the role of female farmers in agricultural production cannot be over emphasized. Women are predominantly farmers (Tanko, 1995) and have been clearly recognized as fundamental in the field of agriculture (FAO, 2006). The female farmers (women) have been involved in the production of crops because they are highly knowledgeable about sustainable agricultural system and also play key role in preservation and exploitation of biodiversity (Eghereuba, 2004). Female farmers play active role in the food chain and value additions. For example they are found to be deeply involved in processing of cassava roots into various food forms such as garri, fufu, flour, starch, tapioca, doughnuts, cake, chin-chin and others (Aniedu, 2006). The female farmers participate more actively in collection of planting materials, weeding, fertilizer application, harvesting, storage, processing and decision or management of crops in Abia State, Nigeria (Onunka, 2011).

Other studies have demonstrated increased involvement of women farming in Abia State in agricultural production. Involvement of women has also contributed immensely to the increased yam production observed in the country (Aniedu, 2006). Adekaye (1999), reported that the female farmers now constitute the majority of smallholders (the core of agricultural sector), provide most of the agricultural labour, manage many farms on a daily basis and are frequently the head of the household. Saito and Spurling (1992), observed that women work more hours than men regardless of their season, both in farming and non-farming activities. They reported that in spite of the significant roles of the female farmers in the third world countries. Their level of productivity is constrained because agricultural production has been designed in such a fact that the farm managers are men. This is why most policies aimed at making agricultural production or agro-technologies inputs accessible to female farmers in Nigeria were actually directed towards men. This situation has been attributed to gender insensitivity to agricultural development (Onunka, 2011).

The production of vegetables such as African eggplant in south eastern Nigeria is gradually but steadily gaining prominence in the farming system of the area. African eggplant is one of the important vegetables produced in the south-east agro-ecological zone of Nigeria. A lot of work has been done on the level of production of this crop (Kalu, 2007; Akinpelu and Ogbonna, 2007; Nworie and Agbaraevo, 2002; Onunka, 2011). What have not been established or known are the factors affecting of the farmers (female farmers) that produce the vital crop (African eggplant), considering the importance of African eggplant as cherished delicacy, snacks and vegetables in likelihood of farm households in the study area. It is, therefore, expedient to examine the factors affecting female producers of the crop in the state. Hence, the main objective of this study is to examine the factors affecting female farmers that produce African eggplant in Abia State, Nigeria.

METHODOLOGY

The study was carried out in three (3) agricultural zones of Abia State. Abia State is one of the nine States of South East Agro-ecological zones of Nigeria. The name ''ABIA" is an acronym formed from the initial letters of four groups of people; Aba, Bende, Isikwuato and Afikpo (now in Ebonyi State). Abia is bounded in the South by Rivers State, Southeast by Akwa-ibom, sharing boundaries in the North-east with Cross-River State while, in the West and North with Imo, Anambra and Ebonyi States respectively. Abia State is located between latitude $4^{o}.49^{1}$ N and $6^{0}.47^{1}$N of equator and longitudes 7^{o} and 8^{o}E of the Greenwich meridian. The annual rainfall ranges from 1600mm-1700mm, distributed from February to December and mean temperature of 27^{0}c all through the year, highest from February- April (NRCRI, 2006). Abia has land area of 7,627.20 square kilometers, with a population of over 2,883,999 made up of 1,434,193 (55%) males and 1,399,806 (45%) females (NPC, 2006). The population is made up of different occupations but majority of the people are involved largely in agricultural activities which are done at small-scale levels. The farmers cultivate both food (yam, cassava, maize, vegetable etc) and cash crops (oil palm, cocoa, rubber, cashew etc).

The sampling technique was multi-stage random sampling procedure. Structured questionnaire was used to obtain necessary data from the respondent four (4) blocks were selected from each zone and one(1) circle from each block making a total of 12 circles in the state. Subsequently, ten (10) African eggplant female farmers were randomly selected and interviewed with structured questionnaire from each circle and a total of 120 female farmers. Both descriptive (simple percentages, tables etc) and inferential (Tobit model) were used. Tobit was used to estimate the value of Y, as a function of a set of explanatory variables (X). The dependent variable (Y) is the level of quantity produced by the farmers which is censored at zero. To avoid the censoring bias that other tools like Ordinary Least Squared could generate, a Tobit procedure is used because, quantity produced by female African eggplant farmers , use smaller than zero, was not observed. Holloway et al (2004) pointed out that even when a Tobit procedure is used, incorrectly assuming that the true point of censoring in the sample is zero also imparts a bias to the parameter estimates (Okoye et al, 2009)

The variables used in the analysis of factors affecting female farmers and the quantities produced with Tobit model includes;

Y = F(x_1,x_2-----------------x_{14} ei)

Y = Total quantity of African eggplant produced by female farmers (kg).

β_1 = Parameters estimated.

X_1 =Age (in years)

X_2 =Marital status (dummy variables, married = 1, otherwise =0).

X_3 =Education status (years)

X_4=Farming experiences (dummy variables, experience=1, not experience=0

X_5=Farm size (hectare)

X_6=Type of farmer (dummy variable; full time=1, part time=0)

X_7=Wage of labour (#)

X_8=Access to credit (dummy variable; access=1, no access=0)

X_9=Quantity of fertilizer (kg)

X_{10}=Quantity of pesticides (lit)

X_{11}=Access to planting materials/seedlings (dummy variables; access=1, no access=0)

X_{12}=House hold size (in number)

X_{13}=Co-operative membership (dummy variables; membership=1, no membership=0)

X_{14}=Extension visit (dummy variables; yes=1, no=0)

ei=error term

RESULTS AND DISCUSSION

Table 2 revealed that estimated results of the Tobit model out of the fourteen independable variable estimated with Tobit model, four (years of experience , Planting material, Quantity of fertilizers and Pesticides) were positively significantly 1% and 5.0% levels in explaining the socio-economic characteristics of female farmers and quantity of African eggplant produced.

The X value (123.58***) was highly significant at 1% level of probability indicating goodness of fit (table two). Year of farming experience (X_5) and planting material (X_7) indicates a positive sign. This suggests that the increase in the year of experience of farming African eggplant by the female, the increase in the production. Also source of planting material is necessary for the production of African eggplant for increased yield .

Table 1 further showed that quantity of fertilizers X_{10} and pesticides used in the production of African eggplant increase the output of the female farmers. This is an indication of the importance of manure for growth, flowering and fruiting of the crop. Ironkwe and Ewuziem (2010) noted that fertilizer is an important production resort and also an improved technology when applied in the right proportion, will help to increase output of the farmers. On the part of quantity of pesticides used, it implies that for increase output of African eggplant, means an increased quantity of pesticides used. This is because *Solanium gilo* production is faced with several pests and diseases in the state. Maraizu (2007) noted some African eggplant pests (fruit borer, boll worm and leaf eating caterpillar) and diseases (soil born fungi) and recommended some chemicals for controlling them.

CONCLUSION AND RECOMMENDATIONS

The study on factors affecting female farmers in the production of African eggplant in Abia State revealed that year of farming experience, availability of planting materials, fertilizers and pesticides were important in increased production of African eggplant by female farmers in Abia State. It, therefore, recommended that policies be formulated that would make improved seed, fertilizers and pesticides available and affordable to farmers on time. This will go a long way to increase the production of African eggplant by female farmers in the state.

Table 1: Tobit Model estimating factors affecting female farmers and quantity of African eggplant produced in Abia State.

Variables	Parameter	Coefficient	Std error	t-ratio
Intercept	Bo	100.3798	110.161	0.91
Age	X_1	-1.08162	9366167	-1.15
Marital status	X_2	-4.409335	31.51462	-0.14
Household size	X_3	6.599105	4.639802	1.42
Educational status	X_4	1.189505	2.909145	0.41
Year of experience	X_5	0.6763003	2.172729	0.31**
Type of farmers	X_6	8.460797	19.38062	0.44
Planting material	X_7	7.06397	28.55939	0.24**
Co-operative society	X_8	-7.769998	5.795952	-1.34
Credit	X_9	0.2222155	17.07774	0.01
Qty of fert/bag	X_{10}	0.2351006	0.0970162	2.42***
Qty of pest/lit	X_{11}	0.0339131	0.0143636	2.36***
Extension visit	X_{12}	1.020251	16.12821	0.06
Farm size/ha	X_{13}	258.2968	42.97135	6.01
Labour	X_{14}	0.05049	0.1121908	0.45
X^2	123.58***			
Log likelihood	311.67752			
Pseudo R^2	0.1654			
Total sample	**120**			

Source: computed from STATA 8A Tobit results/survey 2014.Significant levels at 1.0% and 5.0%.

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ECONOMIC ANALYSIS OF GROUNDNUT PROCESSING AMONG WOMEN IN KACHIA LOCAL GOV ERNM ENT AR EA OF KADUNA STATE, NIGERIA

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ABSTRACT
The study examined the economics analysis of groundnut processing among women in Kachia LGA of Kaduna State. Data were collected from a random sample of 70 groundnut processors. The instrument used for the data collection was the questionnaire. It focused on the relationship between input and output and the efficiency of resource-use in groundnut processing. The data were analyzed using production function and resource use efficiency model. Double-log production function was chosen as the lead equation based on the high value of coefficient of multiple determinations (R^2), the numbers of significant coefficient, appropriate signs and the fact that cobb-Douglas production function explains the production theory better than the other functional forms. The estimated coefficients were further used in computing the resource use efficiency. The result shows the coefficient of multiple determination R^2 of 0.748 implying that 25% of the variation in groundnut processing output was accounted for by the inputs included in the model. The study also revealed that MVP of labour, groundnut seed and firewood is less than (<) the MFC. On the other hand the MPV of purchased input is greater than (>) its MFC. This indicates that purchased inputs are under-utilized in the study area. The underutilization of the purchased inputs might be due to improper management practices. It was recommended that conducive environment should be provided to both the producers and processors for sustainability of production and processing levels and to help in using resource efficiently for the attainment of prominent quality of the products.

Keywords: Groundnut Processors, Efficiency Analysis and Production Function

INTRODUCTION

Groundnut *(Arachis hypogea L.)* otherwise called peanut, monkey nut, gobber pea and arachide belongs to the family legumenosea. It is cultivated for its kernels, oil and hay for livestock. The crop is an important source of vegetable oil and supplementary feed for livestock. Oil from groundnut forms a staple part of the diet for many people and the world over. About 40% of the world yield of groundnuts is processed to oil which has a multitude of domestic and industrial applications. The popularity of groundnut oil arose from its attributes like palatability, inability to absorb odours easily like other cooking oils and it does not smoke [1].It is usually used for cooking, for making margarines, for pharmaceutical and cosmetic products as well as a lubricant and emulsion for insecticides [3].The pressed groundnut cake containing 40-50% proteins is mainly used as a meal for poultry feed and the haulms of the crop, reported to be more nutritious than the gross hay, are used to feed livestock in many countries [3]. Groundnut cake is often deep fried or dried to make a snack locally called kuli-kuli. Groundnut flour is used as an ingredient in soups, sweet, confectionaries and puddings. It is rich in oil and protein and has a high energy value.

According to [2] women produce between 60-80% of the food in most developing countries and are responsible for more than half of the world's food production. More so, not only do women produce agricultural products, but they are of key importance in their processing and marketing. Today, rural women are not only obliged to attend to all the household chores, children welfare, nutrition and family cohesion along with farm work but are often desperately driven to adopt a survival strategy to save the household food security from total collapse by supplementing agricultural production with off farm agricultural related activities such as agro-processing. In Nigeria, the processing of groundnut into various products is mostly done by women either for home consumption or for commercial purposes [5]. The most commercial products of groundnut are: groundnut oil, groundnut cake and fried peanut which are sold at market place or hawked on the streets, [6]. The processing of groundnut is a source of income and employment to a large proportion of rural women in northern Nigeria. In Nigeria despite women's pivotal position in agricultural development the significance of their contributions in agricultural production, processing as well as in household food security is often poorly understood and under-estimated [2]. As a result, few specific policies exist to enhance the rural women's access to education, means of production and other services necessary to integrate them in the mainstream rural development programmes. The bulk of oil produced from groundnut in Nigeria is locally produced using traditional methods. The source of raw materials is mainly the local market with hardly any processor growing his own nuts. The demand for edible oil has increase worldwide due to population growth, rising standards of living as well as consumer preferences arising partly from health consideration [7].Therefore, main objective of the study is to analyze the economics of groundnut processing among women in Kachia Local Government Area of Kaduna State, while the specific objective are to: determine the relationship between groundnut processing output and other variables of production; determine the resource-use efficiency of groundnut processing in the study area.

M ETHODOLOGY

The study was conducted in Kachia Local Government Area of Kaduna State. It has a land mass area of 4,632 kilometers square and has an estimated total population of 309,435 in 2014(NPC,2006).It has a Longitude 7^0 45^1Eand $8^0 40^1$E and Latitude 9^0 25^1N and 10^0 20^1N North. The area has a temperature climate of 10^0C while the rainfall distribution ranges from 550-900mm raining season. Crops cultivated include: Ginger, maize, groundnut, soya beans, millet and guinea corn.

A purposive random sampling technique was conducted in four (4) district of Kachia Local Government Area where groundnut processing was prominent. The four (4) districts are: GidanJibir, GidanMana, Bahago, and Gumel. The primary data in the study were obtained from 70 groundnut processors. This structured questionnaire was used to collect data from the processors during 2014/2015 season. Data were analyzed using production functions and resource use efficiency.

MODEL SPECIFICATION

Production Function

This tool was used to know the nature of production process and resources use efficiency in groundnut processing in the study area. In implicit form, the model is presented as follows:

$Y = f(X_1, X_2, X_3, X_4 \ldots\ldots Xn, e)$

Explicit form of the model can be expressed as follows:-

$\text{Log } Y = b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4$

Where Y = Groundnut processing, X_1 = Cost of equipment's, X_2 =Labour (man/day), X_3 = Groundnut seeds (kg), X_4= fire wood (kg), bo = constant ,e = error term, b = regression coefficient

Resource use Efficiency

This tool was used to determine resource use-efficiency of some of the inputs used by the farmers. It is determined by calculating the ratio of the marginal value product (MVP) to the marginal factor cost (MFC). The MVP is calculated from the respective regression coefficients using the appropriate formula depending on functional form, while the market price of one unit of the input is the MFC.

$$r = \frac{MVP}{MFC}$$

Where r = Efficiency ratio ,IF = r = 1, resources, employed by the farmer are efficiently utilized, r> 1, resources employed by the farmer are under-utilized, r< 1, resources employed bythe farmer are over utilized

$MVPx_1 = MFC = Px_i$

Where

$MVPy_i = MPPx_i .Py$

$MFC = UFC = Px_i$

Px_i = unit price of extra variable input x , Py = unit price of output, MPPx = marginal physical product of input x_i, MVP = marginal value product of output ,MFC = marginal factor cost ($\Delta TC/\Delta x_i = Px_i$).

RESULTS AND DISCUSSION

Production Function of Groundnut Processing in the Study Area

Double-log production function was chosen as the lead equation based on the high value of coefficient of multiple determination (R^2), the numbers of significant coefficient, appropriate signs and the fact that cobb-Douglas production function explains the production theory better than the other functional forms. The estimated coefficients were further used in computing the resource use efficiency. The result in table 1 shows the coefficient of multiple determinations R^2 of 0.748 implying that 25% of the variation in groundnut processing output was accounted for by the inputs included in the model.

Labour: This variable has a positive coefficient (0.1897) and significant at 10% probability level. This implies that an increase use of labour will lead to increase in output. This agrees with [4] in a title of resource use efficiency in groundnut processing in Sokoto State. **Seeds**: This variable has a positive coefficient (0.759) and significant at 1% probability level. This implies that an increase use of seeds will lead to increase in output. This agrees with [4]. **Firewood**: this variable has a positive coefficient (1. 6176) and significant at 5% probability level. This implies that an increase use of firewood will lead to increase in output. This agrees with [4].

Resource use Efficiency of Groundnut Processing in the Study Area

From the table below, the MVP of labour is less than (<) the MFC. This indicates that labour is over-utilized in the study area. This can be attributed to the surplus family labour available to small-scale groundnut processors in the study area. Also the groundnut seeds and firewood were over-utilized. On the other hand, the MVP of purchased inputs is greater than (>) its MFC. This indicates that purchased inputs are under-utilized in the study area. That is more purchased input need to be used. The under-utilization of the purchased inputs might be due to improper management practices.

CONCLUSION AND RECOMMENDATIONS

The study revealed that groundnut processing in Kachia LGA were not efficiently utilized because most input were over-utilized and under-utilized. It is therefore economical for processors in the study area to reduce the amount of all their resources in their processing and also have proper management practices.

Table 1: Double-log production function result for groundnut processing in Kachia Local Government Area

Variables	Regression coefficient	T-values
Constant	5.920	8.092
Cost of equipment's	0.0066	0.278^{ns}
Labour	0.1897	1.872***
Seeds	0.759	10.141*
Firewood	1.6176	2.391**

$R^2 = 0.748$

F –value = 14.43,* = significant at 1% level, ** = significant at 5%,*** = significant at 10%,Ns = not significant

Table 2: Resource use Efficiency of Groundnut Processing

Resources	MVP	MFC	$MVP/_{MFC}(r)$
Labour ($\times_1$)	126.67	335	0.378
Purchased input ($\times_2$)	221	192.0	1.151
Groundnut seeds($\times_3$)	1408.43	1419.5	0.992
Firewood($\times_4$)	9.532	22.15	0.4304

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ANALYSIS OF CASSAVA PRODUCTION ACTIVITIES OF YOUTHS IN UMUAHIA NORTH LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA

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ABSTRACT
The study analyzed the production activities of youths in Umuahia North Local Government of Abia State, Nigeria. A multi-stage random sampling technique was used to select a sample size of 120 respondents. Data were collected using a questionnaire and were analyzed with descriptive statistics such as frequency and percentages. The result indicated that cassava production activities that the youth participated most in were weeding operations (95.8%), planting of cassava cuttings (85%) and harvesting (83.3%). Food security (62.5%) and poverty reduction (70.8%) are the major reason for youth's participation in cassava production. There is therefore, the need for government at all levels to be involved in enlightenment campaign to encourage the youths to see cassava production as a good venture.
Keywords: Cassava, production activities, youths, Umuahia

INTRODUCTION

The agricultural sector in Nigeria has witnessed a considerable high level of evolution within the last three decades. This was occasioned primarily by the desire to increase food production in order to enhance self sufficiency and empower the rural youth economically. Nigeria as a developing country has to develop its agriculture, if it is to be reckoned with, within the committee of nations. There is a decline in agricultural production because there is apparent shift of interest from agriculture to the white-collar jobs such as medical practices, pharmacy, teaching, accountancy and engineering, especially among the youths (Torimiro *et al*., 2008).

Youth in Nigeria may be categorized as young men and women between the ages of 13 and 30 years. This is based on the fact that in Nigeria, the expected age of entry into secondary education or vocation apprenticeship training is 13 years and this generally serves as the entry age into the youthful fold. The National Youth Service Corps (NYSC), that was established in 1973 in Nigeria, with the aim of promoting cultural integration by enlisting graduates from higher institutions to undergo a compulsory one year of service to the father land, was also on this premise. One of the regulations of the scheme stipulated that anybody above the age 30 years is not eligible to participate in the scheme. In addition, National Youth Entrepreneurship Summit (NAYES) (2008) defines youth from the age of 14 to 30 with an extension of up to 35 years. World Bank (2006), estimates that about 55 percent of youths reside in rural areas but that this figure is as high as 70 percent in sub- Saharan Africa and South Asia.

Over the years, there has been an advocacy campaign to get the youths more involved in agriculture. Among the agricultural activities the youths can get themselves involved in, is cassava farming or cassava production.

Cassava *(Manihot esculenta)* production is one of the ways to enhance agricultural production and consequently improve the socio-economic well-being of a community, state, nation, and the world at large. Cassava is one of the world's most important food crops. Nneoyi *et al*, (2008) show that cassava accounts for about 70% of the total calories intake of more than half of the population of Africa. Arega, *et al* (2013) confirm this fact by saying that cassava has become the most important root crop in tropical Africa providing food for over 200 million people. In Nigeria, as in most developing countries, it is also one of the most important carbohydrate sources. According to Nweke (2002) in Arega *et al* (2013) eighty percent of Nigerians in the rural areas eat a cassava meal at least once a day; hence it plays a major role in the country's food security.

The high consumption of cassava in the country, led to an increase in the demand for this crop both for food and industrial uses, which exceeds the supply (Odigbo, 2005). Cassava produces acceptable yields on poor depleted soils where other crops will yield virtually nothing; therefore it can be used to take advantage of marginal soils (Alabi and Alabi, 2002). Almost all the cassava produced is used for human consumption and less than 5% is used as industrial raw materials (Ajayi and Onuche, 2005).

Among the problems of cassava production is the aging of cassava farmers (Okezie and Kosikowski in Tonukari, 2004). The current state of cassava production in Nigeria has put a lot of pressure on production of cassava. The Federal Government of Nigeria constituted a presidential initiative on cassava production and export aimed at raising the production level of cassava to 150 million metric tons by the end of 2010. The programme is also expected to assist the country realize an income of US$5.0 billion per annum from the export of 37.6 million tons of dry cassava products such as starch, cassava chips, adhesive and other derivatives. Apart from local demand, there is a high demand for cassava based products in foreign countries. However, the current supply of the cassava has not been able to satisfy foreign market demand (IFAD and FAO, 2005).

Efforts geared towards effectiveness and sustainability of Cassava Production has been without the youths, who should continue, after the adults are gone. Ekong (2003) noted that the youths who have the energy to take up cassava production do not believe or have the knowledge that cassava production can really be a profitable venture. The current challenges in development are so demanding that only the participation of people who are energetic, creative, innovative, productive, and are committed could bring development, should they all be mobilized (Solanke, 2004). These attributes which are critical to growth and development are substantially discernible in the youth. Thus, they constitute the major resource base for any country that wants to embark on any meaningful agricultural and rural development.

Cassava production is labour intensive; this is worsened by scarcity and high cost of hired labour especially when there is need to expand cassava production beyond subsistence level. Incorporating youths into cassava production will facilitate capacity building and empower them for agriculture sensitivity. This will predispose them to a favourable attitude and future career in agriculture especially in developing countries like Nigeria, with high rate of unemployment. This unemployment for the youths is causing a lot of problems like youth restiveness, armed robbery among others vices. Without this, any withdrawal of the aged farmers from cassava production could endanger food security since cassava products form one of the major staples of Nigerians. Therefore, youths need to be encouraged and their interest in agriculture aroused at the International, National, State and Local Government levels.

Studies in the past had concentrated on examining how to harness youths potentials in agriculture (Nnadi and Akwiwu, 2008; Adesope *et al.*, 2007); factors influencing their involvement in cassava production (Adebisi, Owolade and Jatto (2015); preference to agricultural discipline, value addition, marketing (Ugwoke *et al.*, 2005). None has actually investigated cassava production activities of youths, based on the premise; this research work is anchored on. This work addresses the following objectives:

1. ascertain cassava production activities of youth in the study area;
2. ascertain the reason for youths involvement in cassava production in the study area;

METHODOLOGY

The study was carried out in Umuahia North Local Government Area of Abia State, Nigeria. Multi stage sampling techniques was used in the selection of 120 respondents. In the first stage, three autonomous communities were selected, in the second stage two villages were randomly selected from each autonomous community. In the third stage, twenty youths were randomly selected from each village. This gave a sample size of one hundred and twenty respondents for this work. Data was collected using questionnaire, and analysed using descriptive statistics such frequency, and percentages.

RESULTS AND DISCUSSION

Cassava production activities of youths in the study area

Cassava production involved several activities ranging from land clearing, sourcing of the planting material, stumping, soil tillage, planting of the cassava, weeding operations, fertilizer application, and harvesting etc. the youths participates in different activities of cassava production. The Table 1 shows activities which youths in the study area participate in.

The result in this Table revealed that majority (95.8%) of the youths carried out production activities in weeding operation; planting of cassava cuttings (85%), 83.3% were involved in harvesting of cassava tubers (83.3%) and 62.5% were involved in fertilizer applications. Only 16.7% of the respondents participated in supply of planting materials, 18.7% in storage of processed cassava products, and (25.8%) in soil tillage. This implies that youths are actually participating well in cassava production in the study area. The result is in line with Adebisi, Owolade and Jatto (2015) who reported high percentages of youth participation in cassava production in Oyo State.

Reasons for youth involvement in cassava production

The result in Table 2 shows that majority (70.8%) of the respondents were involved in cassava production as a means of poverty reduction. In a similar vein 62.5% choose cassava production as a means of food security. Also the entries in Table 2 shows that 59.2% choose cassava production as a source employment opportunity, and 56.7% agreed that it was for profit/income. With this result, it can be inferred that the major reasons why the youths participate in cassava production in the study area were for poverty reduction, food security, employment opportunity and for profit and income. This means that cassava farming offers benefits such as employment opportunities, food security, profitability and poverty reduction in the study area. This agrees with Adebisi, Owolade and Jatto (2015) concluded that cassava has high potentials for poverty reduction and food security

CONCLUSION

The youths in Umuahia North Local Government Area participate actively in cassava production especially in the areas of weeding, planting of cassava cuttings and harvesting. They are engaged in these activities for the purpose of food security, poverty reduction and income generation. There is therefore, need for government at all levels to be involved in enlightenment campaign to encourage the youths to see cassava production as a good venture especially now that unemployment is a big problem in Nigeria.

Table 1 Cassava Production Activities in the Study Area

Activities	Frequency	Percentages (%)
Storage of processed cassava products	22	18.3
Land clearing	40	33.3
Stumping	40	33.3
Soil tillage	31	25.8
Planting of cassava	102	85.0
Weeding operations	115	95.8
Supply of planting materials	20	16.7
Fertilizer application	75	62.3
Harvesting	100	83.3

Source: Field survey, 2015
Multiple responses

Table 2 Reasons for Youth Involvement in Cassava Production

Reasons	Frequency	Percentage (%)
Food security	75	62.5
Profit/Income	68	56.7
Poverty reduction	85	70.8
Credit acquisition opportunities	36	30.0
Cheap planting materials (stem)	42	35.0
Drought resistant	45	37.5
Employment opportunities	71	59.2
Demand for cassava	40	33.3
Growth on any type of soil	52	43.3

Source: Field survey, 2015
Multiple responses

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ANALYSIS OF INTRA-HOUSEHOLD GENDER REDISTRIBUTION OF INCOME AMONG PULSES PRODUCING FARMERS IN IBARAPA AREA OF OYO STATE, NIGERIA

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ABSTRACT
In line with United Nations declaration of 2016 as International Year of Pulses (IYP), this study tends to key in at the objective three of the declaration that: ''Encourage connections to further global production of pulses''. The study assessed the production of pulse crops among arable crop farmers in Ibarapa area of Oyo State Nigeria. Multi stage sampling procedure was used to select 121 arable crop farmers under the umbrella of All Farmers Association of Nigeria (AFAN). Structured questionnaire was used to collect data on socio-economic characteristics, most cultivated pulse and contribution of most cultivated pulse to household income and intra-household gender redistribution of income. Data were analyzed using descriptive statistics and logit regression model. Results showed that the mean age of the farmers was 51 years. Most (66.9%) of the respondents were male, while 28.8% had no formal education. Almost all (90.1%) of the respondents cultivate one or more pulses as groundnut is identify as most cultivated pulse in the study area. Intra-household allocation behaviour have accumulated evidence that women contributed 39.5% of their income from groundnut to household food security compare to men 22.7% despite their lower income compaere to men. Logit regression showed religion, major occupation, farm size under pulse cultivation and gender peculiarity of the most cultivated pulse to be significantly influenced the adoption/cultivation of the most cultivated pulse (groundnut). The study recommended increased pulse crop production awareness & research, and avoidance of static gender role, but a responsive change in farming system.
Keywords: Pulse, Gender, Intra-household and Income redistribution.

INTRODUCTION
Pulse is the second largest family after *poaceae* earlier known as *Gramineae* in terms of food and vegetable protein source and fodder. (Ali and kumar, 2006). Common pulse crops like soybean, cowpea and groundnut are important legumes grown in virtually all part of Nigeria.
Despite several years of pulses research and diffusion in Nigeria, Nigeria has witnessed spells with upward trends in pulse crop output since 1997(Osho, 2003). This has mainly been attributed to the increased uptake of improved pulse crop varieties and expansion in the area under cultivation. However, the potential productivity level of the crop is yet to be achieved in term of quantity due to degradable cultivation of most pulse crops. In addition, past studies on common pulse crops in Nigeria have also focused on production efficiency (Ousmane B. and Ajeigbe HA. 2009). Therefore, this study is aim at investigating production trend (continuity or discontinuity) of common pulses as a result of substitution advantage over other crops in terms of allocation of resources and other relevant socio-economic variables as a way of explaining production constraints in common pulse crops production in the study area. The main objective of this study was thus to examine factors influencing farmers' adoption of most cultivated or preferred pulse crop cultivation in the study area. Hence, the specific objectives are to: describe the socio-economic characteristics of the farmers in the study area; to determine the contribution of most cultivated pulse to household income and intra-household gender redistribution of income of the most cultivated pulse.

METHODOLOGY
The study was carried out in seven Ibarapa communities of Oyo state. The communities are made up of seven major towns namely; Lanlate, Eruwa, Igboora, Igangan, Idere, Aiyete and Tapa within three local government areas. Primary data was used through structured interview guide to collect responses from the farmers. The sample size for the study was drawn from the study population of All Farmers Association of Nigeria (AFAN) chapters within the selected local government areas using multi-stage sampling techniques. Stage I: Purposive selection of all AFAN members in the three (3) local Government Area covering the seven (7) communities of the of the study area; Stage II: Simple random selection of 50% of the AFAN Chapter covering the seven (7) communities of the study area was to have Ibarapa Central L.G.A and Ibarapa North L.G.A. chapter, with registered members of 535 and 670 farmers respectively. In Stage III, stratified random selection of 10% of the AFAN members in the two (2) selected chapters was used to have 54 farmers from Ibarapa Central L.G.A. chapter and 67 farmers from Ibarapa North L.G.A. chapter. Data

collected was analysed using descriptive statistical tools such as percentage and inferential statistical tools such as logit regression analysis.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Farmers

The results in Table 1 revealed the mean age of the farmers to be 51 years. Thus, many of the farmers were agile and able bodied characterized with strength. This reason may account for why respondents cultivate various arable crops, including the area of research (Pulses crop) and indirectly contribute to nutritional and socio-economic characteristic of the respondents. Majority (66.9%) of the respondents were male, while 33.1% were female. Some (28.9%) of the farmers had no formal education. Therefore, it can be said that introduction of new ideas and adoption of innovations and technology in the study area will be relatively fall in the hand of the laggard. Most (52.1%) were farmers, 9.1% of the respondents engage in various artisan works as their major occupation. Nearly all (90.1%) of the respondents cultivate one or more pulse crops in the study area, peculiar to their environment, ranging from soya bean, groundnut, cowpea and pigeon pea. The most cultivated pulse or the most preferred pulse in the study area is groundnut with percentage cultivator of 35.5%. Cowpea follows with percentage of 22.3%, pigeon pea is really cultivated by the respondents with 13.2% respondents**.** The peculiarity of the most preferred or most cultivated pulse is considered as men cash crop; while women in the production were confined to the cultivation of other crops with percentage of 73.6%. Furthermore, 86.8% of the respondents claim to regard the most cultivated pulse as family enterprise where men do certain tasks and the women engage in processing. The mean cost of production per hectare by the respondents in the study area was estimated to be N26, 355. Furthermore, mean income per hectare in the study area was estimated to be N63, 836. This reveals the profitability of groundnut production in the study area.

Distribution of Respondents by the Contribution of most cultivated pulse (Groundnut) to Household income and Intra-household Gender Redistribution of Income.

Table 2 presents the results of the contribution of income of groundnut and intra-household income redistribution. It was found that groundnut was profitable to farmers in the study area. Mean groundnut cash income was ₦43,252 for men compared to ₦19, 472 for women. Farmers within Ibarapa North obtained a higher income than farmers in Ibarapa Central, and men had a significantly higher income than women. Nevertheless, women in Ibarapa North had a higher income than men in Ibarapa Central. Since, income from groundnut often came in one lump-sum payment and sold at once after threshing or sold directly. In 2015, for instance, a bag of groundnut (120kg) was sold at ₦25,000. A farmer in Ibarapa Central who earned up to ₦100,000 from groundnut claimed proudly that *''I got so much money from just one harvest of groundnut''*. Intra-household allocation behaviour has accumulated evidence that women's contribution (39.5%) to household food security, nutritional status, health, and welfare of children is of prominent, compared to men (22.7%) despite their lower income compere to men. The findings of this study showed that substantial proportion of women income from groundnut was redistributed into family expenditure a traditionally male responsibility. This finding provide further empirical evidence that women in the study area are actively involved in cultivation of cash crops, and that they earn a substantial share of their income from cultivation of marketed crops, such as groundnut and redistribute their earning into the welfare of the household.

Factors Influencing Farmers' Adoption/Cultivation of Most Cultivated Pulse Crop in the Study Area

The empirical model used to assess these factors or varietal characteristics motivated farmers to adopt or reject the production of pulses in the study area was logit regression model. The model used, integrates only the farmers' socio-economic characteristics and the institutional variable of most cultivated pulse (groundnut) in the study area. Results of the logit model analysis are given in Table 3.

Among the farmers' socio-economic characteristics that were considered; religion, major occupation, farm size under pulse cultivation and gender peculiarity of the most cultivated pulse (groundnut) of the farmers' were significantly related to the adoption/cultivation of the most cultivated pulse (groundnut). The adoption based on religion of the farmers' can be explained by the culture of the people in the study area, as it plays a significant role in adoption process. Groundnut was stated to be culturally preferred and cultivated in the study area. Also, farmers' major occupation was negatively related to adoption. This can be explained in line with alternative means of livelihood of the people in the study area, a slight or more tensed move to their minor occupation may cause decrease in cultivation of most cultivated pulse (groundnut). Furthermore, farm size under pulse cultivation was of paramount importance since there is better contribution to the farmers' income. The differential adoption in cultivation based on gender peculiarity of the most cultivated pulse as specified in the study area opined that ''the most cultivated/preferred pulse is considered as men cash crop, while women were confined to the cultivation of other crops''. This can be explained by gender biases in technology diffusion. Women farmers are not traditionally targeted by extension agents and research and development activities. Innovations are often introduced to heads of households, the majority of whom are men. Thus, access to innovation or information on such innovations is more restricted for women than for men. The implication of this finding is that greater efforts will be needed to close the gender gap in access to, and use of, improved technology. This is important in view of the role of groundnut in intra-household income redistribution, food security and nutrition, and in improving soil fertility in the study area.

CONCLUSION AND RECOMMENDATION

It can be concluded from the results of this study that the most cultivated pulse or the most preferred pulse in the study area is groundnut. Secondly, religion, major occupation, farm size under pulse cultivation and gender peculiarity of the most cultivated pulse (groundnut) of the farmers' were significantly related to the adoption/cultivation of the most cultivated pulse (groundnut). Lastly, the study provides evidence that groundnut production had a positive impact on farmers' income accounting for about half of the total farm income for men as well as women. Hence, women's involvement in groundnut production broadened equity and distributional effect as it was recognized that income in the hands of women contributed more to household welfare, food security, and children's nutritional status.

The study recommended increased pulse crop production awareness & research, and avoidance of static gender role, but a responsive change in farming system.

Table 1: Socio-Economic Characteristics of the Respondents

Characteristics	Percentage	Mean
Age[Years]		
20-30	7.4	
31-40	19.0	
41-50	26.5	
51-60	23.1	
61 above	24.0	**51**
Sex		
Male	66.9	
Female	33.1	
Level of Education		
No Formal Education	28.9	
Adult Education	7.4	
Primary Education	27.3	
Secondary Education	21.5	
Tertiary Education	14.9	
Major Occupation		
Farming	52.1	
Civil Service	19.0	
Trading	19.8	
Artisan	9.1	
Pulses Cultivation		
Yes	90.1	
No	9.9	
Most Cultivated Pulse		
Groundnut	35.5	
Soybean	19.0	
Cowpea	22.3	
Pigeon Pea	13.2	
Farm Size [Ha] under pulses Cultivation		
1-5	65.3	
6-10	19	
11-15	3.3	
16 above	2.5	**4**
Quantity Produce/120kg Bag		
1-10 bags	75.2	
11-20 bags	12.4	
21-30 bags	2.5	**6.3 bags**
Cost of Production/ Ha		
5,000-20,000	43.8	
21,000-50,000	33.1	
51,000 above	13.2	**₦26, 355**
Income on Production/Ha		
20,000-40,000	38.9	
41,000-60,000	31.4	
61,000-80,000	4.9	
81,000-100,000	4.1	
101,000 above	8.3	**₦63, 836**
TOTAL	100	

Field Survey, 2016

Table 3: Contribution of Most Cultivated pulse (Groundnut) to Household Income (Naira per year, 2015 harvest) and Intra-household Gender Redistribution of Income on Groundnut in Ibarapa Area of Oyo State, Nigeria

	Ibarapa North L.G.A(High cultivation area)		Ibarapa Central L.G.A (Low cultivation area)		Total		
	Men	Women	Men	Women	Men	Wome n	Total
	n = 48	n = 19	n = 33	n = 21	n = 81	n = 40	121
Mean groundnut income	59,316	23,392	27,188	15,553	43,252.	19,472	62,727
Mean groundnut income redistribution*	14,829	9,356	5,437	6,065	10,133	7,710	17,843
Percent income of groundnut redistribution	25.4	40.0	20.0	39.0	22.7	39.5	62.2

Source; Field Survey, 2016
*Amount of money in Naira that farmer gives to his wife or her husband from the sale of groundnut; n = number of respondents

Table 4: Logit model analysis of factors influencing the adoption or cultivation of the most cultivated pulse in the study area

Variable	Coefficient	S.E	Wald	p-value	Exp. (B)
Age	-.068	.066	1.074^{NS}	0.300	.934
Sex	.215	1.081	.039^{NS}	0.843	1.239
Marital Status	1.381	1.580	.764^{NS}	0.382	3.977
Household Nature	-.779	1.373	.322^{NS}	0.570	.459
Household Size	-.036	.180	.040^{NS}	0.842	.965
Religion	3.834	1.496	6.565*	0.010	46.257
Educational Level	.042	.548	.006^{NS}	0.939	1.043
Minor Occupation	-.767	.764	1.008^{NS}	0.315	.464
Major Occupation	-1.397	.804	3.021***	0.082	.247
Farming Experience	.070	.063	1.231^{NS}	0.267	1.073
Source of Labour	.370	.564	.429^{NS}	0.513	1.447
Farm Size Under Pulses Cultivation	-.274	.163	2.827***	0.093	.760
Quantity Harvested	.160	.137	1.365^{NS}	0.243	1.173
Cost of Production	.000	.000	.003^{NS}	0.954	1.000
Amount Realized from Sales	.000	.000	.516^{NS}	0.472	1.000
Gender peculiarity of the most cultivated pulse	6.097	3.131	3.793***	0.051	444.478
Constant	-1.117	7.576	.022	0.883	.327

Source: Field Survey, 2016
Note: * indicate significance at 1% level
***** indicate significance at 10% level**
NS indicate Non-significance

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EFFECT OF TIME USAGE PATTERN ON RURAL WOMEN POVERTY STATUS IN OYO STATE, NIGERIA

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ABSTRACT
This study deals with analysis of time usage pattern on rural women poverty status in Oyo state. Simple random sampling technique was used to select 120 respondents which comprises of rural women from two Agricultural zones (Ibadan/Ibarapa and Oyo). Descriptive statistic was used to describe scoio-economic characteristics of the respondents, Time diary was employed to know their daily time usage pattern and Probit regression (PR) was used to determine the effect of daily time usage pattern on the respondents' poverty level. The studies revealed that majority (42.7%) of the respondents are farmers with mean household size and farm size of 5 years and 3 hectares respectively. All of them spent the hours of 12am – 5am sleeping, about 60% of them spent the hour of 8am – 4pm attending to their economic activities only (such as farming, hawking, marketing and civil servant) while about 80% of the rural women in the study area spent the hours of 4pm – 6pm attending to housechore work and relaxing. The result of PR revealed that rural women time usage pattern between 12am - 5am and 8am - 12noon, age of the respondent, household size and educational level were statistically significant to their poverty status. In conclusion, educational level and age were the most prerequisite for poverty status. Therefore, the study recommendations that non-economic activities should be included in the system of National Account and government should also intenstify its effort at enhancing human capital development through formal education in order to improve their poverty status.
Keywords: Time, Rural, Poverty, women, economic

INTRODUCTION

Inequality is a major challenge to development and an obstacle to achieving the Millennium development goals (MDGs). It takes many different forms, including income inequality, unequal access to and control over property, civil and political rights, and social, cultural, and economic rights. All these forms of inequality possess inherent gender dimensions. One form of inequalities that have received much less analysis but has adverse implication for accessing economic right is that relating to time. The allocation of time between women and men in the household and in the economy is a major gender issue in the evolving discourse on time poverty. Bames (2003) in analyzing the allocation of social roles between men and women, shows first how this allocation leads to time poverty among women, and second how this impact the achievement of the MDGs.

An analysis of "who does what and when" within the normal African household shows that women and girls are responsible for collecting water and firewood, cooking, cleaning, taking care of the children, the infirm and the sick, producing food, and marketing any surpluses. They also dedicate a lot of their time to maintaining social cohesion within the community. All these tasks are considered to be low-status activities unremunerated and unrecognized in the national statistics. Women whose spend all their time performing this task are often considered as "not working".

Poverty as often defined as a deprivation of entitlement through lack of access to economic and social resources as well as to political participation and consultation as a contributor to women's poverty (Blacken, 2002). In Nigeria a study by Onibokun (1996) reveals that the population of households living below poverty line in the four cities of Lagos, Ibadan, Kano, and Onitsha were 63.7%, 62.1%, 35.62% and 87% respectively.

Empirical evidence shows that women participate less in the labour market when employed, they are disproportionately concentrated in unpaid jobs that offer low earnings, as a result of their low skills, burden of household responsibilities and labour market descrimination.(Blacken and Wodon, 2006).

Recent studies found that, even when they have the same human capital and job characteristics as men, women earn on average much less (Bardasi and Wodon, 2005).

Women tend to accumulate both types of work; therefore,they are double burdened and have a higher total work than men. Because women suffer from time deprivation as a result of their multiple roles, they enjoy less leisure time to rest and thereby more likely to be "time- poor". (Bamberger, 2010)

METHODOLOGY

The study was conducted in Oyo State which has its headquarters in Ibadan. The study area covers approximately an area of 28,454km^2 with an estimated population of 5,591,589 people (NPC 2006). It is an inland state in South-Western Nigeria. It bounded in the north by Kwara state, in the east by Osun State and the south by Ogun State.

The study populations were mainly rural women in the study area. Multistage sampling technique was used in selecting the respondent for this study. First stage involved random selection of two (2) zones (Ibadan/Ibarapa and Oyo) from four (4) ADP zones in Oyo state. Second stage involved random selection of two blocks from each block making up the zones (ido and igboora from Ibadan/Ibarapa zone while Offa meta and Iseyin from Oyo zone). Third stage involves random selection of random selection of two active cells each from each zone making 8 cells. Fourth stage involves randomly selection of 15 female from each cell making 120 respondents.

Data for the study were collected from the respondents through the use of pre-test structured interview schedule and time diary. Data were analyzed using descriptive statistics and Probit regression.

Construction and determination of the Poverty Line

Poverty line is the level of welfare which distinguishes poor households from non-poor households (Mukherjee and Benson, 2003)

PCE = TCE/ HHS...(1)

MPCHE = THHE/ TNR...(2)

PL =2/3* MPCHE...(3)

Where:

PCE = Per Capita Expenditure	TCE = Total Consumption Expenditure
HHS = Household Size	MPCHE = Mean Per Capita Households Expenditure
TNR = Total Number of Respondents	THHE = Total Households Expenditure
PL = Poverty Line	

RESULTS AND DISCUSSION

Socio-economic characteristics of the Respondents

The distribution of age of the respondents as presented in Table 1 reveals that most of the respondents (41%) fall between 31- 40 years of age with the mean age of 42 years which shows that majority of the respondents are in their active age and expected to be productive (this was in line with Dipeolu et al., 2009). Also, majority (48.3%) has non-formal education and chose farming with the mean household, farm size and farming experience were estimated at 6 persons, 10 hectares and 8 years respectively.

Time Diary of the Respondents

Table 2 below shows the various time usage pattern of rural women in Oyo State. All of the sample respondents sleep during the hours of 12am to 5am. About 59.0% of the responents were involved in economic activities alone during the hour of 8am to 12noon, 42.5% of the responents engaged in economic activities, leisure, game, relaxing, watching tv or listening to radio between the hours of 12 to 4pm.

Description of variables

A- Sleeping alone
B- Praying, house chores (cooking, care of the kids, bathing, eating)
C- Economic activities, leisure, game, relaxing, watching television or listening to radio
D- Economic activities alone
E- Cooking, house chores, watching television or relaxing
F- Leisure, game, taking care of young, cooking,
G- Relaxing, sleeping

Determinant of poverty line

Total Expenditure of the respondents' households in the study area = ₦6123500/day

Total household size in the study area = 589

Poverty line = ₦58.05/day

Parameter Estimates between daily time usage pattern and their poverty level using Probit model

Probit regression model was used to estimate the effect of daily time usage pattern on the respondents' poverty level. Table 9 below showed the definition and outputs of variables entered into the Probit model. Out of the nine (9) explanatory variables hypothesized only five (5) variables were found to be significant. It reveals that their time usage pattern between 12am to 5am and 8 am to 12noon, age, of the respondent and household size were negatively and statistically significant to their poverty status. This implies that the higher the educational level, the higher they move above the poverty line. It means those women with higher level of education were able to manage their time very well. The study was in line with Ellis (2006) that reported time usage pattern and education have a significant impact on poverty status of dwellers in Africa.

CONCLUSION

The result of the study revealed that most of the respondents were farmers, with average household size of 6 and non-formal education was dominant in the study area. The result of the probit model analysis also relvealed that out of the nine explanatory variables tested to be influencing their poverty status, only five were found to be statistically significant that is the activity between the hours of 12am – 5am, 8am – 4pm, age, household size and their educational level.

Based on the results and conculsion of the study, the following recommendations were made:

i. Non-economic activity should be included in the system of National Account.
ii. There should be human capital development programmes for the women in order to improve their educational level which will improve their poverty status.
iii. Other women empowerment programmes should be organized for the women in order to improve their poverty status.

Table 1: Socioeconomic Distribution of Rural Women

Variables	Frequency	Percentage (%)	Mean
Age			
20 – 30	17	14.2	
31 – 40	49	40.8	
41 – 50	38	31.7	42
51 – 60	13	10.8	
61 years and above	3	2.5	
Educational level			
Non-formal education	58	48.3	
Primary education	41	34.2	
Secondary education	12	10.0	
Tertiary education	9	7.5	
Primary Occupation			
Farming	56	46.7	
Artisan	8	6.7	
Trading	51	42.5	
Civil-servant	5	4.2	
Marital status			
Single	0	0	
Married	108	90.0	
Widowed	12	10.0	
Divorced/Separated	0	0	
Household size			
1-3	14	11.6	
4-6	94	78.4	6
6 above	12	10.0	
Farming Experience(yrs)			
>5	51	38.0	
6-10	20	16.7	9.8
11-15	16	13.3	
More than 15	33	27.7	
Farm size			
>3	53	44.2	
4-6	6	5.0	
6 above	61	50.8	8
Total	**120**	**100**	

Source: Field Survey Data, 2014

Table 2: Distribution of the respondents according to their time usage pattern and activities

Activity	Time	Frequency	Percentage(%)
A	12am – 5am	120	100
B	5am – 8am	120	100
C	12am – 4pm	51	42.5
D	8am – 12pm	69	58.5
E	4pm – 8pm	20	16.7
F	8pm – 10pm	100	83.3
G	8pm – 12am	120	100

Source: Field Survey Data, 2014

Table 3: Probit regression of time usage pattern on rural women's poverty level

Parameters	Coefficient	Z – value
12 to 5	-0.267	-2.614***
5 to 8	-0.146	-1.237
4 to 8	-0.014	-.082
8 to12	-0.070	-2.836***
8 to 4	-0.223	-1.575
Age	0.015	1.982**
Educational level	-0.401	4.744***
Household size	-0.417	-5.467***
Marital status	0.149	0.671
Constant	1.599	0.806
Number of Observation	120	
LR Chi^2	76.78***	
Pseudo R^2	0.612	
Log Likelihood	-67.67	

Source: Field survey, 2014

***significant at 1%

** significant at 5%

* significant at 10%

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ASSESSMENT OF WOMENPRENEURSHIP DEVELOPMENT IN AGRICULTURE AMONG WOMEN CROP FARMERS IN IMO STATE, NIGERIA

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ABSTRACT
The study assessed the level of womenpreneurship development among women crop farmers in Imo State of Nigeria. One hundred and eighty women farmers were selected using multistage random sampling technique. Data collected were analyzed using descriptive statistical tools of means, frequency and percentage. A 3-point Likert rating scale of high, moderate and low was used. Majority of the women (55.6%) were between the ages of 41-50years. Greater proportion of them had secondary education and a good percentage of them (77.8%) are married with a large house hold size of between 6-10, with more than 20 years of farming experience and a farm size of 2 hectares. Majority of the women farmers identified personal intention, self realization, unstable income, training in agribusiness, access to land, wanting autonomy among others as their key drive for wanting to involve in womenpreneurship development in the state. However, the women farmers identified lack of start-up capital, poor access to entrepreneurship information, limited availability of land, poor access to agricultural information among others as their barriers to entrepreneurship development in Imo State. Inspite of all these barriers, the women still showed high intentions to involve in agribusiness activities (X=2.9). Based on the above findings, the study recommended among others that; entrepreneurship education at all levels should be fostered by policy makers to ensure capacity building for diverse enterprises in agriculture.
Keywords: Womenpreneurship development, Entrepreneurship drive, Agribusiness.

INTRODUCTION

The word entrepreneurship is used to describe a dynamic process of creating wealth (Shailesh et al, 2013). Thus, womenpreneurship is a dynamic process of wealth creation through agricultural production by women farmers. This wealth is created by women who take the major risks in terms of time and career commitment of providing values to some products or services, such products or services may or may not be new or unique but value must somehow be added by the entrepreneur by securing and allocating the necessary skills and resources. In other words, womenpreneurship is the application of energy for initiating and building an enterprise by women (Mishra et al, 2010).

Today in Nigeria an entrepreneur is an innovator who recognizes and seizes opportunities, converts those opportunities into workable ideas, adds values, efforts, money, skills and assumes the risk of competition to actualize the ideas and claims the reward. Entrepreneurship and womenpreneurship are used interchangeably in this study since they convey the same concept. Womenpreneurship is associated with innovative and dynamic developments of women within small, micro and medium agricultural enterprises (SMME) sector (United states department of agriculture, (2011) as quoted in Esiobu et al,(2015). Womenpreneurship is a charismatic concept which is widely defined as a creative and innovative response by women to the environment.

Empirical evidence emerging from some studies on entrepreneurship development in agriculture, (Esiobu et al, 2015, Nwibo and Okorie, 2013, Shailesh et al, 2013) among farmers yielded results that are inconclusive and contradictory. Thus,the study on womenpreneurship development in agriculture among women farmer in Imo State is yet to be established. This has created a deep dearth in research, knowledge and literature,. Hence to fill this gap, it becomes necessary that this study was undertaken, specifically the study identified socio-economic attributes of women farmers in the study area, identified their extent of entrepreneurship drive in agribusiness, ascertained the exempt of intention to be involved in crop production in the study area and identified some constraints to womenpreneurship development drive in agribusiness enterprises in Imo State.

METHODOLOGY

The study was carried out in Imo State of Nigeria, Imo State is one of the states in the south Eastern part of Nigeria with Owerri as its Capital. The state lies within latitude 4.45N and 7^o 15'N of the equator and longitude 6^o 50'E and 7^o 25'E of the Greenwich Meridian, with land areas of 5,530 square kilometers (ministry of land survey and Urban planning, Imo State, (2002). The State has an estimated population of about 4.8 million people and an annual growth rate of 3.35 percent. The major activities of the people include; farming, trading agro-business and other entrepreneurial activities. The state is divided into three geo political and agricultural zones of Owerri, Orlu and Okigwe and has twenty seven local government areas altogether. These divisions are for easy administrative and extension contact purpose (Imo ADP, 2010). Multistage sampling technique was used to select 180 respondents for the study. The first stage involved the purposive selection of the three agricultural zones of the state namely; Owerri, Orlu and Okigwe zones to ensure adequate representation of the entire women farmers. The second stage involved the selection of two local government areas from each of the zones giving a total of six(6) local government areas. In the third stage, a random selection of three communities was involved, making a total of eighteen (18) communities. In the final stage, 10 women farmers who engage in agribusinesses were randomly selected and this brought the sample size to 180 respondents. Primary and secondary data were used to collect the data for the study. Primary data were collected through the use of structured questionnaire and was supplemented with oral interview in places where the respondents were semi-illiterate. Descriptive statistical tools such as frequency distribution, means, percentages and a three point Likert scale ratings of highly (3), moderately (2) and low (1) were used for data analysis.

RESULTS

Distribution of Women According to Socio-Economic Characteristics

The distribution of woman farmers according to their socio-economic characteristics is shown in table 1: The result showed that only woman farmers were the respondents 100% and that most of the women (55.6%) were between the age brackets of 41-50 years. This result revealed that the women are still young and in their productive ages. This coincides with the findings of Onwumere, (2008) who stated that enthusiasm and vigor to be productive are found more in youths. The result also revealed that majority of them 69.4% had secondary education, 16.7% had primary education, 11.1% had tertiary education while only 2.8% of them had no formal education. The finding implies that the farmers have basic educational background which is relevant for adoption of innovations and skills in entrepreneurship development. This result supports the findings of Ani, (2007), Chukwu (2013) and Esiobu et al., (2015) who reported that people with higher education attainment are usually faster in adoption of improved farming technologies. The result also revealed that majority of the women farmers are married (77.8%), 11.1% are single, 8.3% are widowed while a minute percentage 2.8% are divorced. This implies that most of these farmers are responsible enough to decide on the best action to tackle their entrepreneurial activities to cater for the food security of their families. The table also showed that most of the women, (78.8%) have large household size with more than 20 years farming experience (83.3%). The implication of this result is that these farmers must have used the large family size to enhance their experience in the farming activities. This is because according to Onyeneke and Esiobu (2012) who asserted that large household size ensures availability of labor for women farmers to address their labor challenges. The distribution of farmers according to their belonging to cooperative societies showed that majority of the women, 88.9% belonged to cooperative society while 11.1% do not belong to cooperative society. This result implies that these farmers should have easy access to entrepreneurship training and development activities in the study area. It is expected that membership of cooperative society will afford the farmers the opportunity of sharing information on modern farming practices and project a collective demand, and enhance their participation in entrepreneurial activities in agribusiness. The result in the table equally revealed that the women farmers have an average annual income of ₦301-400 (68.9), ₦161-200,000, (11.1%), less than ₦100,000, (6.7%) and above ₦400,000, (3.3%). This result showed that the farmers are low income earners in spite of their large family size. This agribusiness entrepreneurship will be reduced because Fairlie, (2005) in his study reported that farmers with higher farm income would be involved easily in entrepreneurship activities than those of their counterparts who have low farm income. The table revealed that majority of the women are full time farmers (55.6%). Others engage in some other occupations such as sewing (10.0%) hairdressing (6.6%) and trading (27.8%). This result revealed that most of these women have farming as their major source of livelihood. This implies that women who have farming as their major occupation will readily. Participate in any agribusiness which will help to enhance their cropping activities and enhance food security for their households. This is in line with Kareem and Akinbile (2015) who stated that full time farmers will have interest in any effort made to transform their system of agricultural activities which they perceive to be genuine. Studies by Esiobu and Onubogu (2014) asserted the large farm size increase crop production and improve farmers' technical, allocative and resources for efficiency. Therefore large farm size is a positive variable for entrepreneurship development in agribusiness

Extent of intentions to involve in agribusiness entrepreneurship

Table 2 displays the women farmer's entrepreneurship intentions in agribusiness. The level of entrepreneurship intention in agribusiness for the study was based on asking the woman about their various levels of drive or intents to involve in agribusiness active as an enterprise. The assessment was rated in three point- Likert scale of high -3 moderate-2 , and low-1, majority of the woman farmers with a mean score (x) 2.83 admitted to have high intentions of involving in agribusiness entrepreneurship x=0.07 and 0.02 were moderate and low respectively in decision to engage in entrepreneurship drive. The finding implies that in spite of the challenges of farm land and poor enabling environment for entrepreneurship activities, the woman farmers still have the motive and drive to engage in entrepreneurship activities, this goes to show that a greater hope for womenpreneurship development in the study area, especially if there is adequate support from the government and non-government sectors.

CONCLUSION AND RECOMMENDATIONS

This study was carried out in Imo state of Nigeria and it basically assessed the level of womenpreneurship development in agribusiness activities among women crop farmers in imo state of Nigeria .Multistage sampling technique was used to select 180 women farmers for the study, reasonable percentage of the women farmers identified personal desire, self-realization, unstable income, access to fund, wanting autonomy and the rest of them as the key drive into agribusiness. However the women farmers identified lack of capital to start up the business, poor access to entrepreneurship information, limited availability to farm land among others as their major barriers to womenpreneurship development in the state.

Table 1: Socio-Economic Characteristics of Women Farmers

Variables	Frequency	Percentages (%)	Mean
Gender-female	180	100	
Age (years)			
31-40	50	27.8	
41-50	100	55.6	
51-60	30	16.16	
Total	180	100	
Educational levels (years)			
No formal education (1)	5	2.8	
Primary (2)	30	16.7	
Secondary (3)	125	69.4	
Tertiary (4)	20	11.1	
Total	180	100	
Marital status			
Single (1)	20	11.1	
Married (2)	140	77.8	
Divorced (3)	5	2.8	
Widowed (4)	15	83	
Total	180	100	
Farming Experience (years)			
Less than 10 years	10	5.6	
11-20 years	20	11.1	
21 years and above	150	83.3	
Total	180	100	
Household size (number of persons)			
1-5	28	15.6	
6-10	142	78.8	
11-15	10	5.6	
Total	180		
Membership of cooperative (yes/No)	160	88.9	
Non-member	20	11.1	
Total	180	100	
Average annual income (naira)			
Less than N100,000	12	6.7	
N101,000-200,000	20	11.1	
201,000-300,000	18	10.0	
301,000-400,000	124	68.9	
407,000 and above	6	3.3	
Total	180	100	
Occupation			
Farming	100	55.6	
Sewing	18	10.0	
Hairdressing	12	6.6	
Trading	50	27.8	
Total	180	100	

Source: Survey Data, 2016

Table 2: Distribution of women farmers according to their extent of intentions to involve in Agro business entrepreneurship

Extent of intensions	Frequency	Percentages (%)	Mean	Remark
High (3)	174	94.5	2.83	High intentions
Moderate (2)	6	3.3	0.07	Low intention
Low (1)	4	2.2	0.02	Low intentions
Total/%/Grand means(x)	180	100	2.92	High intentions

Discriminating index = 2.0 Source: Survey Data, 2016

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GENDER MAINSTREAMING IN AGRICULTURE: CASE STUDY OF FEMALE RICE-FARMERS IN ADAMAWA STATE, NIGERIA

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ABSTRACT

Gender mainstreaming in Agriculture and women empowerment is central to achieving the goal of raising food production and lessen the burden of food insecurity globally. This study was therefore designed to examine the productivity of female rice-farmers in Adamawa State, Nigeria. Primary data were collected from 180 randomly selected female rice-farmers in Adamawa State. The data were analysed using both descriptive statistics, and stochastic frontier function analysis. Socio-economic characteristics of rice-farmers in the area were identified. The result of maximum likelihood estimates revealed that the factors responsible for technical in-efficiency of female rice-farmers include education, farming experience, and access to credit facilities. The technical efficiency ranges between 0.43 and 0.94 with a mean of 0.8.4. It was thus recommended that, government policy should encompasses measures that promote women farmers' access to agricultural resources and services at affordable prices thereby bridging the existing gender gap among rice-farmers in Nigeria.

Key Words: Technical Efficiency, Gender, Rice, Production, determinants

INTRODUCTION

Agriculture in sub-Saharan Africa remains to a large extent a gendered occupation with men and women engaged in role differentiation in all farming processes (Angya, 2008). The report by National Bureau of Statistics, NBS (2014) indicated that the Nigerian agricultural sector grew at 3.68% and contributed 20.89% to the country's real GDP in the second quarter of 2014. However, agricultural output has increased less rapidly than the estimated population growth rate, and this has resulted in increase in food importation. According to FAO (2013) the importation of rice in Nigeria in 2012 stood at a staggering figure of about 2.8 million tonnes as compared with the total imports of about 1.7 million metric tonnes in 2007. Therefore efforts towards increasing local food production in Nigeria should give prominence to the different roles played by men and women in agricultural activities especially in terms of labour supply. Dia *et al. (*2009) emphasized that the pace of agricultural development in the country is closely related to the factors which affect productivity of women labour. Hence, the empowerment of women and other vulnerable groups in the society is the most effective way of reducing poverty and improving food security. According to Ismaila *et al.* (2010) addressing the continuing decline in local food production especially cereals such as rice, millet, maize etc. will entail acknowledging the contributions of the various intra-household units in the overall production outputs. The separate roles of men and women in the development of agriculture must be critically identified so as to achieve meaningful impact on food production in the country. According to United Nations Development Programmes, UNDP (2010) policies and programmes that ignore differential impact on gender groups are often gender-blind and potentially detrimental to human development. Gender equality therefore, requires a focus on results to improve the well-being of poor rural women farmers.

METHODOLOGY

The study was carried out in Adamawa State, Nigeria. Adamawa state is in the North-eastern part of Nigeria. It shares boundary with Taraba State in the south and west, with Gombe State in the North – west and Borno State to the North. It lies between latitude 7^0 and 11^0 North, and longitude 11^0 and 14^0 East (Adebayo and Tukur, 1999). Adamawa State has a land area of about 38, 741 Km^2 and a population of 3,178,950 people comprising of 1,607,270 males and 1,571,680 females (National Population Commission, 2006). The predominant occupations in the state are farming and livestock herding.

Multi-stage sampling technique was used to collect data for the study. Three Local Government Areas were purposively selected based on their high involvement in rice cultivation in Adamawa State. Six (6) wards were randomly selected from each of the Mubi North Local Government and Fufore Local Government; while five (5) wards were selected from Lamurde Local Government to give a sum of seventeen (17) wards, proportionate to the total number of wards in each of the three Local Governments. Hence, one hundred and eighty (180) female farmers were randomly sampled proportionate to the population of female rice farmers in the study area.

The data collected for this research were analysed using Descriptive Statistics. Given the inherent stochastic nature of rice production, the stochastic frontier production function approach was used to assess

RESULTS AND DISCUSSION

Socio-economic Characteristics of Female Farmers

The result in Table 1 showed that mean age of female farmers was about 36years. This implies that most of the female farmers participating in the production of rice in the study area were within the active age group. I also revealed that about 41% of the female farmers acquired no formal education. The result further showed that 62.22% of female rice farmers were married. This shows that the majority of the female farmers were married. Similar result was obtained by Bamiro and Aloro (2013) that more married couples were involved in rice production largely because of high demand for labour. As shown in the table, female farmers in the area had a mean house-hold size of about 7.

Technical Efficiency of Female Farmers

Technical efficiency is the ability to produce a given level of output with a minimum quantity of inputs under certain technology. It represents the ratio of observed output to the corresponding frontier output (Bamiro and Aloro, 2013). The Maximum Likelihood estimates of production parameters for the female rice-farmers are shown in Table 2. The value of gamma (γ) was 0.713 and statistically significant at 1% level indicating that 71.3% of variation in rice output was as a result of the technical in-efficiency of the female farmers. Also, the sigma squared value was statistically significant at 1% level. This implies a good fit of the model used, and that the conventional production function is not an adequate representation of the data. The Likelihood ratio test confirmed the presence of technical in-efficiency in the rice production by female farmers as shown in Table 3.

The result in Table 2 revealed that farm-size, fertilizer, and hired-labour were statistically significant determinants of rice output at 1% level. Family-labour had a significant effect on rice production at 5% level. Farm-size had a significant and positive influence on the output of rice by the female farmers. This implies that the output of rice increases with an increase in farm-size. Ayoola *et al*. (2011) similarly observed that access to adequate farm-land had a significant and positive effect on rice production especially of female farmers.

Moreover, Table 2 showed that the factors which contributed to the technical in-efficiency of female farmers include education, farming experience, and farmer's access to credit facilities. Access to formal education has been observed by previous researchers as an important factor that influence farmer's efficiency (Onu *et al.*, 2000; Adebayo, 2001; Oladeebo and Fajuyigbe, 2007; Onu and Adebayo, 2010; Ahmadu and Erhabor, 2012; Ogunniyi *et al*., 2012). The result suggests that with improvement in education, the technical efficiency of the farmers will be improved.

The study also showed that female farmers tend to be more technically efficient with more years of farming experience. As a farmer's experience increases, so do his skills in optimally allocating the resources at his/her disposal. The more experience a farmer has, the higher the technical efficiency. Similar findings were reported by Ogunniyi *et al*. (2012) and Ayinde *et al.* (2012). Furthermore, the availability of credit facilities was statistically significant at 1% level, and had a great influence on the technical efficiency of the farmers. Bamiro and Aloro (2013) also identified credit availability as having positive relationship with the technical efficiency of rice farmers. The result in Table 4 revealed that the technical efficiency of female farmers ranges between 0.43 and 0.98 with a mean value of 0.84 which implies that on the average, female rice-farmers had the capacity of increasing their production by 16% given the existing technology.

CONCLUSION AND RECOMMENDATIONS

The study established the existence of technical in-efficiency in the production of rice by female farmers in the study area. The socio-economic factors which contributed to the technical in-efficiency of female farmers include educational status of the farmer, farming experience, and access to credit facilities. The research findings showed that farm-size, fertilizer, and hired-labour were statistically significant determinants of rice output of female famers at 1% level. Family-labour had a significant effect on rice production at 5% level. It was therefore recommended that Government policy should emphasize measures that promote women farmers' access to agricultural resources and services at affordable prices thereby bridging the existing gender gap among rice-farmers in Nigeria.

Table 1: Socio-economic Characteristics of Respondents

Variables	Frequency	Percentage
Age (Years)		
≤ 30	54	30.00
31-40	76	42.22
41-50	35	19.44
51-60	12	06.67
> 60	03	01.67
Total	180	100.00
Minimum	16	
Maximum	69	
Mean	36.42	
Education		
No Formal Education	74	41.11
Primary	36	20.00
Secondary	42	23.33
Tertiary	28	15.56
Marital Status		
Single	45	25.00
Married	112	62.22
Divorced	08	04.44
Widowed	15	08.34
Household-size		
2 – 4	31	17.22
5 – 7	85	47.22
8 – 10	44	24.44
11 – 13	11	06.11
14 – 16	06	03.33
>16	03	01.68
Total	180	100.00

Source: Field Survey, 2015

Table 2: Maximum Likelihood Estimates of the Parameters of the Stochastic Frontier Production Function for the Female Respondents

Variable	Parameter	Coefficient	Standard Error	t-ratio
Production Factors				
Constant	β_0	1.9464	0.7264	2.6795 *
Farm size	β_1	1.0520	0.4118	5.5460 *
Seed	β_2	0.5604	0.4013	1.3964
Fertilizer	β_3	0.0331	0.0105	3.1574 *
Hired Labour	β_4	0.0498	0.0132	3.7772 *
Family Labour	β_5	0.0304	0.0142	2.1385 **
Herbicide	β_6	0.0246	0.0630	0.3899
In-efficiency Factors				
Age	α_1	- 0.1914	0.2119	- 0.9034
Education	α_2	- 0.0197	0.0969	- 2.0341 **
Farming Experience	α_3	- 0.0127	0.0371	- 3.4205 *
House-hold size	α_4	0.0074	0.0464	0.0159
Extension services	α_5	- 0.0816	0.1813	- 0.4500
Credit facilities	α_6	- 0.0400	0.0150	- 2.6568 *
Sigma squared	δ^2	0.4494	0.0051	8.8863 *
Gamma	Γ	0.7130	0.0146	4.8998 *
Log likelihood function			26.3282	

Source: Computer output from Frontier 4-1

* Significant at 1%   ** Significant at 5%.

Table 4: Distribution of Technical Efficiency of Female Respondents

Efficiency Levels	Frequency	%
≤ 0.50	4	2.22
0.51 – 0.60	13	7.22
0.61 – 0.70	21	11.67
0.71 – 0.80	35	19.44
0.81 – 0.90	77	42.78
0.91 – 1.00	30	16.67
Total	180	100.00

Source: Computer printout, 2015

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ROLE AND CONSTRAINTS OF RURAL WOMEN IN AGRICULTURAL DEVELOPMENT IN ABIA STATE, NIGERIA

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ABSTRACT
The study investigated the role and constraints of rural women in agricultural development in Abia State, Nigeria. Multiple random sample technique was employed to select a sample size of 120 respondents (rural women) used for the study. Primary data were generated through structured interview schedule, and analyzed with descriptive statistics such as frequency table, percentage and mean scores. The study revealed that majority of the rural women in the area are literate, have average age of 39 years, and have average farming experience of eighteen years. They also have average household size of 7 persons. From the study the major roles of rural women in agricultural production were planting, weeding, sanitation in farm houses, transporting of produce, land clearing, fertilizer application, harvesting, processing, feeding of livestock and marketing. Major constraints faced by rural women in agricultural development are inadequate capital, excessive workload, lack of agricultural inputs, lack of credit facilities, inadequate land, low soil fertility, poor road network and inadequate extension services. It is therefore recommended that women should be economically empowered by provision of loan and credit facilities to support their efforts in agriculture.
Keywords: Role, constraints, rural women and agricultural development

INTRODUCTION
Many rural women depend on agricultural sales for their livelihood to provide for their families. Large number relies on agricultural products for daily nourishment. Unfortunately, in many areas in Abia state, soil conditions, seed supply and other factors are not ideal for successful farming, which leads to poverty. Agricultural development promotes the proper conditions for farming so that planting, harvesting and processing of crops can be done effectively, which ultimately can reduce poverty and save lives (WISEGEEK.com, 2014). Similarly, Okereke (2013) stated that agricultural development means providing assistance to the crop producers with the help of various agricultural resources. It also includes helping out farmers with regard to animal agriculture, rotational grazing which extends benefits for the protection of natural resources, preserving water by managing livestock, utilization of forage crops right through season and quality production.
Rural women in Nigeria make a significant contribution to food production and to the processing and marketing of foodstuffs (Adekanye, 2013). They produce 60 – 80 percent of food in the country, provide about 80 percent of agricultural labour force and contribute to well being of their households through their income generating activities (Rahman *et al*., 2004). However, these rural women still face formidable challenges to their potential role as a major economic and social force in agricultural development. It is against this background that this study was undertaken to ascertain the roles and constraints of rural women in agricultural development.

METHODOLOGY
The study was carried out in Abia State, Nigeria. It is one of the states in south-eastern Nigeria. The state has a total land area of about 8,000 square kilometers and a population of about 2,833.999 made up of 1,454,195 males and 1,599,806 females and population density of 578 persons per square kilometer (NPC, 2006). Unstructured interview and structured questionnaire were employed in data collection. Multistage random sampling technique was used in selecting 120 rural women from the three agricultural zones of the state namely Aba, Ohafia and Umuahia. Two extension blocks were randomly selected from each zone and two circles from each block. A total of ten rural women were randomly selected from the list of women in each of the selected circles and administered copies of structured questionnaire. Data collected were analysed using descriptive statistics such as frequency, percentage, mean score and role index using a 3 point likert type rating scale of Never involved = 1, Rarely involved = 2, Always involved = 3. The mean score for each of the activities were calculated; any mean score equal to or above 2.0 means full participation. Constraints were realised also with mean score using a 3 point likert type rating, weighted in these order: never – 1, mild – 2 and severe = 3. Mean score response equal to or above the calculated mean score of 2.0 were regarded as major constraints.

RESULTS AND DISCUSSION
Socio-Economic Characteristics
Results in Table 1 show that the rural women had average age of 39 years. This shows that the women are strong and active in agricultural activities. They have mean household size of seven persons. This implies that the women

have large household size. Large household size is an indication of availability of family labour. Adegbite *et al* (2008) stated that large household size in farming communities provide free family labour on the farm. From the result the women had average farming experience of eighteen years. Years of farming experience gives an indication of practical knowledge acquired on how the individual can overcome certain inherent problems associated with farming (Iheke, 2010).

Role of Rural Women in Agricultural Activities

Table 2 shows the role of rural women in agricultural activates in Abia State, Nigeria. The result shows that the major roles of rural women in agricultural activities were planting (2.9), weeding (2.9), sanitation in farm houses (2.9), transporting of produce (2.8), land clearing (2.6), fertilizer application (2.7), harvesting (2.8), processing (2.7), feeding of livestock (2.6) and marketing (2.6).

Constraints of Rural Women in Agricultural Development

Table 3 shows the constraints of rural women in agricultural development. The results revealed that the major constraints faced by rural women in agricultural development were inadequate capital (2.8), excessive workload (2.7), lack of agricultural inputs (2.6), lack of credit facilities (2.5), inadequate land (2.4), low soil fertility (2.3), poor road network (2.2) and inadequate extension services (2.1). These constraints retard women's efforts in enhancing agricultural production, especially the problem of excessive workload. This is in line with the report of CTA (2010) that, despite the efforts of rural women to combine income-generating activities with unpaid household responsibilities, the burden of work form a considerable constraint (in terms of time, mobility and energy) at the expense of their health, well-being and productivity. Other constraints were pest and diseases (1.8), lack of electricity (1.6), poor storage facilities (1.5), low technical know-how in use of technologies (1.4) and poor marketing channels (1.3).

CONCLUSION

The findings revealed that the rural women in the study have average age of 39 years, literate, and had an average farming experience of eighteen years. They have average household size of 7 persons. The study shows that the major roles of rural women in agricultural production were planting, weeding, sanitation in farm houses, transporting of produce, land clearing, fertilizer application, harvesting, processing, feeding of livestock and marketing. Major constraints faced by rural women in agricultural development are inadequate capital, excessive workload, lack of agricultural inputs, lack of credit facilities, inadequate land, low soil fertility, poor road network and inadequate extension services. It is therefore recommended that women should be economically empowered by provision of loan and credit facilities to support their effort in agriculture.

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ASSESSMENT OF PRODUCTION CONSTRAINTS AMONG WOMEN CASSAVA FARMERS IN OLUYOLE LOCAL GOVERNMENT AREA, OYO STATE, NIGERIA

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ABSTRACT
Women take part actively in farming activities in addition to their domestic and reproductive responsibilities. However, it has traditionally been difficult for them to obtain production resources necessary for farming. The study was thus designated to assess the production constraints among women cassava famers in Oluyole local government area, Oyo State with a view to specifically describe the socio-economic characteristics of women cassava farmers; assess the contribution of women cassava farmers and identify the constraints faced by women in cassava production. Multi-stage sampling was used to select one hundred and twenty (120) women cassava famers. Descriptive and inferential statistics were employed for data analysis. The result revealed that the mean age of the women cassava famers was 47 years, 72.5% were married, 38.3% had secondary education and majority cultivating on a mean farm size of 2 acres. The constraints encountered by the respondent in the study area include difficulty in land acquisition, unavailability of planting materials, lack of access to credit facilities and extension agent. The study further revealed that marital status and age have significant relationship with constraints faced by women cassava farmers. It is thus recommended that women cassava farmers should be encouraged with provision of necessary modern farm tools to enhance good production.
Keyword: cassava, constraints, women farmers, resources and contributions.

INTRODUCTION

The role women play in agriculture and rural society is fundamental to agricultural and rural development in Nigeria. They play a vital role in food production and food security. FAO (2006) estimated that the rural woman contribute two-third of all the time that is put into traditional agriculture in Africa and 80% of the Yoruba women of the South-Western Nigeria are engaged in farm work growing yams, maize, tobacco, cassava, poultry and fish farming. They also participate in bush clearing, land preparation and weeding in addition to their role in processing and marketing farm produce. Women account for 70% of agricultural workers, 80% of food producers, 100% of those who process basic foodstuffs and they undertake from 60% to 90% of the marketing (Fresco, 1998) and this is why Mgbadu (2002) described Black Africa as the region of female farming per excellence.
Adegeye et al., (2002) asserted that women are active in the cassava industry and that they are more predominant in the processing and marketing than men folk who dominate the production of cassava roots. He further stated that women activities in root production have increased due to men's off farm employment or part-time work off the farm therefore. Women now involve in weeding, harvesting, transportation, storage, processing and marketing. In spite women heavy involvement in agriculture, they are generally faced with a lot of challenges such as social, economic and cultural barriers which limits their opportunities for broad participation. Folasade (1991) emphasized that lack of separate land for women and inadequate contact with extension agents are serious constraints faced by women farmers. Women generally do not own land or other assets and it has traditionally been difficult for them to obtain Bank loans or other forms of credit through the banking system because land tenure system is largely by inheritance. This lack of title to land, according to (Famoriyo, 1979) prevents women from exercising or improving on their expertise in crop production and animal husbandry. With these numerous constraints against women, assessment of production constraints among women cassava farmers is thus important in order to improve women efficiency in agricultural activities. The specific objectives of this study were to describe the socio-economic characteristics of women cassava farmer, assess the contribution of women cassava famers and identify the constraints faced by women in cassava production in the study area.

Hypothesis

Ho – There is no significant relationship between socioeconomic characteristic of women cassava farmers in the study area and constraints faced in cassava production.

METHODOLOGY

The study was carried out in Oluyole Local Government area of Ibadan Oyo State and the population targeted were rural women that engage in cassava production. The sample frame of women who engage in cassava production in six villages randomly selected under the study area was drawn. Twenty (20) cassava women farmers were randomly selected from each of the villages which include (Idi-ayunre, Aba-nla, Aba – Agbo, Olubadan, Olounde, Oke – Ibadan) respectively making a total of 120 respondents used for the study. Primary data were obtained through the use of structured questionnaire and data collected were on the women's socio-economic characteristics, their contribution and constraints. These data were subjected to descriptive and inferential statistics.

RESULTS AND DISCUSSION

Socio-Economic characteristics of respondents

Table 1 shows that the mean age of women cassava farmers in the study area was 47 years but specifically, 25.8% were in the age range 31-40 years, 21.7% were between 41-50 years and l5.0% were less than 30 years of age. This indicates that 62.5% of the respondents fall within the age group of 50 years or less. Over seventy percent (72.5%) of the respondents in the study area were married, 20.0% were widow and 7.5% were single. This indicates that married people look for more ways of making money to cater for their families. Approximately 46% of the respondents in the study area had household size between 4-6 members, 38% between 7-9 members while 11.0% had 10 and more members. Also, table 1 reveals that 38.3% of the respondents had secondary education, 37.5% had primary education and 11.7 had adult education. In terms of experience, 49.2% of the women cassava farmers had 10-15 years of experience and 28.3% had 6-10 years. The mean experience was 9 years. This shows that the women cassava farmers were not new in the production business and it has been argued that more experienced producer could predict the future outcome of production with some probability by considering performance of past years.

Contribution of women to cassava production

Table 2 reveals that about 46.7% of the respondents spent 3 – 4 hours in a day while 35.8% of the respondents spent 5- 6 hours. The mean hour per day was 4 hours and it could be inferred that relatively more time is spent on farm by these women when other domestic chores are put into consideration. Majority (78.4%) cultivated between 1-2 acres of land, 15.9% cultivated 3-4 acres while 13.0% cultivated 5-6 acres. This indicates that most of the women cassava farmers in the study area cultivated small acres of land as mean acre cultivated was 2 acres. This could be attributed to the fact that most of them got their farm land by rent and the available land was shared among larger number of people which resulted to having access to small acres of land. Also, 41.7% of the respondents harvested between 7-8 tonnes of cassava per annum, 33.3% harvested between 9-10 tonnes while 12.5% harvested 4 tonnes or less. The mean harvest per annum was 7 tonnes and as part of the respondents' contribution to cassava industry, more than three quarter (75.8%) engaged in processing aside production. Thus indicates that most of the women engaged in both production and processing of cassava.

Constraints that women faced in cassava production

Table 3 shows that more than half (54.2%) of the respondents find it difficult to acquire farm land while 45.8% of the respondent do not find it difficult to acquire farm land in the study area. This is so because majority (57.5%) acquired farm land by rent and there was no easy access to farm land. Majority (81.7%) of the respondents were using manual farm implements while 18.5% of the respondents use hired tractor to perform their land preparation. This indicates that the level of production will be low for majority and they will not be able to cultivate more farm land even if it is available. It was also reveals that unavailability of planting materials contributes to the constraints faced by women cassava farmers in the study area as 71.7% find it difficult to get good painting materials while 28.3% do not find it difficult to get good planting materials. Higher percentage (53.3%) of the respondents suffer from insufficient credit facility and this indicates that even with access to cooperative loans by some, it is still not enough for them to carry out their farming operation successfully. Table 3 further revealed that majority (71.7%) of the respondents never had contact with extension worker. This agrees with the report of Swanson *et al*., (1984) that women cassava farmers had little or no contact with extension service.

Hypothesis Test Result

Table 4 shows that education and Household size were greater than 0.05 significance value. Thus, there is no significant relationship between them and constraints women cassava farmers faced in the study area. However, marital status and age have P-value less than 0.05 significant value. Thus, there is significant relationship between them and constraints women cassava farmers faced in the study area.

CONCLUSION AND RECOMMENDATION

The overall result of this research work showed women cassava farmers with mean age of 47 years dominate cassava production in the study area cultivating on a mean farm size of 2 acres. It was revealed that on average, they spent 4 hours per day on farm and engaged in processing asides production. Most of their activities were carried out using manual or traditional methods and this was due to general economic challenges of women cassava farmers in the study area. This study further reveals that marital status and age have significant relationship with constraints faced by women cassava farmers in the study area. Base on the study therefore, women cassava farmers in the study area should be encouraged with provision of necessary modern farm tools to enhance good production as majority engaged in manual farming.

Table 1: Socio-Economic Characteristics of the Respondents

Variables	Frequency	Percentage
Age (years)		
21 – 30	18	15.0
31 – 40	31	25.8
41 – 50	26	21.7
51 – 60	17	14.2
>60	28	23.3
Total	120	100
Mean	47	
Marital status		
Married	87	72.5
Single	9	7.5
Window	24	20.0
Total	120	100
House hold size		
1 – 3	5	4.2
4 – 6	55	45.8
7 – 9	46	38.3
10 and above	14	11.7
Total	120	100
Mean	7	
Education level		
Adult education	14	11.7
Quranic education	4	3.3
Primary education	45	37.5
Secondary education	46	38.3
Tertiary education	11	9.2
Total	120	100
Ethnicity		
Yoruba	88	73.3
Igbo	26	21.7
Hausa	6	5.0
Total	120	100
Experience		
1-5	27	22.5
6-10	34	28.3
11-15	59	49.2
Total	120	100
Mean	9	

Sources: Field Survey, 2015.

Table 2: Contribution of women in cassava production.

Variables	Frequency	Percentage
Time spent on farm per day		
1 – 2 hrs	18	15.0
3 – 4 hrs	56	46.7
5 – 6 hrs	43	35.8
>6 hrs	3	2.5
Total	120	100
Mean	4	
Acres of land cultivated		
1-2	94	78.4
3-4	19	15.9
5-6	7	13.0
Total	120	100
Mean	2	
Annual harvest		
1-2	5	4.2
3-4	10	8.3
5-6	15	12.5
7-8	50	41.7
9-10	40	33.3
Total	120	100.0
Mean	7	
Did you engage in cassava processing		
No	29	24.2
Yes	91	75.8
Total	120	100

Sources: Field Survey, 2015.

Table 3: Constraint that women faced in cassava production

Variables	Frequency	Percentage
Difficulty in land acquisition		
No	55	45.8
Yes	65	54.2
Total	120	100
How did you acquire farm land		
Inheritance	36	70.8
Purchase	15	12.5
Rent	69	57.5
Total	120	100
Mode of land preparation		
Manual	98	81.7
Tractor	22	18.3
Total	120	100
Unavailability of planting materials		
No	34	28.3
Yes	86	71.7
Total	120	100
Access to credit		
No	64	53.3
Yes	56	46.7
Total	120	100
Extension agent visitation		
No	86	71.7
Yes	34	28.3
Total	120	100

Sources: Field Survey, 2015.

Table 4: Hypothesis test result

Variables	X^2	P-valve	Decision
Education	22.967	0.290	Not significant
Household size	55.512	0.455	Not significant
Marital status	25.784	0.004	Significant
Age	2.475E2	0.012	Significant

Sources: Field Survey, 2015.

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SENSITIZATION ON GENDER AND SOCIAL DYNAMICS IN SEED YAM PRODUCTION IN ABUJA, NIGERIA

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ABSTRACT
Gender Sensitization workshops were conducted in 2015 in twelve (12) communities in Kwali and Bwari Area Councils of the Federal Capital Territory (FCT) Abuja, Nigeria. The purpose was to sensitize the project partners and communities involved in the Community Action in Famers Saved Seed Yam (CAY-Seed) project in Nigeria on the need for equal participation of gender groups in seed yam production. Qualitative data were collected by the use of mixed methods, and analyzed with descriptive statistics. Results showed that both male and female farmers participate in seed yam production and marketing, most of the project partners and community members had no previous knowledge of gender. Women play more roles in seed yam production than men and youth. However, some of these roles played by women are complementary roles whereas the men and youth do most of the physical activities. Men have complete access and control of productive assets and income from seed yam production. Women are mainly engaged in the marketing activities even though they do not have access and control of money realized from the sales. The major constraints to seed yam production in the communities include: pests and diseases attack, scarcity of clean seed yams, poor soil fertility, low level of mechanization, and poor infrastructural facilities. It was recommended that more sensitization is required to educate the people on the need to be gender sensitive in their production and marketing activities and also to enhance the women's access and control of productive resources. In so doing, women's potential will be fully exploited to increase productivity and income from seed yam production in the study areas.
Key words: Communication, gender, marketing, production, seed yam, sensitization

INTRODUCTION
Empirical reports have shown that technology development and transfer processes have been gender insensitive and tend to overlook the complex needs and livelihood realities of rural women in agricultural production but concentrate on that of the men (Ironkwe, 2011). This process has failed to recognize the roles and constraints of the various gender groups involved in agricultural production. Consequently, the results of such projects are not sustainable, hence low productivity resulting from low adoption of such technologies developed (Ekop, 2001). Women are farmers, workers and entrepreneurs, but almost everywhere they face more severe constraints than men in accessing productive resources, markets and services. This "gender gap" hinders their productivity and reduces their contributions to the agriculture sector and to the achievement of broader economic and social development goals. Closing the gender gap in agriculture would produce significant gains for society by increasing agricultural productivity, reducing poverty and hunger and promoting economic growth.
Women farmers are often not as efficient as they should be because gender relations frequently do not allow them to be effective decision-makers. Many agricultural policy and project documents still fail to consider basic questions about the differences in the resources available to men and women, their roles and the constraints they face – and how these differences might be relevant to the proposed intervention. Moreover, the implementers of most agricultural projects, are not gender sensitive as a result, it is often assumed that interventions in areas such as technology, infrastructure and market access have the same impacts on men and women, when in fact they may not.
In most parts of Nigeria, yam is regarded as a man's crop, simply because it is a food security crop and huge revenue earner. Women's contribution to yam production is not recognized in the communities. Some research results show that gender is significant and positively related to technical efficiency in yam production with men reported to be more technically efficient (Simonyan and Obiakor, 2012), but the reasons for this is not highlighted in view of the social diversity that exists among the communities. It therefore became necessary to consciously engage and build capacity of women in seed yam value chain. To do this, a programme to sensitize the rural people on gender issues becomes paramount.

Gender sensitization according to Sharma (2014) refers to the modification of behavior by raising awareness of gender equality concerns. It may be seen as the awareness which informed disposition or propensity to behave in a manner which is sensitive to gender, justice and equality issues. Gender awareness therefore requires not only intellectual understanding and effort but also sensitivity and open-mindedness to change one's views and limited perspectives and values. It opens up the widest possible range of life options for both females and males and builds their capacities to be more wholesome and human.

CAY-Seed project is a community action project that aims at improving the quality of farmers saved seed yam for increased and sustainable yam production in the country. As a development project, it aims at a gender responsive research that involves all gender groups in the development, implementation, monitoring and evaluation of its project activities for the benefit of men, women and youths. One of the components of the project is on Gender and Social Dynamics in seed yam production which conducted gender sensitization workshop for the project partners, and the communities participating in the project in the study areas.

Objectives

- To sensitize project partners and communities on the need for equal participation of gender groups in seed yam production.
- To identify gender training needs of the project partners.
- To identify the roles of males and females in seed yam production and marketing.
- To identify their major constraints in seed yam production.

METHODOLOGY

Twelve (12) farming communities were purposively selected from 2 Area Councils in FCT Abuja Nigeria where Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project operated before. The communities in Kwali Area Council include: Kwali, Ijah Sariki, Leleyi Gwari, Kilankwa 1, Kilankwa 2 and Chikuku while those in Bwari Area Council are: Yaupe, Sunape, Panunuke, Guto, Kuzhako, and Tokulo.

Also, a total of 18 CAY-Seed project partners drawn from collaborating institutions like NRCRI Umudike, IITA, Ibadan and MSHR, Abuja were sensitized on gender issues. Qualitative data were collected by the use of mixed methods such as Focus Group Discussions, gender lens, observations, and structured questionnaires from the community members and project partners. Data were analyzed with descriptive statistics.

RESULTS AND DISCUSSION

Results showed that 84% of the project partners had no previous knowledge of gender. Those that knew about it had not given gender issues any kind of serious attention. This revealed the relevance of the sensitization on making the partners gender sensitive in carrying out the project activities. Among the gender training needs identified from the project partners are: gender mainstreaming in project activities, gender roles, needs and constraints in agriculture, gender disaggregation of data and gender based analysis are the most important (Table 1).

In the 12 communities, a total of 715 community members were sensitized. By Area Council, more youths attended the gender sensitization in Kwali while women dominated that of Bwari. On the whole, 334 participants representing 46.71% came from Kwali Area council while 381 representing 53.29% came from Bwari (Table 2).

Result of the study showed that almost all the participants were not gender sensitive in their production processes and relations. In seed yam production activities, it was discovered that women in the communities indirectly play more roles than other gender groups. Although men, do most of the physical activities such as land preparation and harvesting, women also join them but may not do as much as men. In addition to this, women prepare food, fetch drinking water to the farm and take care of the children. The activities of women complement those of men in almost all the areas of production (Table 3).

In the communities, there are specific responsibilities for men, women and the youth. Men in most cases take the responsibility of family upkeep and use of resources including farm incomes, while women are responsible for family care including children needs and food with the youth complementing the responsibilities of the men or women depending whether a boy or girl is involved. Most decisions are taken by the men, the women may contribute if given the opportunity but their contributions are not binding on the men. The youths are not involved in decisions except in female headed households. Men have full access and control of all household resources including labour. In some cases, women and youth have access but no control over family resources. However, in female headed households, the women have limited control but full access.

Major constraints in seed yam production in the study area

The major constraints to seed yam production in the communities include the following:

- ✓ Pests and diseases attack
- ✓ Scarcity of clean seed yams
- ✓ Poor soil fertility
- ✓ Low level of mechanization

- ✓ Poor infrastructural facilities

CONCLUSION

Gender based activities of the CAY-Seed project undertaken in 2015 in Nigeria has shown that women and youth in the seed yam producing communities have not been allowed to express their full potentials. Men acknowledge the importance of women and youths in the household farming activities. Also, most of the project partners are beginning to appreciate the need to give all the gender groups equal opportunities to participate in their primary duties and project activities. With further sensitizations, the communities and project partners will gradually begin to mainstream gender in their project activities.

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Table 1: Specific gender training needs for CAY-seed partners in Nigeria

S/N	Gender Needs	Frequency	Percentage	Rank
1	Gender Mainstreaming	17	94.44	1st
2	Gender roles, needs and constraints in agriculture	17	94.44	1st
3	Gender disaggregation of data	16	88.89	2nd
4	Gender based analysis in agriculture	13	72.22	3rd
5	Development of gender based proposals	10	55.56	4th

Table 2: Number of participants in the two Area Councils

Area council	**Men**	**Women**	**Youth**	**Total**
Kwali	88	108	138	334
Bwari	96	159	126	381
Total	184	267	264	715

Table 3: Gender roles in Seed yam production activities

Activities	Men's Roles	Women's Roles	Youth Roles
Site selection	Select land	Support selection	Support selection
Land clearing	Clear land	Assist in clearing land Take care of children Cook for laborers	Clear land
Burning	Burn debris	Packing Gather fire wood	Burn debris
Herbicide application	Apply herbicide	Fetch water	Apply herbicide
Heap making	Make heaps	Cook food	Make heaps
Planting	Plant yams	Convey seed yams to farm Place seed yams on heaps Cook for laborers	Plant yams
Mulching	Mulch	Gather mulch materials Mulch	Mulch
Weeding	-	Weed yam farm	Weed yam farm
Staking	Stake yams	Gather stakes	Stake yams
Fertilizer application	Purchase fertilizer	Apply fertilizer	Apply fertilizer
Harvesting	Harvest yams	Gather harvested yams	Harvest yams
Sorting	Sort yams	Sort yams	Sort yams
Marketing	-	Market yams	-
Total involvement	**11 activities**	**19 activities**	**12 activities**

Source: Field data, 2015

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ADOPTION OF IMPROVED TECHNOLOGIES IN RICE PRODUCTION IN IMO STATE, NIGERIA

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ABSTRACT
Imo State is one of the States where rice is produced in southeast Nigeria. In recent times, rice production in the area has fallen short of the demand due to low yield ascribed to low adoption of improved production technologies disseminated by the Agricultural Development Programme (ADP) of the State. This study was undertaken to investigate the adoption of improved rice production technologies in Imo State of Nigeria. Random sampling technique was used in selecting one hundred and thirty (135) rice farmers from the communities where rice is produced in the State. Data were collected with the aid of a well-structured questionnaire, and analyzed using descriptive statistics. The result obtained shows that 73.33%, 67.41%, 78.52%, 86.67%, and 45.4% of the rice farmers adopted improved rice varieties, use of agrochemicals, fertilizer application, optimum seed rate, and mechanical harvesting respectively. The result also identified constraints such as lack of fund and credit facilities (97.04%), tediousness of the technology and risk involve (84.44%), high cost and scarcity of labour (74.81%), poor government support (93.33%) and low farm income (85.19%) militating against the adoption of improved technologies in rice production in the State. human/technology attributes, technical constraint, financial constraints, and poor institutional support as major constraints to adoption of improved rice production technologies in the State. Necessary recommendations such as designing improved rice production technologies that reflect the socio-economic attributes, and complementing agricultural innovations with proper institutional framework for credit mobilization were made.
Keywords: Adoption, Rice Technologies, Farmers, Imo State, Nigeria

INTRODUCTION
The domestic production of rice in Nigeria has not met the demand, leading to food shortage problems. Estimated national demand for rice is put at 5.2 million ton per annum, production is estimated at 3.3 million ton leaving a demand gap of 1.9 million tons which is imported with the attendant drain on foreign reserve (FMARD, 2011). This gap has continued to increase relative to demand. As a result, the Nigeria government invested on developing improved rice varieties for farmers so as to increase production and cut importation of rice. For instance, the National Rice Development Strategy (NRDS) was established to improve domestic production by encouraging farmers to adopt improved rice varieties (NRDS, 2009). To enhance the adoption improved rice varieties and technology options for rice production, and increase the production level of rice, Nigeria also adopted the African Rice Initiative (ARI). African Rice Initiative was established in 2002 to promote the dissemination of improved technologies in rice production in many countries in Sub-Saharan Africa. The Federal Government of Nigeria launched the Presidential Initiative on rice in 2003 aimed at increasing rice production, processing and export. Also, the Federal Government of Nigeria in 2011 launched the Rice Transformation Agenda. The goal of the Rice Transformation Agenda was self-sufficiency in rice production and complete substitution of imported rice by year 2014 (FMARD, 2011). The Rice Transformation Agenda adopted the value chain approach, identified and organized rice farmers to readily access inputs such as improved seeds, fertilizer, agrochemicals and modern methods of rice production from extension services. However, despite all these efforts, research findings still indicate that rural farmers in most cases find it difficult to obtain improved rice production inputs that are suitable to their local conditions (Awotide *et al.*, 2012a; Awotide *et al.*, 2012b; BATNF, 2015). To date, farmers in rural areas especially in southeast Nigeria are still planting non-improved rice varieties despite the availability of improved ones (Onumadu and Udemgba, 2012; Onumadu and Osahon, 2014). This could have negative effect of adoption in view of the fact that if a farmer does not have access to improved varieties, adoption would be impossible and there would be no yield increase.

METHODOLOGY
The study was carried out in Imo State, Nigeria. Imo State is in the southeast zone of Nigeria. The State is made up of twenty seven Local Government Areas and three agricultural zones- Owerri, Orlu and Okigwe agricultural

zones. Imo State lies between latitude 5°12′ and 5°56′ North of the Equator and between longitudes 6°38′ and 7°25′ east of the Greenwich Meridian. It is bordered by Abia State on the east, by the River Niger on the west, by Anambra State on the north and River State on the south. Imo State occupies a land mass of about 5,530 km^2 with a total population of approximately 3.9 million persons (NBS, 2006). Ideato North, Ihitte Uboma, and Oguta Local Government Areas (LGAs) are the LGAs where rice is grown in Imo State. Two-stage random sampling techniques was adopted in the selection of respondents for this. Firstly, three communities were randomly selected from each of the LGAs where rice is cultivated in the State. Secondly, fifteen (15) rice farmers were randomly selected from the communities, making a total of one hundred and thirty five (135) respondents for the study. Structured questionnaire was administered on 135 selected rice farmers. Data collected were analysed using descriptive statistics.

RESULTS AND DISCUSSION

Adoption of Rice Production Technologies

Adoption of improved rice production technologies is presented in Table 1. The table shows that 73.33% of farmers adopted improved rice varieties. This implies that improved rice varieties assist farmers in increasing the yields and production of rice. Adoption of improved varieties by farmers will mean more than just increased rice production and reduced imports, but will contribute to food security and poverty reduction among farmers (Nweze, 2004). Table 1 reveals that 78.52% of rice farmers adopted fertilizer use/application in rice production. Unamma *et al.* (1985), in a survey on farming systems in Nigeria, reveal that fertilization of crops was not new to over 91% of surveyed farmers. This implies that fertilizer plays an important role in faster growth and maturity of improved rice varieties. The amount of fertilizer applied in rice cultivation depends on the qualities and level of residual nutrients in the soil (Maduakor, 1991). The table shows that 45.4% of the farmers adopted modern milling/processing in improved rice technology. The implication is that farmers make more profit since there is the potential to produce clean, less broken, polished rice with improved milling/processing. Rice milling /processing removes the husk and the bran layers from paddy to produce whole white rice kernels that are sufficiently milled, free of impurities and contain a minimum number of broken kernels. Small proportions (26.67%) and (14.07%) of the farmers adopted improved line spacing and ideal planting depth respectively in improved rice production. However, the table reveals that greater (86.67%) percentage of the farmers adopted optimum seed rate. Improved rice planting methods provide advantages in terms of better weed control, more uniform maturation of the plants, higher grain yield under intensive management, and more efficient use of the land for rice innovation system (Barker *et al.*, 1985). The study reveals that 67.41% of the farmers adopted agrochemicals (seed treatment, use of insecticides and fungicides, pest and disease control methods) in improved rice production. Pest and disease attacks are serious problems in rice production (Ekeleme *et al.*, 2008). Pest and disease can cause significant yield loss in rice production. There is need for knowledge of pest ecology and dynamics to allow minimal loss of rice yield to pests and diseases in rice innovation system. About 14.81% of the farmers adopted mechanized harvesting in rice production. Harvesting is a major operation among actors in rice innovation system (Nkama, 1992).

Constraints to Adoption of Improved Rice Production Technologies

Table 2 shows the distribution of rice farmers according to constraints to adoption of improved technologies. Majority of the rice farmers indicated lack of fund and credit facilities (97.04%), tediousness of the technology and risk involve (84.44%), high cost and scarcity of labour (74.81%), poor government support (93.33%) and low farm income (85.19%) as the problems militating against the adoption of improved technologies in rice production in the area. This is an indication that the adoption of improved rice production technologies will be improved if such factors as lack of fund and credit facilities, tediousness of the technology and risk involve, high cost and scarcity of labour, poor government support and low farm income are addressed in the area.

CONCLUSION

Improved rice production technologies adopted by rice farmers in Imo State are use of agrochemicals and fertilizers, and improved rice varieties. Lack of fund and credit facilities, tediousness of the technology and risk involve, high cost and scarcity of labour, poor government support and low farm income are the major problems militating against the adoption of improved rice production technologies in the area. The adoption of improved rice production technologies will be improved if such factors as lack of fund and credit facilities, tediousness of the technology and risk involve, high cost and scarcity of labour, poor government support and low farm income are addressed in the area.

Table 1: Distribution of rice farmers according to adoption of rice production technologies

Improved technologies	Frequency	Percentage
Improved rice varieties	99	73.33
Improved line spacing	36	26.67
Planting depth	19	14.07
Use of agrochemicals	91	67.41
Fertilizer application	106	78.52
Mechanized harvesting	20	14.81
Improved nursery	11	8.15
Timely transplanting	18	13.33
Optimum seed rate	103	86.6
Modern rice milling	49	45.4

Source: Field survey, 2015

Table 2: Distribution of the constraints to adoption of improved rice production technologies

Problems	Frequency*	Percentage
Lack of fund and credit facilities	131	97.04
Lack of awareness of improved technologies	6	4.44
Tediousness of the technology and risks involve	114	84.44
Unavailability of improved seed	26	19.26
Poor extension services	33	24.44
Insufficient land for cultivation	12	8.89
High cost and scarcity of labour	101	74.81
Poor government support	126	93.33
Low farm income	115	85.19

*multiple response

Source: Field survey, 2015

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YOUTH INVOLVEMENT IN AGRICULTURAL PRODUCTION: FACTORS THAT INFLUENCE CREDIT ACCESSIBILITY AMONG RURAL YOUTHS IN AKWA IBOM STATE, NIGERIA

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ABSTRACT
The study determined factors that influence rural youths' access to credit in Akwa Ibom State. Data were collected from 300 youths spread across the rural areas of the State. The Logit model estimates revealed that household size, membership in social organization, non-farm income and commercial purpose of farming were positive determined of credit access among youth farmers in the study area. On the other hand, marital status, education, land tenure and farming experience of youths were negative determinants of credit access among youth farmers. Based on the result, it is recommended that, a sound family welfare package should be design in the rural communities to check excessive household expenditures among youth farmers. Also, social capital formation should be encouraged among youth farmers in the region.
Key words: youth, agriculture, credit, accessibility, Akwa ibom

INTRODUCTION
Many analysts believed that agricultural sector is naturally endowed with enormous potentials to absorb unemployed and surplus labour from other sectors of the economy (Akpan, 2010, Naglers and Wim 2014 and Temirbulatova and Moara 2015). Nigeria has vast natural resource potentials in agricultural sector that could sufficiently engross the surplus labour in her economy. However, the manner agricultural innovations are package and presented to farmers to an extent determined farmers' involvement in agricultural activities. Farm credit is example of an agricultural innovation that is essential for agricultural production, and with it, farmers can secure farm inputs such as; farm equipment and hired labour among others and explore the abundant opportunities in the sector (Oladeebo and Oladeebo, 2008, Odoh, *et al.,* 2009). Following the important of credit in agricultural system, tiers of government in Nigeria have attempted to stimulate youths' interest in agricultural production through provision of credit facilities. For instance, in 2008, the Akwa Ibom State government set up a micro credit scheme to assist youths engaged in the agricultural production. Also, in 2011, a gender specific skill development scheme was enunciated to help improve the wellbeing of enterprise female youths in the state, through the provision of soft loans to beneficiaries. Recently, in 2016, the Akwa Ibom State government guaranteed soft loans to poultry farmers and supply varieties of farm inputs. Despite these few incentives; literature still provided evidence of poor credit accessibility among rural farming households in the State (Nwaru et al., 2011 and Akpan et al., 2013). The result of insufficient credit among youth farmers has led to decline in youths' involvement in agricultural activities in recent years and the off-farm income activities have risen instead. The over- all impact of the scenario is the disguised unemployment generated among youths in the urban centers and the underutilization of farm resources in the rural area.

Farm credit is widely recognized as one of the intermediating factors between adoption of farm technology and increase farm income among rural farmers in Nigeria (Akpan *et al.,* 2013). It is one of the fundamental ingredients of sustainable agricultural production; as such its accessibility and demand are among the prerequisites for attaining the national goal of reducing rural poverty and ensuring self -sufficiency in food production in the country (Nwaru *et al.,* 2011 and Akpan *et al.,* 2013). Many researchers have analyzed farm credit in relation with farm household in Nigeria. For instance, Jeiyol et al., (2013) examined various issues related to access to credit by both male and female crop farmers in Benue State. The estimated Logit model revealed that farmers' household expenditure; cost of hired labour, farm size and farm income were significant determinants of access to credit among male and female farmers. Similarly, Akpan et al., (2013) examined the determinants of access and demand for credit among poultry farmers in Ikot Ekpene, Akwa Ibom State. The result revealed that, farmers' age, gender, farm size, membership of social organization, extension agent visits, distance from the borrower's (farmer) resident to lending source, years of formal education and household size are important determinants of access to credit. Recently, Agbo et al., (2015) examined the access to credit by vegetable farmers in Owerri, Imo State. The Logit results showed that education, land tenure, household size, off-farm income and farming experience had significant relationship with farmers' access to credit. However, the few literature reviewed have not dealt with youth farmers. On that premised, this study is designed to identify factor that influence accessibility of farm credit among youth farmers in the study area.

METHODOLOGY

The Study Area, Data Source and Sampling Technique

The study was conducted in Akwa Ibom State. The state is located in the Southern region of Nigeria. It is located between latitudes 4°32[1] and 5°33[1] North and longitudes 7°25[1] and 8°25[1] east. It has a total land area of areas of 7,246km^2. The mean annual temperature of the state lies between 26°C and 29°C and average sunshine of about 1,450 hours per year. Primary data were used and respondents were youths. Combination of sampling methods was used to select respondents. Hence, a total of three hundred (300) rural youths were randomly sampled and used for data collection. Youth farmers are those farmers that fall in the category of 15 – 35 years as defined by the National Youth Council of Nigeria.

Empirical Model

A binary Logit model was used to identify factors that influence probability of youths' access to credit sources (both formal and informal sources) in the study area. Implicitly, the specify model is shown in equation 1:

$$ACC = \left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 EDU + \beta_2 HHS + \beta_3 MAR + +\beta_4 SOC + \beta_5 LAO + \beta_6 FIN + \beta_7 NFI + \beta_8 EXT + \beta_9 PUR + \beta_{10} COS + +\beta_{11} EXP + U_i \ldots\ldots\ldots\ldots..\ldots (1)$$

The marginal effect of the Logit model measures by computing the derivative of the conditional mean function with respect to each explanatory variable as thus;

$$\frac{\delta P_i}{\delta X_i} = \frac{E\{Y|X\}}{\delta X_i} = f(Z_i)\beta_i = f(X\beta_i)\beta_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Variables used in equation (1) are defined as follows:

ACC = Access to credit sources (1 for access and 0 otherwise); **EDU** = Formal education of Youth (years); **HHS** = Household size of farmers (number); **MAR** = Marital status of a Youth (1 for married and 0 otherwise); **SOC** = Membership of a social group (number of years); **LAO** = Land tenure (dummy; 1 for owned land and 0 otherwise); **FIN** = Last season farm income (₦); **NFI** = Non-farm income (Naira); **EXT** = Number of times in contact with extension agent()s in the last farming season; **PUR** = Purpose of farming (1 for commercial and 0 for family used); **COS** = Average wage rate per day of hired labour (₦); **EXP** = Farming Experience

RESULTS AND DISCUSSION

Factors that Influence the Probability of Access to Credit Sources by Rural Youth Farmers in Akwa Ibom State

The Logit model estimates used to identify determinants of youth access to credit sources is shown in Table 1. The diagnostic statistics revealed the log likelihood ratio of 48.55 and is significant at 1% probability level. This indicates that the specified Logit model has a strong explanatory power. The pseudo R^2 of 0.1291 shows that about 12.91% of variability in the dependent variables is associated with the specified independent variables.

The empirical result revealed that, the marginal effect of marital status of youths has a significant negative relationship with the probability of credit access among youth farmers in the study area. This implies that, a unit increase in marital status of youths' reduces the probability of credit access by 17.33% or reduces the log odd of credit accessibility by 53.91%. Married youths will likely have increase household expenditure profile, which could prevent farm expansion and investment as noted by Akpan *et al.*, (2013). Similar relationship was obtained for education. A unit increase in formal education of youth farmers reduces credit accessibility by 1.15% or reduces the odd log of credit access among youth farmers by 5.40%. The result suggests that, increase in years of education of youth farmers exposes them to alternative sources of livelihoods. In the same manner, a unit increase in land ownership among youths reduces credit access by 13.71% or reduces log odd of credit acquisition by 49.15%. This result implies that, farm land ownership is very important in sustaining agricultural activities among youths in the rural areas of the State. Land fragmentation among rural farming households is a serious impediment to positive growth of agricultural sector in Nigeria. This result calls for an urgent move to revisit the current land Act in the country and the rehabilitation of marginal lands in the country.

Also, youths' farm experience also has negative correlation with the probability of credit access among youth farmers in the study area. Hence, a unit increase in youth farming experience reduces the chance of accessing credit by 1.48% or reduces log odd of credit accessibility among youth farmers by 7.25%. Increase in farming experience connotes increase in alternative ways of handling farm operations and accessing as well as adopting more efficient innovations or technology. This reduces the demand for alternative farm input like credit.

On the other hand, the coefficient of youth farmers' membership in social organization exhibited a strong positive correlation with the probability of credit access among youth farmers in the region. This means that, increase in years of membership in social societies increases the probability of credit access by 1.47% or increases the log odd of credit accessibility by 7.34%. As opine by Akpan et al., (2013) and Agbo et al., (2015), social interaction or networking helped to spread information on credit availability among youth farmers. Similarly, increase in youth farmers' non-farm income increases the chance of accessing farm credit among them. A unit increase in non-farm income increases the probability of credit access and the log odd of credit access marginally. The finding shows that farmers are rational, and will like to increase their income continuously. Akpan et al., (2013) reported similar result in Akwa Ibom State.

The result further showed that, youths who are involved in commercial agriculture have higher probability to access farm credit compared to those who are not commercially oriented. The result indicates that, a unit increase in the commercial purpose of farming among youth farmers will result to about 13.03% increase in credit access or 94.31% increase in the log odd in favour of credit access in the region. This connotes that, commercial agriculture is an most important factor influencing youth access to farm credit in Akwa Ibom State. In a similar way, the coefficient of household size exhibited positive relationship with the probability of credit access among youth farmers in Akwa Ibom State. The result means that, a unit increase in household size will lead to about 7.44% increase in the probability of credit access by youth farmers in the study area. Alternatively, the log odd in favour of farm credit accessibility among youth farmers increases by 43.07% for every unit increase in in household size. The finding corroborates the reports of Agbo *et al.*, (2015), Akpan et al (2013) and Jeiyol *et al.*, (2013).

CONCLUSION AND RECOMMENDATIONS

The study has revealed significant policy variables that are important in formulating sound credit policies for farmers in the State. Based on the findings, it is recommended that; a sound family welfare package should be design and implemented in the rural communities to check excessive family expenditure by youth farmers. Youths' groups or social capital formation should be encouraged among youth farmers in the region. Marginal farm land should be developed and farm lands re-distributed to both male and female farmers in the State.

Table 1: Estimates of the Logit Model (Determinants of Youths access to credit sources in Akwa Ibom State)

Variable	Coefficient	Std. Error	Z -Value	Slope	Log Odd
Constant	−1.0551	0.6190	−1.7045*	-	-
Marital Status	−0.7745	0.3839	−2.0174**	−0.1733	0.4609
Household size	0.3582	0.0782	4.5816***	0.0744	1.4307
Education	−0.0555	0.0337	−1.6462*	−0.0115	0.9460
Social Group	0.0708	0.0402	1.7638*	0.0147	1.0734
Land ownership	−0.6817	0.3117	−2.1866**	−0.1371	0.5058
Non-farm income	6.265-06	3.124e-06	2.0054**	1.302e-06	1.0000
Wage rate (Hired)	6.128e-05	0.0002	0.3967	1.273e-05	1.0000
Extension visit	−0.0264	0.0192	−1.3720	−0.0055	0.9739
Purpose of farming	0.6643	0.3338	1.9900**	0.1303	1.9431
Farm income	1.641e-07	6.179e-07	0.2656	3.409e-08	1.0000
Farm experience	−0.0753	0.0263	−2.8628***	−0.0156	0.9275

Diagnostic Test

Mean dep. Var.	0.3200	Std. dependent Var.	0.467256
McFadden R2	0.1291	Adjusted R-Square	0.065265
Log-likelihood	−163.7871	Akaike Criterion	351.5742
Schwarz criterion	396.0196	Hannan-Quinn	369.3614

Likelihood ratio test: Chi-square(11) = 48.5474 [0.0000]

Number of cases 'correctly predicted' = 222 (74.0%)

Source: Computed by authors using gretl software, data from field survey 2015. Asterisks *, ** and *** represent significant levels at 10%, 5% and 1% respectively. Variables are as defined in equation 1.

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GENDER DIFFERENTIAL AND MARKETING EFFICIENCY AMONG RETAILER HEADS OF HOUSEHOLDS IN MINITUBER YAM MARKETING IN ABIA STATE, NIGERIA

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ABSTRACT
The study was conducted to determine the socio-economic characteristics and the factors influencing the marketing efficiency of male and female retailer heads of households in minituber yam marketing in Abia state, Nigeria. Multistage sampling technique was used for the study. Data collected from 202 retailers heads of households were subjected to simple descriptive, statistical and Ordinary Least Squares (OLS) multiple regression model. Results of the study showed that minituber yam marketing by male and female retailer heads of households in the study area was gender sensitive, profitable and efficient. Fifty-five (55.0) percent of the variations in marketing efficiency of male retailer heads of households and 52.0 percent of the variations in marketing efficiency of female retailer heads of households were significantly explained by the socio-economic variables investigated in the study area. These results called for public policy for increased gender access to improved socio-economic variables that significantly increase the marketing efficiency of the marketers in the supply of minituber yam from minituber yam producers to seed yam producers, and thereby promote economic development in terms of increase in employment, income and food security in the study area.
Keywords: marketing, mini-tuber yam , efficiency, gender

INTRODUCTION
Recent advances in the marketing of root and tuber crops in sub-Sahara Africa had laid emphasis on market participation by farmers in the marketing of cassava (Okoye, *et al*., 2010), sweet potato (Ohajianya and Ugochukwu, 2011) and potato (Sebatta *et al.* 2012). Madueke (2013) reported on market participation by male and female heads of households (middlemen) in the marketing of ware yam in Abia state. This study was directed at minituber yam marketing by male and female retailer heads of households, in order to meet the aggregate demand for minituber yam from seed yam producers, and thereby increase the output of ware yam for food consumption and industrial uses in the study area. Yam (*Dioscorea rotundata*) is an important tropical tuber crop with socio-cultural and economic values. In Nigeria, yam is ethnocentric and is designated a "king crop" among other roots and tubers (Chukwu and Ikwelle, 2000). The crop contributes significantly to national economy and rural income by providing employment to many rural dwellers (Asumugha *et al.,2010*) and cheap carbohydrate staple for over 80 percent of the populace (Nwachukwu, 2008), and reduces poverty level (Emokaro and Law-Ogbomo, 2008). In Nigeria, scarcity and high cost of seed yam are major challenges in ware yam production and marketing and the contribution of yam production to economic development. This has made minituber yam marketing by male and female heads of households assume great importance in meeting the aggregate demand for minituber yam (planting material) from seed yam producers. In Nigeria, both male farmers (74%) and female farmers (26%) adopt the minituber yam technique of seed yam production (Asumugha *et al.*, 2007). Minituber yam technique of seed yam production is more economic and more readily reduces scarcity and high cost of seed yam by supplying planting material to seed yam producers at a seed rate of 8000 stands ha^{-1} (Ogbonna *et al*., 2010) compared to the minisett technique which supplies planting material to seed yam producers at a seed rate of 40,000 stands ha^{-1} (Okoli *et al.*, 1982). Minituber yam ranges in weight from 30 to150 grams realized from 6-10 grams cut setts. It could be planted directly on ridges, mounds or beds, and the average yield ranges from 9 to 11 ton ha^{-1} (Ogbonna *et al*., 2010). It implies that, in Nigeria, effective gender roles in minituber yam production and marketing have implications for increasing the supply of minituber yam (planting material) from minituber yam producers to seed yam producers and thereby increase the production of ware yam for food consumption and industrial uses. In Abia State, efficient marketing of minituber yam by male and female retailer heads of households promotes economic development by meeting the aggregate demand for minituber yam from seed yam producers. The entire minituber yam production, distribution and marketing chain has potential to increase employment, income and food security among the marketers.

Objectives of the Study
The objectives of study were to determine the socio-economic characteristics and the factors influencing the marketing efficiency of male and female retailer heads of households in minituber yam marketing in Abia state, Nigeria.

METHODOLOGY

Data Collection

Multistage sampling technique was used for the study. The three agricultural zones in Abia State, namely Aba agricultural zone, Ohafia agricultural zone and Umuahia agricultural zone were used for the study. The 9 local government areas (LGAs) used for the study comprised 3 LGAs randomly selected from each agricultural zone. The 36 markets used for the study comprised 4 markets randomly selected from each LGA selected for the study. Ten (10) respondents were randomly selected from each of the 36 markets randomly selected for the study. The 360 heads of households selected for the study comprised 158 wholesaler heads of households and 202 retailer heads of households. The respondents were selected from a list of registered marketers (males and females) in each selected markets, with the assistance of the agricultural extension agents and enumerators assigned to the local government areas (LGAs) studied. Well structured questionnaires administered to the 202 retailer heads of households were used to collect cross-sectional primary data on socio-economic characteristics and specific marketing variables influencing minituber yam marketing in the study area.

Data Analysis

Data collected from retailer heads of households were subjected to simple descriptive, statistical and econometric analysis in order to achieve the objectives of the study. Objective i - the socio-economic characteristics of the marketers were analyzed using simple descriptive statistics such as tables, means and percentage values. Objective ii – factors influencing the marketing efficiency of the marketers were estimated using the Ordinary Least Squares (OLS) multiple regression model, based only on data from minituber yam net sellers (household heads whose net sales are positive) (Okoye *et al*., 2010; Onyenobi, 2015). The model is implicitly expressed as follows:

$Y = f(X_1, X_2, ..., X_{14}, e_i)$ ……. (1)

where:

Y = Marketing efficiency of household head (%); X_1 = Age of household head (years); X_2 = Marital status (dummy variable: 1 = married; 0 = unmarried); X_3 = Household size (number); X_4 = Educational level of household head (years); X_5 = Marketing experience of household head (years); X_6 = Cooperative membership (dummy variable: 1= member; 0 = non-member); X_7 = Access to credit (dummy variable: 1 = formal; 0 = informal); X_8 = access to market information (dummy variable: 1 = yes; 0 = no); X_9 = Transportation cost (₦ kg^{-1}); X_{10} = Loading/offloading cost (₦ kg^{-1}); X_{11} = Packaging cost (₦ kg^{-1}); X_{12} = Storage cost (₦ kg^{-1}); X_{13} = Market taxes (₦ kg^{-1}); X_{14} = Net marketing margin (income) (₦ kg^{-1}); X_1-X_{14} = vectors of explanatory variables influencing marketing efficiency of heads of households; e_i = Error term.

Four functional forms of the multiple regression model viz: the linear, exponential, semi log and double log functional forms were fitted to the data. The best-fit regression form was chosen as the lead equation for the study based on statistical and econometric criteria such as the value of coefficient of multiple determination R^2, level of significance of the overall equation (F-statistic), number and level of significance of each coefficient in the model, and sign of each coefficient relative to a priori expectations of the OLS multiple regression model. following other studies (Onyenobi *et al*. 2013; Onyenobi, 2015).

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Male and Female Retailer Heads of Households in Minituber Yam Marketing in the Study Area

The socio-economic characteristics of the marketers (Table 1), indicate that minituber yam marketing by male and female retailer heads of households in the study area was gender sensitive and offered vast employment opportunities for sustained increase in yam production for food security and income in the study area.

Determination and Comparison of the Factors that Influence the Marketing Efficiency of Male and Female Retailer Heads of Households in Minituber Yam Marketing in the Study Area

Table 2 shows the OLS regression results for factors influencing the marketing efficiency of male and female retailer heads of households in minituber yam marketing in the study area, using only data on socio-economic characteristics of net sellers, following Okoye *et al* (2010) and Onyenobi (2015). Among male retailer heads of households (Table 2), the exponential log functional form was chosen as lead equation for the study. The coefficient of multiple determination R^2 of 0.5535 for the lead equation was significant based on the F-value (2.23) that was significant at 10.0 percent probability level. This indicates that 55.35 percent of the variations in marketing efficiency of male retailer heads of households were significantly explained by the variables investigated in the study area. The five (5) socio-economic variables that significantly influenced their marketing efficiency include education level, cooperative membership, packaging cost, market taxes and net marketing margin. The coefficient of educational level (-0.020) was negatively and significantly related to marketing efficiency of male retailer heads of households at 10.0 percent probability level, but not in conformity with *a priori* expectation. This implies that an increase in educational level significantly led to a decrease in marketing efficiency of male retailer heads of household in the study area. This indicates that male retailer heads of households with low formal education increased their marketing efficiency when they belonged to cooperatives.

The coefficients of packaging cost (-1.262) and market taxes (-3.478) were negatively and significantly related to marketing efficiency at 5 percent probability level, in conformity with *a priori* expectations. These imply that an increase in packaging cost and market taxes significantly led to a decrease in marketing efficiency of male retailer heads of households in the study area. The negative effects of packaging cost and market taxes on marketing efficiency of male retailer heads of households in the study area agree with other studies (Fafchamps *et al*., 2002; Anyaegbunam, 2013) on the negative effect of marketing cost on marketing efficiency in the study area. The coefficients of cooperative society membership (0.470) and marketing margin (income) (0.110) were positively and significantly related to marketing efficiency of male retailer heads of households at 1.0 and 5.0 percent probability levels respectively, in conformity with *a priori* expectations. The positive effect of cooperative society membership on marketing efficiency of male retailer heads of households is very informative because cooperative society members have more access to agricultural information, credit and other production inputs as well as more enhanced ability to adopt innovations which increase the level of efficiency in both production and marketing of agricultural produce. The positive effect of net marketing margin (income) on marketing efficiency indicates that minituber yam marketing by male retailer heads of households in the study area was profitable.

This positive effect in the marketing chain provided opportunities for employment, income and food security among male retailer heads of households in the study area.

On the other hand, among female retailer heads of households (Table 2) the semi log functional form was chosen as lead equation for the study. The coefficient of multiple determination $R^2 = 0.5241$ for the lead equation was significant based on the F-value (4.64) that was significant at 1.0 percent probability level. This indicates that 52 percent of the variations in marketing efficiency of female retailer heads of households were significantly explained by the variables investigated in the study area. The six (6) socio-economic variables that significantly influenced their marketing efficiency include household size, educational level, access to credit, transportation cost, storage cost and marketing margin. The coefficients of household size (-0.225), was negatively and significantly related to marketing efficiency of female retailer heads of households at 5.0 percent probability level, but not in conformity with *a priori* expectation. This is because female retailer heads of households with large proportions of people aged 1 to 18 years and over 60 years and invalids usually put more effort in the upbringing and upkeep of their households and less in marketing activities that increase their efficiency. The coefficients of transportation cost (-0.571) and storage cost (-1.537) were negatively and significantly related to marketing efficiency of female retailer heads of households at 5.0 percent probability level, in conformity with *a priori* expectations, and in agreement with other studies (Fafchamps *et al*., 2002; Anyaegbunam, 2013) on the negative effects of variable and fixed costs on marketing efficiency. The coefficients of educational level (0.517), access to credit (0.165) and marketing margin (0.213) were positively and significantly related to marketing efficiency at 1.0, 10.0 and 5.0 percent probability levels respectively, and in conformity with *a priori* expectations. These imply that increase in the positive effect of each of these factors significantly led to an increase in marketing efficiency of female retailer heads of households. This positive effect in the marketing chain provided opportunities for employment, income and food security among female retailer heads of households in the study area.

CONCLUSION

Minituber yam marketing by male and female retailer heads of households in the study area was gender sensitive, profitable and efficient. Fifty-five (55.0) percent of the variations in marketing efficiency of male retailer heads of households were significantly explained by five (5) socio-economic variables (educational level, cooperative society membership, packaging cost, market taxes and marketing margin), while 52.0 percent of the variations in marketing efficiency of female retailer heads of households were significantly explained by six (6) socio-economic variables (household size, educational level, access to credit, transportation cost, storage cost and marketing margin). These results call for public policy for increased gender access to improved socio-economic variables that significantly increase the marketing efficiency of the marketers in the supply of minituber yam from minituber yam producers to seed yam producers, and thereby promote economic development in terms of increase in employment, income and food security in the study area.

Table 1: Mean Socio-Economic Characteristics of Male and Female Retailer Heads of Households in Minituber Yam Marketing in Abia Nigeria

	Male Retailer Heads of Households				Female Retailer Heads of Households			
Marketing Variable	Net Seller	Aut-arky	Net Buyer	Pooled Mean	Net Seller	Aut-arky	Net Buyer	Pooled Mean
Age	41.53 (4.75)	41.87 (6.10)	46.20 (4.44)	43.20 (5.10)	42.79 (5.26)	46.60 (4.88)	46.60 (5.50)	45.33 (5.21)
Marital Status (%)	77.78	75	45	65.93	80.95	80	60	73.65
Household Size	5.19 (2.01)	5.50 (2.27)	6.60 (0.89)	5.76 (1.72)	5.50 (2.19)	7.40 (0.55)	6.40 (0.55)	6.43 (1.10)
Educational Level (years)	11 (2.68)	9 (5.55)	12 (0.00)	10.67 (2.74)	9.43 (4.62)	12 (0.00)	12 (0.00)	11.14 (1.54)
Marketing Experience (years)	9.22 (3.50)	_	10.20 (1.64)	6.47 (1.71)	9.64 (3.85)	_	10 (1.22)	6.55 (1.69)
Cooperative Membership (%)	75	_	_	25	73.81	_	_	24.60
Access to Credit (%)	19.44	_	_	6.48	21.42	_	_	7.14
Access to Market Information (%)	41.67	_	40	27.22	42.86	_	20	27.62

Observations of Retailer Heads of Households = 202, comprising:
Male Retailer Heads of Households: Net Sellers (72), Autarky (16), Net Buyers (10); and
Female Retailer Heads of Households: Net Sellers (84), Autarky (10), Net Buyers (10).
Note: Figures in parentheses are standard deviations.

Source: Field survey data, 2014.

Table 2: Comparison of the OLS Lead Equation Forms for Factors Influencing Marketing Efficiency of Male and Female Retailer Heads of Households in Minituber Yam Marketing in Abia State, Nigeria.

Variables	Variables Male Retailer Heads of Households +Exponential Log Functional Form	Female Retailer Heads of Households ++Semi Log Functional Form
Constant	0.612(0.38)	2.700(1.75)*
Age (X_1)	-0.003(-0.35)	0.220(0.65)
Marital status (X_2)	-0.045(-0.50)	-0.087(-0.93)
Household size (X_3)	-5.03e-4(-0.02)	-0.225(-2.34)**
Education level (X_4)	-0.020(1.92)*	0.517(5.67)***
Marketing experience (X_5)	-0.016(-1.18)	0.089(1.16)
Cooperative membership (X_6)	0.470(4.43)***	0.109(1.27)
Access to credit (X_7)	0.081(0.85)	0.165(1.92)*
Access to market information (X_8)	0.029(0.40)	-0.061(-0.91)
Transportation cost (X_9)	0.074(0.52)	-0.571(-2.45)**
Loading/offloading cost (X_{10})	0.045(0.18)	-0.287(-0.57)
Packaging cost (X_{11})	-1.262(-2.76)**	0.702(0.49)
Storage cost (X_{12})	-0.051(-1.16)	-1.537(-2.82)**
Market taxes (X_{13})	-3.478(-2.83)**	-0.109(-0.13)
Net margin (X_{14})	0.110(2.47)**	0.213(2.50)**
R^2	0.5535	0.5241
Adjusted R^2	0.4948	0.4111
F-Ratio	2.23*	4.64***

Source: Field survey data, 2014.
+ = Lead equation for male retailer heads of households
++ = Lead equation for female retailer heads of households
***, **, *, = significant at 1%, 5% and 10%, respectively.
Figures in parentheses are t-ratios.

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DYNAMICS OF WOMEN PARTICIPATION IN COOPERATIVE SOCIETIES IN NIGERIA: A STUDY OF RURAL WOMEN IN KABBA/BUNU LOCAL GOVERNMENT AREA OF KOGI STATE

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ABSTRACT
The study examined the level of participation of women in cooperative organization in Nigeria, with a focus on rural women in Kabba/Bunu local government area of Kogi State. Attention was focused on women involvement in cooperatives as a means of improving their standard of living and as a means of boosting their businesses. The two-stage random sampling techniques were used to select 80 respondents and 8 cooperative organizations, while descriptive statistics and Logit regression analysis were used to analyze data collected from the survey. The result of the descriptive analysis shows that most of rural women in the study area engage in cooperatives, the logit regression analysis indicate that the number of dependants, educational level, distance to the nearest cooperative, cost of transport and expected benefits significantly determined membership of cooperative societies among rural women. In terms of the constraints, inadequate capital, lack of awareness, work load in the household, lack of specialization, lack of training and experience were the most significant challenges women face in cooperative activities. The study recommends that government should provide a policy platform to enhance provision of financial assistance and affordable farm credits to cooperative members, while also promoting public awareness on the importance of engaging in cooperative societies.

Keywords: cooperative, women participation, Kogi

INTRODUCTION
Co-operative societies are service enterprises aimed at rendering service to its members, as defined by International Cooperative Alliance (1995), cooperative is an autonomous association of persons united voluntarily to meet their common economic, social, and culture needs and aspiration through jointly owned and democratically controlled enterprises. The International Labour Organization (ILO, 1995), viewed cooperative as important in improving the living and working conditions of women and men globally as well as making essential infrastructure and services available even in areas neglected by the state and investors-driven enterprises.

The growing need for credit and access to the basic necessities of life and articles of trade led to the formation of most of the co-operative societies. Cooperatives offer women as members the opportunities for participation and influence over economic activities, thus, women gain self- reliance through their participation as well as access to opportunities which they would not have been able to obtain on their own (ILO, 2002). Active participation of women in all function of cooperative including social, economic planning, decision making and implementation plays a significant role in the overall development of society (Sintayehu, 2003). Women form a significant part of the population in the rural areas, and are involved at all stages of agricultural enterprises, (Njar, 1990; Mgbada, 2002; Rahman, 2004).

In spite of the availability of cooperative societies and efforts of government and Non-Governmental Organizations (NGO's) at various levels to support these organizations, it appears that a significant proportion of rural women are either unaware of the existence of such co-operative societies or are lacking in the basic socioeconomic characteristics that form the prerequisite for participation in such activities (Idrisa *et al.*, 2007). This study examined the level of participation of women in cooperative organization and major problems militating against cooperative membership in the study area.

RESEARCH METHODOLOGY
The study was carried out in Kabba/Bunu Local Government Area (LGA) of Kogi State, Nigeria. Data were collected with the aid of a well structured questionnaire. Data collection involved a multi-stage random sampling technique used to select 80 rural women and 8 cooperative societies. In the first stage, four towns were randomly selected (Kajola, Okedayo, Aiyeteju and Aiyewa). In the second stage 20 rural women were randomly selected making a total of 80 respondents. For the cooperatives, 2 cooperatives were selected from each town to give a total number of 8 cooperatives and questionnaires were administered to them.

Data analysis involved the logit regression analysis, mean score, and simple descriptive statistics such as frequency distribution, cross-tabulation and likert scales. The Logit model was used to establish the determinants of cooperative membership, with a linear function of the predictors specified as:

$$\text{Logit}(\pi_i) = X_i^1 B_i$$

Where X_i is a vector of covariates X_1 …………X_n defined in this study as shown in Table 3.
The constraints faced by women membership of cooperative societies in the study area were identified using the mean score, using the following formular:

$$\bar{X} = \frac{\Sigma f x}{N}$$

Where $\bar{X}$= means response, Σ= Summation, f= number of respondents choosing a particular scale point, x= numerical value of the scale point and N= total number of respondents to the item. The mean score was calculated with women responses that were obtained using a four Likert type of scale specified as follows: Strongly agreed (4), agreed (3), disagreed (2), strongly disagreed (1). It was specified that any constraint with a mean score equal or above 2.5 was considered a major constraint while those below 2.5 were considered not a constraint.

RESULTS AND DISCUSSION

Table 1 presents the socio economic characteristics of the respondents described as age, marital status, household size, number of dependants, educational level and self-assessment of poverty. The result shows that the majority of the respondents (63.75%) were married, and between the ages of 20 to 40, suggesting greater involvement of married people in cooperatives perhaps as a result of high family/household economic demand. The result also shows high percentage (80%) of dependants, and high levels of education among the respondents are generally high when compared with the Eastern and Northern regions which recorded only 38% and 28% respectively (Audu *et al*., 2010).

Table 2, presents the distribution of women cooperative societies by modes of operations. The result indicates that majority (50%) of the co-operative membership size ranges between 51-100 members and less than 50 and above 100 have the same percentage which implies that most of the cooperative societies membership size are within 50 – 100. The result also shows that co-operatives in the study area get their credit facilities through savings of members, suggesting that government does not render financial assistant to cooperative societies in the study area.

Table 3 presents the result of the logit regression used to analyse factors that determine cooperative member of rural women. The result shows that number of dependants, educational level, distance to the nearest cooperative, cost of transport and expected benefit significantly determined membership of cooperative societies while age, marital status, household size and occupation were not statistically significant. This suggests that rural women of all ages and marital status could potentially be members of cooperative societies. The finding also suggest that household size does not influence cooperative membership choice of rural women, while number of children or elderly in a household affects the choice of respondent becoming members of cooperative society, indicating that households with larger number of dependants are more likely to be cooperative members. Also, rural women that are more educated are more likely to be cooperative members, while distance to the nearest cooperative affects choice of membership such that the farther the distance and cost of transport to the nearest cooperative society, the less likely their choice of been a member.

Table 4 presents the constraints that militate against women membership of cooperative societies. The result suggests that the major constraints faced by cooperative women in the study area is inadequate capital, lack of awareness and workload, while lack of specialization, lack of training and experience, lack of cooperation/loyalty, and language barrier, lack of information and cost of getting to the nearest cooperative are not among the major constraints.

CONCLUSION AND RECOMMENDATIONS

Despite the barriers militating against women's participation in cooperative societies, their level of participation is not affected as the benefit they derived outweighs those challenges they face. The capacity to expand their businesses in terms of financial needs becomes less of a problem to them because the cooperative societies in which they are members have served as a reservoir of capital where with adequate budget, they can draw out capital for their businesses. The economic empowerment of women through cooperative societies will not only raise the standard of their livelihood but also benefit the entire community in which they live. In view of the findings, the study recommends the following: Government should promote a policy platform to enhance provision of financial assistance to cooperative members in the rural areas especially those who cannot meet the requirements of securing loan from banks. Government should promote public awareness on the importance of engaging in cooperative societies especially in the rural areas. To solve the problem of loyalty, cooperative societies should set up a disciplinary committee which should liaise with law enforcement agencies. Cooperatives members should trained on record keeping, this might involve the services of extension officers. The government should provide support for cooperatives that engage in agricultural activities by providing inputs at affordable rate.

Table 1: Distribution of Respondents According to their Socio- Economic Characteristics.

Variables	Frequency	Percentage (%)
Age		
20 – 40	51	63.75
41 – 60	23	28.75
61 – 80	6	7.5
Marital status		
Single	14	17.5
Married	50	62.5
Divorced	8	10.0
Window	8	10.0
Household size		
1 – 5	50	62 .5
6 – 10	27	33.75
11 – 15	3	3.75
Dependents		
0	6	7.5
1 – 5	64	80.0
6 – 10	8	10.0
11 – 15	2	2.5
Number of years of Formal Educational		
0	0	0
1-6	19	23.75
7-12	12	15.0
12 and above	49	61.25

Source: Field survey, 2015

Table 2: Distribution of Women Cooperative Societies by Modes of Operations

Variable	Percentage
Meeting time	
Morning	37.5
Afternoon	50.0
Evening	12.5
Committee election	
Democratic	100.0
Others	0.0
Any membership qualification	
Yes	12.5
No	87.5
Management structure	
Staff members	12.5
Part time	37.5
Full time	50.0
Type of record	
Attendances register	37.5
Minute book	12.5
Ledgers	50.0
Membership size	
1 – 50	25.0
51 – 100	50.0
100 and above	25.0
Saving structure	
Weekly	
Monthly contribution	100.0
Credit facilities	
Members	100.0
Non Members	0.0

Source: Field survey, 2015.

Table 3: Logistic Regression Analysis on the Effect of Socio Economic Characteristics on Drive to be a Co-operative Member

Variable	Marginal Effects	Standard error	P-value
Age	0.0571626	0.1254079	0.649
Marital status	-0.0914116	0.239494	0.941
Household size	0.2962088	0.4263918	0.487
Dependant	0.0513112**	0.3022871	0.042
Educational level	0.1406996**	0.0608975	0.021
Occupation	-0.5673282	0.9465708	0.549
Distance to the nearest cooperative	-0.1296778**	0.3091778	0.015
Cost of transport	-0.0435405*	0.0233868	0.063
Expected Benefit	0.2013855 *	0.6166045	0.051

Source: Field survey, 2015. Note: * significant at 10%, ** Significant at 5%
Log- likelihood = -10.022096

Table 4. Distribution of Respondents according to the constraints that militate against women membership of co-operative societies

S/N	Constraints	Mean	Ranking
1.	Inadequate capital	2.60	1st
2.	Lack of awareness	2.55	2nd
3.	Work load in the household	2.50	3rd
4.	Lack of specialization	2.46	4th
5.	Lack of training and experience	2.45	5th
6.	Poverty status of household	2.43	6th
7.	Lack of cooperation/loyalty among members	2.41	7th
8.	Inability to apply for loan on individual basis	2.36	8th
9.	Language barrier	2.36	8th
10.	Lack of access to information	2.33	9th
11.	Lack of demand of better prices for their product	2.24	10th
12.	Cost of getting to the nearest cooperative	1.95	11th

Source: Field survey, 2015.

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COMPARATIVE ANALYSIS OF THE PROFITABILITY OF CASSAVA PRODUCTION BY GENDER IN ANAMBRA STATE, NIGERIA

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ABSTRACT
This study was designed to estimate and compare the profitability of cassava production by gender in Anambra State. A multi-Stage random sampling technique was used in choosing the sample. Primary data collected from a sample of 120 farmers consisting of 60 males and 60 females were analyzed by descriptive statistics (mean, frequency and percentage) and net income analysis. The socio-economic result indicates that farmers in the area are small scale farming in less than 1ha of land with majority of them attained primary school and had mean farming experience of about 20-23 years. The cassava production provided profit to the male and female farmers as indicated by net income of N40864.31 and N68672.91 respectively. The results calls for policies that aimed at encouraging and increasing the cassava production level of male and female farmers through mechanization, good market facilities, provision of processing plants and soft loan provision to farmers.
Keywords: comparative analysis, profitability, cassava, gender

INTRODUCTION

Nigerian agriculture is characterized by: multitude of small scale farmers, rudimentary farming system, low capital investment, low yield per hectare and inefficiency with which farmers manage resources on their farms to improve crop production (Okonkwo, *et al.*, 2016). Most importantly, due to low capital investment and low yield per hectare, the income from farm is so small that youths are being discouraged to invest on agriculture (Okonkwo, *et al.,* 2016). Perhaps, the alarming situation over the sector especially crop production has prompted government of Nigeria to recently encourage the use of cassava to produce wide range of industrial and food products such as ethanol, glue, glucose, syrup and confectionaries (bread, cake, chin-chin, etc) (Sanni *et, al.,* 2005). Cassava is now one of the most important staple food and cash crops that has played and continued to play remarkable roles in the food sector of Nigeria (Agwu and Anyaeche, 2007). It accounts for up to 40% to 50% of all calories consumed in southern and central parts of Nigeria (FAOSTAT, 2010). The crop is readily adaptable to different environmental conditions and well suited for integration into the farming systems and socioeconomic conditions of Africa (Nweke, 1996a). The crop's ability to provide a stable food base is a function of its flexibility in terms of planting and harvesting strategies and because of its relative tolerance to poor soil and pests/diseases problems (GOG, 1996).

Okonkwo, *et al.,* (2016) reported that cassava production is a profitable enterprise that would better-off the standard of living of farmers as well as improve the economic development of a nation if full concentration would be paid to it. Reports have shown that a higher proportion of cassava farmers, in Nigeria get a higher income from its production than they get from most other major staples (Ezeibe, *et al.,* 2015).

According to Kock and Krysher (2010), gender inequity is a "worldwide problem" and is an extremely significant debilitating factor in many countries of the world over economic development. Past experiences have shown that rural agricultural (cassava inclusive) development programmes or initiative do not affect the lives of men and women equally. Cassava was traditionally among the crops grown by male in Nigeria not until recent time when the female involvement started increasing due to the impact of the crop to economic development of the country (Ewebiyi and Arimi, 2013). Male and female were found to specialize in different tasks in cassava enterprise (Carter and Jones, 1989). Men work predominantly on land clearing, ploughing and planting while women specialized on weeding, harvesting, transporting and processing (FAO, 2009). Women are now known to play more active role in cassava production, processing, storage and marketing than men (Nsoanya and Nenna 2011). Based on these differences in the gender work in cassava enterprise, there should be a significant difference in the profit from the sector by male and female. Therefore because of the apriority expectation on the profit margin, this study was designed to estimate the profitability analysis of the cassava production by gender in Anambra State.

METHODOLOGY

Study Area

This study was conducted in Anambra State, in South Eastern Nigeria, which comprises of 21 Local Government Areas (LGAs) namely: Aguata; Awka North; Awka South; Anambra East; Anambra West; Anaocha; Ayamelum; Dunukofia; Ekwusigo; Idemili North; Idemili South; Ihiala; Njikoka; Nnewi North; Nnewi

South; Ogbaru; Onitsha North; Onitsha South; Orumba North; Orumba South; Oyi. The State is divided into four Agricultural zones; Aguata, Anambra, Awka and Onitsha (ASADEP, 2003). It was created on 27th August 1991; with its capital at Awka. Its population figure was estimated to be 4,055,048, (NPC, 2006); the State has two main ethnic groups; the Igbo with a population of about 3973947 (98%) and Igala with a population of about 811001 (2%) who live in the North western part of the State (ASADEP, 2003).

The area lies within the 6°13' and 7° 9' North and longitudes 7°49' and 7°57' East (Nfor, 2006). It covers a land area of about 4,416sq km of the total land area of Nigeria: about 70% of this is arable land, and less than 55 percent is under cultivation (NPC, 2006). The area lies mainly on plains under 200M above sea level (ASADEP, 2003). It has tropical rain forest vegetation, humid climate and a rainfall of between 152mm- 203mm. It experiences two seasons in a year; from late October to early May marks the dry season while from April to early October marks rainy season (Okorji *et al.*,2012).

Farming is the predominant occupation of the rural inhabitants. The main crops in the State are roots, tubers, cereals and tree crops. Cassava is a crop that grows and thrives in all the agro-ecological zones of the LGAs in the State (PIND, 2011). The State has comparative resource advantage in the production of cassava (ASADEP, 2003): available markets for the sale of products from crops (ASADEP, 2003).

Sample Selection

A multi-stage sampling technique was used in choosing the samples. Anambra agricultural Zone was randomly selected for the study. Secondly from the selected zone, three (3) extension blocks were randomly selected. Thirdly, two villages were randomly selected from each of the block, thus a total of six villages were selected. In the fourth stage, 20 respondents (that is 10 male and 10 female) were randomly selected from each of the village. Thus a total of 120 cassava farmers were selected for the study. The farmers were selected from the list of 350 registered cassava farmers provided by Anambra Agricultural Zone, Anambra State.

Data Analysis

Descriptive statistics such as mean, frequency, and percentages was used to estimate the socio-economic characteristics of the respondents.

The profitability analysis was analyzed using net income (NI) model. The model is specified as follow:

NI = TR-TC

Where; NI = Net Income

TR = Total Revenue (Price x output quantity)

TC = Total Cost (Total Variable Cost + Total Fixed Cost)

Profitability Index (PI) = $\frac{Net\ Income}{Total\ Revenue}$

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents:

The distribution of respondents according to socio-economic characteristics of the respondents is presented in table1.The results in Table1 show the socio-economic characteristics of the respondents. The results show that the mean age of male farmers was 49 years while that of female farmers was 48years. This implies that the farmers were within their active age therefore, they will adopt any technology or intervention that would gear towards improving their cassava production system. This is because new technology in agriculture requires physically able men and female. This finding is consistent with the findings of Rathmen, *et al.*, (2002).

The result of educational status indicates that 38.33% attained primary school education while 43.33% of the female farmers attained secondary school education. This implies that female farmers had higher level of educational than their male counterparts and therefore would be better-off to cope with cassava production technologies introduced to them than male. Education predisposes farmers to be innovative and puts them in a better position to cope with the challenges of the adoption of new technologies introduced to them (Adewuyi, *et al*., 2013).

Male farmers had an average household size of 5 persons while female farmers had 4. The implication is that male farmers have more persons under their care than the female farmers. This indicates that male farmers would have more labour availability in their household than the female farmers since family size is one of the determinants of family labour or labour force in a society. The report from (FAO, 2011) showed that female headed households had less labour available for farm work than male- headed households because they typically had fewer working age adult members but more dependents.

From the findings, male farmers had mean farming experience of 20 years while female farmers had 23 years. This implies that female farmers had more cassava farming experience than their male counterparts in the area and therefore would tend to adopt innovations on cassava than men.

The mean farm size for male farmers was 1.8 ha while female farmers had 1.2 ha. The results show that arable land was more available to male farmers than their female counterparts. This could be that male farmers had access to farm land than female farmers due to culture. This is consistent with FAO, (2010) who stated that globally women scarcely own land due to norms and custom. The results further show that famers were more of small farm holders since they had farm size less than 5 ha. This is consistent with Onyebinama, (2004) who stated that farmers with less than 5 ha of farm land are small holder farmers.

Profitability of Cassava Production among men and women

The results in Table 2 show the profitability analysis of one hectare of cassava produced from improved cassava production technologies by gender.

The average total cost of producing a hectare of cassava by male farmers was N100232.98, average total revenue was N141097.29 and average net income was N40864.31 with a total cost of N91470.51, total revenue of N160143.42 and net income of N68672.91 obtained by female farmers. The results imply that cassava production was more profitable for female farmers than their male counterparts probably due to the cassava profit orientation training undergone by women during women and youth empowerment training (NRCRI, 2013). The more profit by female farmers indicated that women traditionally are known to play more active role in cassava production, processing, storage and marketing (Nsoanya and Nenna 2011) which in turn provide them with income. Mgbekor and Nwamba,(2013) also noted that women are more involved in virtually all activities like production, processing, and marketing of cassava which provided them with additional income- earning opportunities and enhanced their ability to contribute to their household food security.

The profitability index results show that the male farmers had profitability index of 0.29 while female farmers had 0.43. The implication is that female farmers had higher return to investment capital on cassava production than male farmers. The results also indicate that when a male farmer invests N1 on cassava production, 0.28k will be obtained in return compared to a female farmer who invests N1 on cassava production with 0.43k realized on it. The result is inconformity with the finding of Adeoye *et al*., (2013) who reported that, women are almost entirely responsible for the production of cassava which provides them with additional income earning opportunity and enhance their ability to contribute to house hold food security.

CONCLUSION AND RECOMMENDATION

The results show that farmers in the area are small scale farm-holders that operate on less than 5ha of cassava farm and use mainly rudimentary farm tools for farm work. The results also show that cassava enterprise is a profitable venture to male and female farmers but female had the higher profit margin than the male. The study would be a window to economic development of a nation if fully embraced. This work therefore calls for policy initiative that would gear towards enhancing the cassava production enterprise of Nigeria and other African countries; there should be an establishment of cassava processing plants in cassava production areas in order to improve on cassava value addition and reduce glut thereby increasing the income of the farmers. Cassava production in Nigeria should be mechanized in order to encourage not only the youths into its production. There should be also well established market facilities for sale of cassava products. Finally both government and NGOs should provide soft loan to farmers to encourage large scale production.

Table1: Distribution of respondents according to socio-economic characteristics:

Variables	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Age (Years)				
18-35	9	15.00	6	10.00
36-53	28	46.67	30	50.00
54-71	23	38.33	18	30.00
72-89	0	0	6	10.00
Mean	**49**		**48**	
Educational Status				
Primary School	23	38.33	20	33.33
Secondary School	22	36.67	26	43.33
Tertiary	10	16.67	8	13.33
None	5	8.33	6	10.00
Household Size				
1-5	35	58.33	38	63.33
6-10	25	41.67	22	36.67
11-15	0	0	0	0
Mean	**5**		**4**	
Farming Exp (yrs)				
1-10	15	25.00	7	11.67
11-20	28	46.67	20	33.33
21-30	12	20.00	18	30.00
31-40	4	6.00	14	23.33
41-50	1	1.67	1	1.67
Mean	20		23	
Farm Size (ha)				
0.1-2.0	42	70.00	55	91.67
2.1-4.0	15	25.00	5	8.30
4.1-5.0	3	5.00	0	0
6.1-7.0	0	0	0	0
Mean	**1.8**		**1.2**	

Source: 2015 Field survey

Table 2: Estimated Profitability Per ha of Improved Cassava Production Technologies For The Male and Female:

			Male			Female		
	Budget Item	**Unit**	**Average Quantity**	**Price per Unit (₦)**	Revenue (₦)	**Average Quantity**	**Price per unit (₦)**	**Revenue** (₦)
A	**Cassava output**	**Tones**	**11.5**	**12269.33**	141097.29	**12.3**	**13019.79**	**160143.42**
	Variable cost							
B	**Cost of inputs**							
	Cassava cuttings	Bundle	45	450	20250	45	450	20250
	Fertilizer	50kg	2.5 bags	6000	15000	2 bags	6000	12000
	Manure	(bag)	0	0	0	10 bags	150	1500
	Herbicides	50kg	5	800	4000	5	800	4000
	Total	(bag)			**39250**			**37750**
		Litre						
C	**Cost of Labour**							
	Land clearing	**Md**	**10**	650	6500	12	600	7200
	Stumping	**Md**	**7**	578.33	4048.31	9	350	3150
	Ridging	**Md**	**12**	850	10200	14	650	9100
	Planting	**Md**	**6**	482.5	2895	7	550	3850
	Supplying	**Md**	**4**	441.67	1766.68	5	250	1250
	Herbicide	**Md**	**3**	642.5	1927.5	4	300	1200
	application	**Md**	**3**	450	1350	3	400	1200
	Fertilizer	**Md**	**6**	505.83	3034.98	8	350	2800
	application	**Md**	**5**	1028	5140	7	300	2100
	Supplementary				**36862.47**			**31850**
	weeding (one)							
	Harvesting							
	Total							
D	Miscellaneous cost				2801			1050
	Total Variable cost (B+C+D)				**78913.47**			**70650**
E	**Fixed cost**							
	Cutlass		6	593	3558	9	650	5850
	Hoe		7	785.83	5500.83	8	350	2800
	Wheel barrow		1	8703	8703	1	7500	7500
	Axe		1	1190	1190	1	950	950
	Head pan		2	906.5	1813	4	750	3000
	Annual depreciation				554.68			**720.51**
	Total Fixed cost				**21319.51**			**20820.51**
	(TFC)				**100232.98**			**91470.51**
	Total Cost (TC)				**40864.31**			**68672.91**
	(B+C+D+E)							
	NI=TR-							
	TC(A(B+C+D+E))							

Source: Field Survey 2014. Note: TR = Total Revenue, NI= Net Income

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COCOYAM PRODUCTION IN THE 21ST CENTURY: A CASE STUDY ON THE PARTICIPATION OF WOMEN IN AHABA IMENYI, ABIA STATE NIGERIA

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ABSTRACT
A survey of the involvement of women in cocoyam production in meeting food demand for the new century was conducted on forty-four households in Ahaba Imenyi in Isuikwuato LGA of Abia State. The questionnaire technique was adopted after random sampling of households in three communities in the area. Of the 44 respondents, 35(79.5%) were aged 31 and above, 26(59.1%) had only primary education, 5(11.4%) had secondary education while 13(29.5%) had no kind of formal education. Also, only 9(20.5%) were civil servants. The rest were either fulltime farmers or combined farming with petty trading. The study revealed that cocoyam production is on the decline in the study area as it ranked third compared with other root and tuber crops. Long-term socio-economic stability of the womenfolk is yet to be fully assured even through historical evidence of women's role as food producers reveal that women have been and still are key players in food production. Women cocoyam farmers are saddled with lots of production and processing problems.
Keywords: Cocoyam, women participation, production, Nigeria

INTRODUCTION
The involvement of women in agricultural production, storage and processing cannot be disputed worldwide. Historical evidence of women's role as food producers in Africa generally and Nigeria in particular does not seem to be fully realized in long-term socio-economic stability (Boserup, 1970; Beringer, 1978; Buvnie and Mehra, 1990; Muchena, 1994; Imoh, 1997). Women contribute significantly to social and economic life, and their income is becoming increasingly necessary to all households yet they are not recognized in development planning (Steady, 1985; Oladunmi, 1992; ILO, 1994). In Nigeria, women farmers participate actively in food production and processing mainly at the subsistence level, with little developed technology inputs and information services.
Cocoyams are grown in many parts of the tropical regions of the world. Nigeria is the world's largest producer of cocoyams, and most of Nigeria's cocoyams are grown in the southeastern part of the country. Cocoyam production has encountered neglect in recent times partly because it is a female crop along with cassava and vegetables, and partly because of inappropriate technology and population pressure. It is regrettable note that of all root and tuber crops in our society, cocoyams seem to have received the least research attention, even in present times. No wonder, it has featured least in national development programmes. The corms of cocoyam contain digestible starch as well as substantial amount of protein, vitamin C, thiamine and niacin. It is also a crop with promising economic value (Knipscheer, et al., 1980). Cocoyam is used as fufu, portage, soup paste. It can be eaten roasted or boiled with palm oil, also the fresh and tender leaves are used as vegetables (Nwagbo, et al., 1982).
In Ahaba Imenyi cocoyam is a female crop. Like all female crops cocoyam production and processing remain undervalued partly because they have not attained commercial or economic value. Since women farmers in the area depend largely on traditional agriculture for subsistence, any meaningful effort for their effective participation and improved living standards must be directed toward improving their production and storage technology. Therefore, there is urgent need to encourage women farmers and to bring them to the limelight of sustainable agricultural development worthy of the new millennium. Thus, this is the basis of the survival on the extent of women participation in cocoyam production.

METHODOLOGY
Three villages (Amaogudu, Amahia and Amainyi) were randomly selected from Ahaba Imenyi a community in Imenyi one of the admistrative units in Isuikwuato LGA of Abia State, Southeastern Nigeria. Isuikwuato is presently made up of three administrative units (Imenyi, Oguduassa and Isuamawo). Furthermore, a systematic random sampling of households with average family size of 9 was carried out and 63 respondents were drawn for the study. However, only 44 respondents were actually available for interview. A set of structured questionnaire administered to married women was used to collect data for analysis. Data were analyzed using descriptive statistics.

RESULTS AND DISCUSSION

Social-economic characteristics of women farmers

Most of the women of this community are farmers and petty traders. Many of them (56.8%) belong to the age group of 31-40 years. While 29.5% belong to the age group 41 -50 years. This implies that the younger women are either away to the cities for greener pastures or are engaged in other occupations. Most of the women had primary education (59.1%), while 29.5% had no formal education (**Table 1**). These findings agree with Monsen, (1991) that women of developing countries are moving into farm activities.

Production of cocoyam in relation to other tuber crops in the area

The major tuber crops grown in the area include cassava, yam, cocoyam and three leaved yams. Cassava, in this community, was a female crop, but today it is being cultivated by both men and women because it has achieved great economic value. It is the number one crop cultivated in the area today. All of the respondents (100%) cultivate cassava. Cocoyam ranks number three tuber crop cultivated in the area (**Table 2**). It has continued to be a female crop, that is, men do not grow cocoyam in the area. The study revealed that only 34 percent of respondents still grow cocoyams. The growing of cocoyam is still done with traditional methods and tools without any scientific improvement. This has resulted in low average yields even at the subsistence level. Cocoyam farming has continued to be on the decline since after the civil war in this country. Respondents gave various reasons for the decline in cocoyam cultivation in the area. Many of the respondents (80%) attributed the change to poor yield. Others (76%) said less social value is attached to its fufu and as a result they pay more attention to cassava farming while 97.7% said that cocoyam production has less economic value when compared to other tuber crops grown in the area (**Table 2**).

Cocoyam Production Problems

The major production problems are those arising from diseases and storage. All of the respondents (100%) said this was the major problem in cocoyam production. Many others (79.5%) responded that lack of planting materials constitute another major problem since most of the coccyams are consumed after harvest (**Table 3**). Also 30% of respondents attributed lack of improved planting materials as part of the problems against cocoyam. It is regrettable that both government and the people have neglected the importance of the valuable crop in our farming systems.

CONCLUSION

It is widely accepted that women play important role in food production generally. It is also acknowledged that productivity on the part of women could be enhanced if constraints on their path are removed. In the case of cocoyam production in our study area, disease control measures, storage facilities and the removal of socio-cultural and economic barriers attached to the utilization of cocoyam will surely increase its production. Secondly is the removal of the existing differential access to agricultural inputs such as extension services, farm implements, and appropriate intermediate technology that will be available and affordable locally. Government should intervene through the mass media as the appropriate information service to encourage the production and the use of cocoyam-based on its nutritional importance. Its uses could be enlarged and commercialized. Research Institutes how mandate is on improvement of this crop like the NRCRI, Umudike should be funded adequately to be able carry out its work. We can have industrial powder and chip from cocoyams. Cocoyam processing industries should be established and agric engineers should be trained by the Federal Government to fabricate cocoyam processing machines. These no doubt will culminate into surplus production and food security.

Table1. Social-economic characteristics of women cocoyam farmers

Social characteristics	Number of respondents	Percentage
Education		
Primary	26	59.1
Secondary	5	11.4
No formal education	13	29.5
Age		
21-30	6	13.6
31-40	25	56.8
41- 50	13	29.5
Occupation		
Farming	35	79.5
Petty trading	34	77.2
Civil servants	9	20.4
Marital status		
Married	34	77.2
Separated	2	4.5
Widowed	7	15.9
Divorced	1	2.2

Table 2. Cocoyam production in relation to other tuber crops in the area

Crops	Number of Respondents	Percentages
Cassava	44	100
Yam	11	25
Cocoyam	15	34.1
Three leaved yams	35	79.5

Table 3. Response to cocoyam production problems

	Number of Respondents	Percentages
Diseases/Storage	44	100
Lack of planting materials	35	79.5
Lack of improved technology	44	100
Ignorance of nutritional value of cocoyams	34	77.2
Inputs (material/human) less economic value	43	97.7

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME V:

CLIMATE CHANGE: CLIMATE SMART TECHNOLOGIES, RENEWABLE ENERGY, GREEN ECONOMY & HEALTH

DETERMINANTS OF CLIMATE CHANGE VULNERABILITY IN SOME RURAL COMMUNITIES OF KATSINA STATE, NIGERIA

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ABSTRACT
This study estimates the determinants of climate change vulnerability in some rural communities of Katsina state. A total of 150 respondents were randomly selected from fifteen communities across nine LGA which were purposefully selected for the study. Both structured questionnaires and Focus Group Discussions were used to elicit information from the respondents. Multi-criteria vulnerability index, descriptive statistics and multiple regressions were used to analyze the data. The study shows that 43% of the households in the communities perceived themselves to be more vulnerable to climate change than other households. Unusual rainfall pattern and cropfailure were the major concern expressed by community members due to climate change. The study also shows that amount of credit accessed, Shannon index and membership of association are the determinants of household climate change vulnerability in the study area. The study calls for good policies that will enhance credit access and utilization; diversification of crop production, forming and strengthening of farmer's associations in their areas.
Keywords: climate change, farmers, diversification, Multi-criteria vulnerability index

INTRODUCTION
Climate variability and change according to Abaje *et.al* (2014) is one of the greatest socio-economic and bio-physical challenges confronting the world in the 21st century. Climate change is a long term shift, alteration or change in the type of climate prevailing over specific location, region or the entire planet. In Nigeria, climate change impact is not same in all the regions. The Northern region of Nigeria is more likely to suffer the impacts of climate change than other regions because it is naturally characterized by extreme weather conditions (Sada, 2002). Climate change has affected adversely agricultural production in Katsina State (Adeola *et al.* 2014). This lends credence to the vulnerability of northern region to the adverse effect of climate change. Therefore to approach the issue of climate variability appropriately, Apata *et.al.*,(2009), maintained that, one must take into account rural communities' understanding of climate change, since they are the most vulnerable. Vulnerability as used in this study is the probability of an acute decline in access to food or consumption often in reference to some critical values that defines minimal values of human well-being (Kuku-Shittu *et al., 2013)*. Also, as these local communities perceive climate change as having a strong spiritual, emotional, and physical dimension due in part to their level of exposure. It is assumed that these communities have an inborn, adaptive fore knowledge from which to draw and survive in high-stress ecological and socio-economic conditions. This study therefore aims at understanding the perception of households on their vulnerability to and concern for climate change and well as estimating the determinants of rural household's vulnerability to climate change in the study area.

METHODOLOGY
Katsina state, one of the seven states in the North-western region of Nigeria has thirty-four Local Government areas. The state has land mass of about 24,192 square kilometers and a population of about 6 million peoples. The location of the state falls within longitudes 7^0 30^1E and $7^0 50^1$ E of the Greenwich Meridian and latitudes 12^0 15^1N and $12^0 25^1$ N of the equator. The temperature range within the state is between 17^0C and 33^0C while rainfall ranges from 800mm to 100mm per annum. Crop production and livestock farming are the two major agricultural practice within the state. The agro-ecological zones in the state are Savannah around the wetter parts of the state, Sudan and Sahel in the drier part of the state.

For this study a total of nine Local Government areas (LGA) were purposefully selected; three from each of the agro-ecological zones in the state to capture climatic variability and other characteristics of interest. Fifteen communities were randomly selected from the selected LGA where focus group discussions were conducted to get information on certain indicators as perceived by the community members. Multi-criteria Analysis Vulnerability Index, ordinary lead square regression and simple descriptive statistics were used to analyze the data collected.

Multi-Criteria Analysis (MCA) Vulnerability Index

A vulnerability index was computed using the multi-criteria analysis approach adapted and modified from a study by Mengesha (2013). It combines different socio-economic and bio-physical factors is assessing the vulnerability of households in the study area. For the purpose of MCA analysis, the scores were described in numbers and standardized by converting each value to a Z-score from which a single aggregated (Vulnerability Index) was established. The vulnerability index thus obtained was used as dependent variable against some socio-economic variables to establish the relationship that exist between them. The regression equation is as presented below:

$V_{index} = X_0 + X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + \varepsilon_0$

Where:

V_{index}= Vulnerability Index, X_0= constant of the model, X_1= age of the household head in years, X_2=household size measured as the number of people in the household,X_3= Amount of credit accessed for farm work in Naira, X_4= number of associations that a farmer belong to,X_5= dependency ratio (the ratio of members of household employed to those not employed),X_6= Shannon index (measure of degree of diversification), ε_0= error term

RESULTS AND DISCUSSION

The farming communities are societies where there are different levels of interactions among the households. It therefore means that households are aware of their vulnerability levels relative to some other households in the same communities. Overtime, with respect to climate change vulnerability, according to fig. 1, about 43% of the households believed they feel the impact of climate change more than others. On the other hand, 44% of the household interviewed perceived that they are better than others in terms of vulnerability to climate change. This implies that households in farming communities are aware of the effect of climate change in their farming operations and other activities; in addition to its resultant effect on household welfare. This understanding will aid the implementation of good policies that will ameliorate the adverse effect of climate change on the rural communities.

Figure 2 shows the major concerns expressed by households in the study areas. Ranking highest among these are crop failure and unusual rainfall pattern which are the concerns of more than 80% of the households. Other concerns are increased temperature, low crop yield and animal sicknesses of which about 60%, 60% and 56% of the households indicated as major concerns respectively. These concerns are in line with a priori expectation given that are global effects of climate change and well documented.

A regression analysis was used to investigate the factors that affect climate change vulnerability. The results on table 1 shows only age and farm size as major factors that influence vulnerability.

The R-square of the model is 24% indicating that the independent variables account for about 24% of the variability that occur in the vulnerability of the farming households in the communities studied. The result shows that the amount of credit accessed, Shannon index and number of association that the household head belong to are factors that have significant influence on household vulnerability in the area. The amount of credit accessed, Shannon index and number of associations that the household head belong to are significant at 5%, 1% and 10% levels and are all negatively related to the level of vulnerability to climate change that each of the households experienced. This implies that as each of these socio-economic variables increase the level of susceptibility to the adverse effect of climate change increases. This is in line with the *a priori expectation*. The amount of credit received, the level of crop diversification (Shannon index) and the number of association belong to should help to shield the households from the effect of climate change antecedents on their socio-economic standards.

CONCLUSION

The households have genuine concerns resulting from limate change. Major among these are crop failure and unusual rainfall pattern. The study established the fact that there is a relationship between climate change vulnerability and the variables examined since none of the coefficients is zero. Household size, the amount of credit accessed, Shannon index (diversification) and number of associations belong to are significant determinants of vulnerability to climate change in the study area. The study recommends that in view of the nature of climate prevalent in the study area, government should irrigate more farmlands for the farmers. This will help cater for the failure of crops which in most cases are due in part to delayed or unusual rainfall pattern. Furthermore, it is recommended that policies that will enhance credit access and utilization should be put in place; farmers should diversify crop production and farming activities such as practicing mixed farming in order to reduce risk inherent in single crop or livestock farming. Finally, farmers should form themselves into social associations and strengthened the existing ones

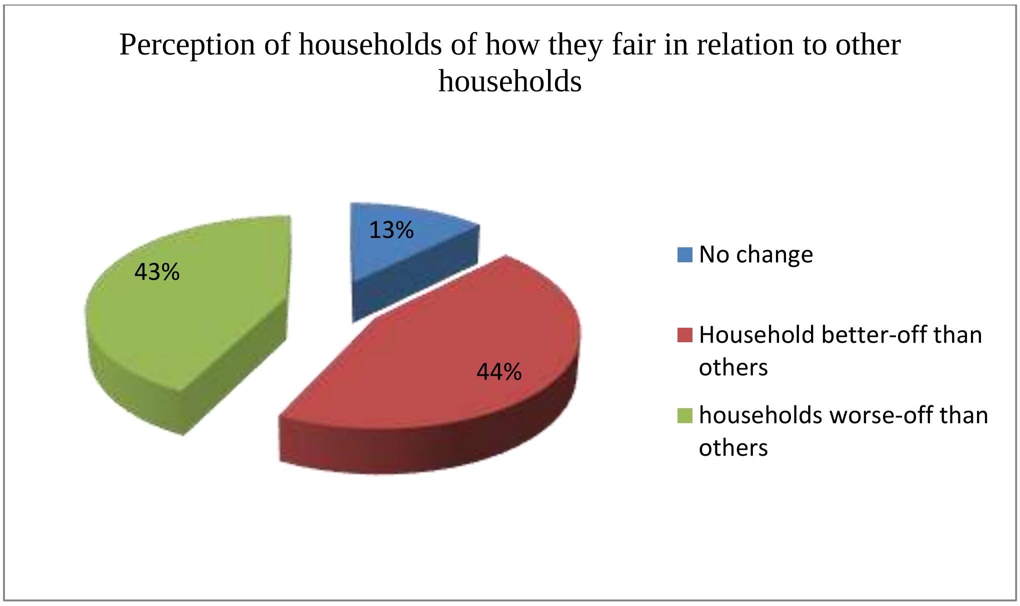

Figure 1: Perception of climate change impact on different households

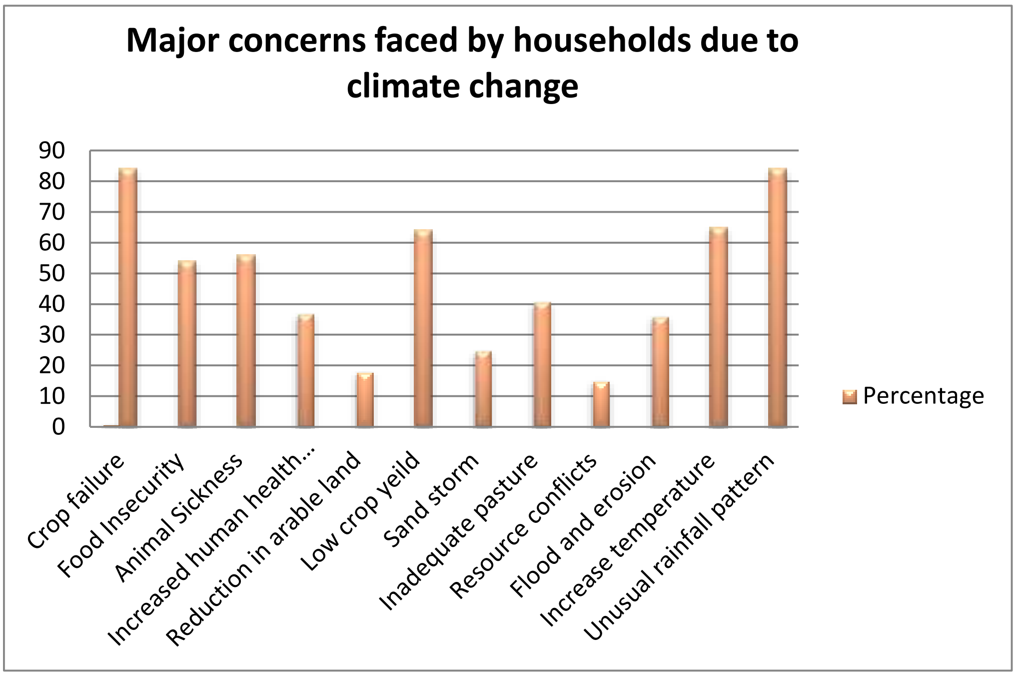

Figure 2: Major concerns faced by households due to climate change

Table 1: Regression Analysis

Variables	Coefficients	t-ratio
(Constant)	26.991	4.448
Age	0.143	1.485
Household size	-0.326	-0.197
Credit Amount	-7.69E-005	-1.933*
Dependency Ratio	-0.097	-0.544
Shannon Index	-26.800	-3.644***
No of Associations	-1.924	-1.632*
R-square = 23.9 %		

Source: computed from field survey 2016

*, **, *** =sig at 10%, 5% and 1% level respectively level

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CLIMATE SMART AGRICULTURAL (CSA) PRACTICES IN AJIWA AGRICULTURAL ZONE OF KATSINA STATE, NIGERIA

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ABSTRACT
The need for farmers to maximally use Climate Smart Agriculture (CSA) to curb the negative effect of climate change is of paramount importance. This study was carried out to estimate the extent to which CSA is been practiced in Ajiwa agricultural zone of Katsina state. A total of 119 questionnaires were administered in six villages across two local government areas. The tools for analysis were descriptive statistics and Adaptation Strategy Use Index (ASUI). The results from the research shows that majority of the respondents are male (94.96%) more than 16 year farming experience (51.26%). Also, the perception of the farmers about climate change indicates that temperature is on the increase, while rainfall is decreasing. Likewise, the effect of climate change on crop yield is negative, while the state of water supply has worsened as a result of climate change. Majority of the respondents also opined that the magnitude of drought in the study area is moderate. The ASUI results indicates that Planting of drought and heat tolerant crops is the most commonly used CSA practice in the study area. This is necessary in curbing the problem of shortage in rainfall, increase in temperature and shortage of water supply posed by climate change. The study therefore recommends that farmers should be encouraged by extension agents and private agencies interested in agriculture to practice CSA frequently in order to boost agricultural production in the face of climate change.
Keywords: Climate Smart Agriculture, climate change, ASUI, temperature and rainfall.

INTRODUCTION

The concept of "Climate-Smart Agriculture" was invented by the United Nation Food and Agriculture Organization (FAO) in 2010. According to the original definition, "Climate-Smart Agriculture" is agriculture that "sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation) and enhances achievement of national food security and development goals". The term Climate-Smart Agriculture (CSA) has developed to represent a set of strategies that can help to meet climate change challenges by increasing resilience to weather extremes, adapting to climate change and decreasing agriculture's greenhouse gas (GHG) emissions that contribute to global warming (Steenwerth *et al*., 2014).

The need for CSA practices cannot be underestimated as agriculture also contributes to greenhouse gases emission. Smith, *et al*. (2014) posits that cattle and rice production contribute vast quantities of methane that contributes to greenhouse gas emission and also, during the production of synthetic nitrogen fertilizers, Nitrous oxide, another powerful greenhouse gas, is released to the atmosphere and it is also released from soils that are fertilized. The emission of methane and Nitrous oxide from the agricultural sector amount to between 10 and 12% of total global greenhouse gas emissions (Smith *et al*., 2014).

As a result of the above, global yields of maize and wheat have already been shown to reduce by 3.8% and 5.5% respectively since 1980, relative to what they would have been in the absence of climate change due to changing climates (Lobell *et al*., 2011). Although climate change is global, but its impact in less developing countries are more hence FAO focuses its work in these countries, with a mandate that includes helping to eliminate hunger and food insecurity, and increasing the resilience of developing countries to the impacts of climate change on agriculture (Doreen, 2014).

According to Wheeler and von Braun (2013), Global demand for agricultural products, be they food, fibre or fuel, continues to increase because of population growth, changes in diet related to increases in per capita income and the need for alternative energy sources while there is less and less additional land available for agricultural expansion. Agriculture thus needs to produce more on the same amount of land while adapting to a changing climate and must become more resilient to risk derived from extreme weather events such as droughts and floods. They also state that "Adaptation measures such as diversifying crop rotations, integrating livestock with crop production systems, improving soil quality, minimizing off-farm flow of nutrients and pesticides, and other practices typically associated with sustainable agriculture are actions that may increase the capacity of the agricultural system to minimize the effects of climate change on productivity".

To move the concept of "Climate-Smart Agriculture" forward, a number of developed countries, led by the Dutch government and the World Bank, with the US, FAO, and CGIAR playing important supporting roles, sought to create a more formal institution. The first meeting to try to generate enthusiasm for a global alliance was held in

The Hague in 2010, with subsequent meetings in Hanoi in 2012 and Johannesburg in 2013. Despite tepid reception of the idea to create a more formal alliance by most participating countries at each of these meetings, the main proponents have not been deterred in their efforts. Indeed, these same actors are now attempting to create what they call the Global Alliance for Climate-Smart Agriculture.
This research therefore seeks to find out the frequency of usage of CSA practices in the study area as a panacea to reduce the menace of climate change.

METHODOLOGY

This study was carried out in Ajiwa agricultural zone of Katsina State. This zone lies between longitude $12^0 28'$ N and latitude $7^0 29'$ E. It has a mean rainfall of about 400mm and temperature of 34.9^0, while the crops grown in this area include millet, sorghum, maize, soybean, cowpea and seseme. The people in this area speak the Hausa language.
A Multi-stage simple random sampling technique was used for this study. The first stage includes purposive selection of Ajiwa agricultural zone, because this zone is mainly agrarian and has also experience the effect of climate change. In the second stage, two (2) local government areas were randomly selected from Ajiwa agricultural zone. The third stage involves the selection of six (6) villages from the two local government areas already selected. A total of 119 respondents were used for this study.
Data collected for this research were analyzed using descriptive statistics such as percentages, frequency distribution tables and Adaptation Strategy Use Index (ASUI). The ASUI will reflect the relative position (ranking) of each of the Climate-Smart Agricultural practices identified in the study area in terms of their frequency of usage.
ASUI was adapted from Adesoji and Famuyiwa (2010) in Umunna *et al*., (2013). The frequency of use of the Climate-Smart Agricultural practices was expressed using a four-point likert scale, that is, 3, 2, 1, and 0 for Frequently used, Occasionally used, Rarely used and Not used respectively. The formula is as stated below:

$$ASUI = \frac{[(N_1 \times 3) + (N_2 \times 2) + (N_3 \times 1) + (N_4 \times 0)]}{M}$$

Where:
N_1 = Number of farm households that Frequently used a particular Climate-Smart Agricultural practice.
N_2 = Number of farm households that Occasionally used a particular Climate-Smart Agricultural practice.
N_3 = Number of farm households that Rarely used a particular Climate-Smart Agricultural practice.
N_4 = Number of farm households that did Not use a particular Climate-Smart Agricultural practices.
M = n x 3,
n= total number of respondents

RESULTS AND DISCUSSION

The results in Table 1 show that majority of the respondents are male adults with ages between 46 to 60 years, which is an active year for effective farm labour, This indicates that women who engage in farming activity in the study area are few. In terms of the educational status of the farmers, about 47.90%, which is the majority, obtained Quranic education, which is the common type of education in the study area, while 50.42% of the respondents have household size ranging from 11-20 persons. Large household sizes imply availability of more family labour, which is of benefit to the farmer in his farming activities. Majority of the farmers in the study area are well experienced in farming activities, as a large number of the farmers (88%) have been into farming for more than 16 years.
The result in Table 2 shows the perception of farmers on the impact of climate change on their cropping activities for the past five years. Farmers’ ability to perceive climate change is a key precondition for their choice of CSA practice to use. Majority of the respondents (62.18%) ascertained that there is increase in temperature for the past five years. This is in line with *a priori* expectation. It confirms that there is global warming, which has brought about an increase in temperature with negative effect on crop production. About 94.96% of the respondents perceived decreased rainfall pattern for the past five years. Rainfall/precipitation is a vital requirement for agricultural activity and if there is shortage in rainfall, it will definitely affect crop production. This result agrees with Gbetibouo (2011) who found out that over the years temperature has been increasing and rainfall/precipitation has been decreasing due to climate change impact. Also, 89.92% of the respondents affirm that climate change has negative effect on their crop yield, 90.76% said that the state of water supply in their environment has worsened as a result of climate change, while 88.39% stated that the magnitude of drought in their farming environment is moderate. All these indicate that climate change has one way or the other affected the cropping system in the study area negatively. There is therefore the need to use CSA as a panacea to these problems.

The results in Table 3 show the frequency/degree of usage of Climate Smart Agriculture as resilience to climate change impact in the study area. The result indicates that Planting of drought and heat tolerant crops is the major CSA practice in the study based on the ranking, while planting of cover crops, use of organic manure, crop rotation and crop diversification are second, third, fourth and fifth respectively in terms of ranking. Soil conservation techniques and mulching are the least used Climate Smart practices in the study area. The CSA practices used by the farmers may depend on their perception of climate change and its impact on their farming activities. The ranking in Table 3 supports the results in Table 2, as majority of the farmers in the study area carry out their cropping activities using drought and heat tolerant crops, since the major effect of climate change in the study area are increasing temperature, decreasing rainfall and low water supply.

CONCLUSION

The results from this study reveal that the farmers in the study area are practicing the various types of CSA at different frequencies. From the results, it is clear that planting of drought and heat tolerant crops is the commonly used CSA practice in the study area and this is as a result of the challenge of low rainfall, high temperature and little water supply being faced by the farmers. The study therefore recommends that farmers should be encouraged by extension agents and private agencies in the agricultural sector to practice CSA frequently in order to boost agricultural production in the face of climate change.

Table 1: Socio-economic characteristics of respondents

Variables	Frequency	Percentage (%)
Age:		
31-45	28	23.53
46-60	70	58.82
61-75	20	16.81
76 and above	1	0.84
Gender:		
Male	113	94.96
Female	6	5.04
Education:		
No formal edu	5	4.20
Quranic edu	57	47.90
Primary edu	24	20.17
Secondary edu	22	18.49
Tertiary	11	9.24
Marital Status:		
Single	3	2.52
Married	111	93.28
Widowed	5	4.20
Household size:		
1-10	57	47.90
11-20	60	50.42
21 and above	2	1.68
Farming experience:		
1-15	12	10.08
16-30	61	51.26
31-45	34	28.57
46 and above	12	10.08
TOTAL	**119**	**100**

Source: Field survey (2016)

Table 2: Perception of respondents on Climate change impact

Features of Climate change	Increasing	Decreasing	No change
Change in temperature	74 (62.18)	45 (37.82)	-
Change in rainfall pattern	5 (4.20)	113 (94.96)	1 (0.84)
Effect of Climate change on crop yield	**Positive**	**Negative**	**No change**
	9 (7.56)	107 (89.92)	3 (2.52)
Effect of Climate change on water supply	**Improved**	**Worsened**	**No change**
	8 (6.72)	108 (90.76)	3 (2.52)
Magnitude of drought*	**Mild**	**Moderate**	**Severe**
	11 (9.82)	99 (88.39)	2 (1.79)

Source: Field survey (2016)
Note: Figures outside the bracket are frequencies, while the ones in the bracket are percentages (%).
*=Only 112 respondents out of the 119 indicated that their crops were affected by drought.

Table 3: Frequency of usage of Climate Smart Agriculture (CSA)

S/N	Climate Smart Agriculture (CSA)	ASUI	Ranking
1	Conservation agriculture	0.5518	6th
2	Agro-forestry	0.3109	8th
3	Use of organic manure	0.8431	3rd
4	Crop rotation	0.8123	4th
5	Crop diversification	0.6022	5th
6	Mulching	0.1177	10th
7	Use of wetland (Fadama)	0.3698	7th
8	Planting of drought and heat tolerant crops	0.9440	1st
9	Planting of cover crops	0.9188	2nd
10	Soil conservation techniques	0.2101	9th

Source: Field survey (2016)

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ASSESSMENT OF FARMERS' PERCEPTION OF CLIMATE CHANGE AND ADAPTATION STRATEGIES ADOPTED ON CROP PRODUCTION IN KAFUR LOCAL GOVERNMENT AREA, KATSINA STATE

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ABSTRACT
This paper assesses farmers' perception of climate change and adaptation strategies adopted on crop production in Kafur Local Government Area, Katsina State. The study focused on the perceived causes of climate change, nature of climate change, consequences of climate change and adaptation strategies. Multi stage sampling technique was adopted to select 135 crop farmers in 2014 cropping season. Data were elicited from the farmers using structured questionnaire and analyzed with descriptive statistic such as percentages and likert scale. Results obtained revealed that 83.33%, 60% and 62.50% of the respondents indicated burning of fossils fuel from vehicles, deforestation and bush burning as the major causes of climate change respectively. Other causes of climate change perceived by the farmers were desertification/loss of forest resources (47.61%) and erratic rainfall pattern (41.49%). The constraint faced by rural farmers in adapting to climate change were: lack of access to weather forecast on farming season (80.86%), limited access to improved crops and draught resistant varieties (64.4%) and absence of government policy on adaptation programs to rural farmers (54.93%). Indigenous adaption strategies used by crop farmers were use of wet land/valley (81.21%), multiple cropping system (77.10%), and mulching (72.28%). It is recommended that research institutes should train farmers on the use of draught tolerant/resistant varieties and adoption of sustainable land management practices to adapt to climate change.
Key words: climate change, perception, adaptation strategies, crop production, family farming

INTRODUCTION
United Nation framework convention on climate change (UNFCC, 1992) define climate change as a change of climate which is attributed directly or indirect to humans activities that alter the composition of global atmosphere which is addition to natural climate variability observed over comparable time periods. Climate change is one of the most serious environmental threats facing mankind worldwide; it affects agricultural activities in several ways including its direct impacts on food production. Climate change which is attributable to the natural climate cycle and human activities has adversely affected agricultural productivity in Africa (Ziervogel et al. 2006). Available evidence shows that climate change is global but its impact is more in developing countries especially those in Africa, due to their low level of coping strategies (Nwafor, 2007; Jay tap, 2007). As a result of this impact, it is projected that crop yield in Africa may fall between 10-20% by 2050 or even up to 30% due to climate change particularly because African agriculture is predominantly rain fed and hence fundamentally dependent on the vagaries of weather (IPCC, 2007; Deresa et al 2008).
Nigeria is one of those developing countries (Odjugo, 2010) that is susceptible to the varies of climate change impact especially the northern region than other regions in Nigeria due in part to its geographical location. As the planet warms, rainfall pattern shift and extreme event such as drought, floods and forest depletion by fires become more frequent, it aggravates the impact on rural people as they strive to overcome other challenges such as poverty and advance their economic status through increases capacity on crop production. More so, some northern and regional rural areas have not made efforts towards tackling the menaces. Other habits such as deforestation and over grazing on land resources and burning of bush indiscriminately is a common practice among our rural areas that aggravates these impact. Although the issue of climate change on agriculture is not a recent development, there has been little or no efforts aimed at scientifically documenting the existing situations among our rural communities in the northern region.
Federal and State Governments have made some effort to mitigate and adopt strategies on the risk of changing climate. The efforts are still rudimentary especially when compared with the impending catastrophe such as drought, drying of streams, irregular rain patterns, rise in sea level, flooding, heat stress and outbreaks of newly formed disease among rural communities where their major activities are farming and livestock production. It is against this background that this study seeks to x-ray knowledge regarding farmers' perception on causes, constraints and strategies adopted for climate change in Kafur Local Government Area.

METHODOLOGY
This study was conducted in Kafur Local Government Area of Katsina state. It is found 218km away from Katsina, the state capital. And lies between the longitude 26^0 E and latitude 16.2^0 N. kafur has 10 geo-political wards and

two districts with a population of 329,257 (NPC, 2006). The major occupation of the people are farming, trading and livestock production. The major food crops grown are maize, guinea corn, rice, groundnut, cotton and millet. Based on preliminary survey conducted, a multi-stage sampling technique was adopted to select 135 crop farmers. In the first stage, two districts Kafur and Daneji were chosen purposively. In the second stage, three wards, Kafur, Gozaki and Mahuta were randomly sampled out of all 10 wards. In the third stage, three villages were randomly sampled from 3 wards. A sample frame was obtained from the farmer's association and fifteen (15) farmers were randomly sampled from each of the villages selected for the study.

Data for the study was obtained through questionnaire and personal interviews. Information sought included: personal bio data, awareness, perceptions, causes of climate change and measures of adaptations etc.

Analytically, descriptive statistics such as mean, percentage and likert scale were used in analyzing data collected.

Analytical Approaches

A 3 point likert rating scale was used to measure the level of agreement of perceived causes and constraints in adapting to climate change using often (3), seldom (2) and never (1). Respondents with mean score of 2.0 and above imply they are in agreement that the attributes are important while respondents with mean score of less than 2.0 were not in agreement. And a 5 point likert rating scale was used to measure the level of agreement on the perception of the nature of climate change using strongly agreed (5). Agreed (4), strongly disagreed (3), disagreed (2) and undecided (1). Respondents with mean score of 3.0 and above imply they are in agreement that the attributes are important while less than 3.0 were not in agreement.

To determine the mean likert level = Xs = OX. Xs of each item was computed by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum with the number of respondent to the items. This can be summarized with equation below

$$Xs = \sum fn/N$$

Where Xs = mean score

$\sum$ =summation

f = frequency

n = likert nominal value

N = number of the respondents

RESULTS AND DISCUSION

The results in Table 1 Show the likert scale analysis of perceived causes of climate change in Kafur Local Government Area. The result show that the burning of fossil fuel, deforestation and bush burning had mean scores greater than 2 except overgrazing and excessive irrigation and chemicals. Burning of fossil fuel, deforestation and bush burning had mean scores of 4.00, 3.33 and 2.96 respectively. This implies that they were in agreement with respect to the response questions. This response show evidence of varying causes of climate changes.

Farmers' Perception on the Nature of Climate Change

The results in Table 2 show the response rate analysis of farmers' perception on the nature of climate change in the study area. The results show that desertification (3.89), erratic rainy season (3.57) and drying of streams and rivers (3.16) were the most important and significant perceived nature of climate change in the area. The mean scores were greater than 3 indicating they are in agreement with the response questions.

Constraints in Adapting to Climate Change

The result in Table 3 shows the likert scale analysis of farmers' constraints on adapting to climate change in the study area. The result shows that lack of access to weather forecast (3.10), limited access to improved/ drought resistant varieties (3.04) and absence of government policy on adaptation (3.01) are the most important constraints on adapting to climate change in the area. The mean scores were greater than 3 indicating they are in agreement with the response questions.

Adaptation Strategies

The result in Table 4 shows the actual adaptation strategies used by the farmers in the study area. The result shows that use of wet land/valley (3.79), multiple cropping system (3.17) and mulching (3.10) were the most dominant system in the study area. This therefore implies that most of the farmers in the study area are aware and use many adaptation strategies to mitigate the effects of climate change on crop production. This result is in line with Molua (2008), Rudolf and Hermann (2009) and Apata *et al* (2009), that the main strategies for reducing climate risk is to diversify production and livelihood systems like soil and water management measures and plant protection measures that are varied to maintain adequate crop yields.

CONCLUSION

The results show that burning of fossil fuels and human activities like bush burning, indiscriminate cutting of trees were perceived causes of the changing climate while the rains are decreasing leading to decreased cop yields in the study area. Respondents perceived the constraints on adapting to climate change to be lack of access to weather forecast and limited access to improved /drought resistant varieties. It is evidenced from this study that crop farmers are experiencing change in climate and they have already devised a means to survive. It is recommended that reliable and effective measures of adaptation need to be implemented and made accessible to end user.

Table 1: Likert scale Analysis of Perceived Causes of Climate Change

Variable	Often	Seldom	Never	Total	Mean	Rank
Over grazing	62.50 (250)	22.50 (90)	15.00 (60)	400	2.96	3
Bush burning	15.38 (30)	25.64 (50)	58.97 (115)	195	1.44	4
Deforestation	60.00 (270)	22.22 (100)	17.77 (80)	450	3.33	2
Excessive irrigation/chemical	39.08 (68)	31.61 (55)	29.31 (51)	174	1.29	5
Burning of fossil fuel	83.33 (450)	9.26 (50)	7.41 (40)	540	4.00	1

Source: field survey, 2014

Figures in parenthesis are response frequencies.

Table 2: Likert Scale Analysis of Farmers' Perceived Nature of Climate Change

Variables	SA	A	SD	D	U	Total	Mean	Rank
Erratic rainy season	41.49 (200)	24.90 (120)	12.86 (62)	16.60 (80)	4.15 (20)	482	3.57	2
Unusual early rain	30.00 (90)	33.33 (100)	10.00 (30)	23.33 (70)	3.33 (10)	300	2.22	5
Flood/drought	40.00 (140)	45.71 (160)	7.14 (25)	5.71 (20)	1.43 (5)	350	2.59	4
Desertification	47.61 (250)	28.57 (150)	11.43 (60)	7.62 (40)	4.76 (25)	525	3.89	1
Drying of stream/rivers	40.98 (175)	42.15 (180)	10.54 (45)	3.98 (17)	2.34 (10)	427	3.16	3

Source: Field Survey, 2014

Figures in parentheses are response frequencies

Table 3: Likert Scale Analysis on Farmers' Constraints on Adapting to Climate Change

Variables	Very serious	Serious	Not serious	Total	Mean	rank
Lack of financial support	41.57 (158)	31.58(120)	26.84 (102)	380	2.81	4
Inadequate awareness	4.35 (15)	20.29 (70)	75.36 (260)	345	2.56	5
Absence of government policy on adaptation	54.93 (223)	26.61(108)	18.47 (75)	406	3.01	3
Lack of access to weather forecast	80.86 (338)	19.14(50)	7.18 (30)	418	3.10	1
Limited access to improved/drought resistant varieties	64.39 (264)	23.19 (95)	12.44 (51)	410	3.04	2
Beliefs/practices	5.56 (10)	11.11 (20)	83.33 (150)	180	1.33	6

Source: field survey, 2014

Figures in parenthesis are response frequencies

Table 4: Likert scale Analysis of Adaptation Strategies Adopted by Farmers to Mitigate the Effect of Climate Change on Crop Production

Variables	SA	A	SD	D	U	Total	Mean	Rank
Mulching	72.28 (300)	19.28 (80)	4.82 (20)	1.20 (5)	4.82 920)	415	3.10	3
Use of wet land/valley	81.21 (415)	10.96 (56)	3.91 (20)	2.94 (15)	0.98 (5)	511	3.79	1
Mixed farming	27.90 (77)	22.10(61)	36.23 (100)	8.70 (24)	5.07 (14)	276	2.04	8
Intensive manure application	55.56 (200)	9.44 (70)	12.50 (45)	6.94 (25)	5.56 (20)	360	2.67	4
Changing in planting date	29.13 (90)	27.18 (84)	40.13 (124)	2.59 (8)	0.97 (3)	309	2.29	7
Practiced zero tillage	46.71 (156)	25.45 (85)	13.47 (45)	11.98 (40)	2.40 (8)	334	2.47	5
Multiple cropping system	77.10 (330)	11.68 (50)	5.84 (25)	4.64 (20)	0.70 (3)	428	3.17	2
Use of non-resistance/ LVS	23.00 (50)	19.00 (38)	44.50 (89)	8.50 (17)	3.00 (6)	200	1.48	9
Cereal/legume intercropping	38.46 (120)	22.44 (70)	17.31 (54)	12.82 (40)	8.97 (28)	312	2.31	6

Figures in parentheses are response frequencies
Source: Field survey, 2014

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EFFECTS OF THE SOCIO-ECONOMIC CHARACTERISTICS OF YAM FARMERS ON ADOPTION OF CLIMATE CHANGE ADAPTATION STRATEGIES IN KUJE LOCAL GOVERNMENT AREA OF ABUJA, NIGERIA

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ABSTRACT
The study was carried out to analyze the effects of the socio-economic characteristic of yam farmers on adoption of climate change adaptation strategies in Kuje Local Government Area. Questionnaires were used to collect primary data from yam farmers using random sampling procedure in the 2015 farming season. The data collected was analyzed using descriptive and inferential statistics. Results from the study indicated that only a few of the farmers were aware of the effects of climate change on crop agriculture. However, most of them practiced crop protection measures as a coping strategy to crop failure. Result of the Tobit analysis showed that age, education, household size and awareness of climate change were significant variables that determine the farmer's adoption of climate change adaptation strategies. To forestall crop failure and promote crop agriculture, the study recommends that farmers should be educated about the reality of climate change preferably using their local dialects. Policies aimed at mitigating the effects of climate change should also be implemented.
Keywords: Socio-economic, Yam, Climate, Adaptation, Kuje

INTRODUCTION
The issue of climate change has become more threatening not only to the sustainable development of socio-economic activities (including agriculture) of any nation but to the totality of human existence. Various studies by the Intergovernmental Panel on Climate Change (IPCC) have identified Africa as one of the most exposed continents to suffer the devastating effects of climate change because of inadequate adaptive capacity (IPCC, 2007).

The African rain-fed agriculture is viewed by many observers to be the most vulnerable sector to climate variability. Climate change has been a topical issue in the sustainability of environment as crop yield and production becomes very important to economy and human livelihood. The sub-humid climatic zone of Africa permits the cultivation of a variety of crops in a pattern that is responsive to local conditions (Ziervogel *et. al*., 2008 and Onyekwelu *et. al*., 2006). It follows therefore that any change in climate may affect the agricultural sector and other socio-economic activities. Agricultural production and access to food in many African countries is assumed to be severely compromised by climate variability and change in precipitation. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid area, are expected to decrease. In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020 (Brett, 2009).

Agricultural production in Nigeria is weather dependent. Climatic variability and change have a direct, often adverse influence on the quantity and quality of agricultural production in Nigeria (Umeghalu, and Okonkwo, 2012). There is observed decline in crop yield and food crop production due to reduction in rainfall and relative humidity, and increase in temperature in Nigeria (Agbola and Ojeleye, 2007). Like other developing countries, the challenge of climatic change and global warming is enormous in Nigeria due to widespread poverty. This paper therefore attempts to analyze the effects of the socio-economic characteristic of yam farmers on adoption of climate change adaptation strategies in Kuje Local Government Area of Abuja.

MATERIALS AND METHODS
This study was conducted in Kuje Local Government Area, Federal Capital Territory, Abuja, Nigeria in 2015. The Area is about 10km from the airport, and about 40km south of Abuja. Kuje Area Council is located on latitude 12^0 11'N and longitude 6^0 42'E. The Area Council comprises of about one hundred and sixty two (162) Communities, widely spread within a land mass of about 1,800 square kilometer and a population of over 420,000. It is characterize by rocky terrain which makes it difficult to access. Most of the indigenes are farmers who produce crops such as Yam, Cassava, Maize, Guinea corn and Rice. They also produce vegetables such as spinach and tomatoes along the river bank. Finally, tree crops grown in the area include mango, cashew and palm trees.

Multiple random sampling techniques was used in selecting respondents for the study. The first stage was the purposive selection of the area council because of the preponderance of yam farmers in the area. In the second stage, ten wards were randomly selected out of which a village was selected from each of the wards. Ten (10) yam farmers were selected randomly from each of the selected villages to arrive at 100 respondents who were considered for the study. Primary data was obtained from the respondents using a well structural questionnaire complimented by oral interview. The questionnaire was an open and close ended type and was designed to obtained data to suit the objective of the study. Descriptive statistics (frequencies and percentages), likert scale and Tobit regression were used to analyze the data.

Likert scale

A 3 point likert rating scale was used to measure the level of response of the respondents to the effect of climate change using 1 to denote Highly intense (HI), 2 to denote Partially intense (PI) and 3 to denote Not intense = (NI). To determine the mean likert level of each item, the frequency was multiplied with its appropriate nominal value and divided by the sum of frequency. The likert scale is expressed as:

$$\text{Weighted Average } X_w = \frac{3(N_1) + 2(N_2) + 1(N_3)}{F} \text{ -- (1)}$$

Where;

X_w =Weighted average

$N_1 + N_3$ = Rating scale

F = Frequency of respondents =100

(ii) The mean score of respondents was set at 2.00 that is

$$X = \frac{3 + 2 + 1}{3} = 2 \text{--- (2)}$$

Tobit regression

The relationship between the socio economics characteristics of the yam farmers and the probability of their adoption of climate change adaptation strategies was analyzed using the Tobit regression model. The model is expressed following Tobin (1958). Tobit decomposition frame work examines the effect of changes in the explanatory variable (Xs) on the probability of adopting measures to adapt to climate change by the yam farmers. The Tobit regression model can be mathematically expressed as follow:

$$V_i = \begin{cases} V_1 = \beta X_i + \varepsilon_i \text{ if } V_1 > V_1^* \\ V_0 = \beta X_i + \varepsilon_i \text{ if } V_1 \leq V_1^* \end{cases} \text{ -- (3)}$$

Where V_I is the number of respondents, V_0 is the limited dependent variable, it is discrete if the farmers don't adopt climate change mitigation measures (it assumes zero value if in this case) and continuous if they adopt i.e equal to V_1*. $V_I^* > 0$ implies that V_i is observed; $V_i^* \geq 0$ implies that V_I is not observed; X_I is a vector of explanatory variable; β is a vector of unknown coefficient and ε_I is an independently distribute error term.

The empirical model used for determining socio economic factors that influenced the adoption of climate change adaptation strategies by yam farmers in Kuje Local Government Area was specified as:

$$V_1 = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \varepsilon_i \text{ ------------------------------- (4)}$$

Where:

V_1 = Limited dependent variable, it is the adoption or otherwise of climate change adaptation measures.

β_0 = Constant

β_i = vector of unknown parameters

ε_i = independently distributed error term

$X_1 - X_9$ = The independent variables specified as determinants of adoption of climate change adaptation by yam farmers and defined as follows:

X_1 = Gender; X_2 = Age (year); X_3 = level of education (years); X_4 =House Hold Size (number); X_5 = Marital Status (dummy, single= 0 married=1); X_6 =membership of a co-operative (dummy, yes=1, No=0); X_7 = Farming experience (years); X_8 = Access to credit (₦); X_9 = Awareness of climatic change (dummy, aware = 1, Not aware = 0); e = error term.

The presence or absence of multi collinearity was verified by comparing the number of significant coefficients of the regressors with the coefficients of determination. According to Gujaratti (1995) multi collinearity among the explanatory variables is likely with a high coefficient of multiple determination and very few significant t-ratios of the regressors. This method according to Olayemi (1998) is better than the pair-wise correlations among regressors because high level zero-order correlations are a sufficient but not a necessary condition for the existence of multi collinearity because it can even exist when the correlations are comparatively lower than 0.5.

RESULTS AND DISCUSSION

Effect of Climate Change on Yam Production

The mean of the Likert scale was found to be 2; this therefore implies that any variable in Table 1 whose mean score was ≥2, will imply that such an effect was perceived by the farmers to be highly intense. The variables with a mean score < 2 on the other hand signifies that the effect of climate change on yam production was perceived to be low. Therefore, the farmers perceived that climate change was highly responsible for drought and irregular rainfall often experienced in the area.

Coping Strategies Adopted by the Respondents in the Study area

Result on Table 2 shows the different strategies employed by the respondents to protect their crop from the harsh effect of climatic change. Mulching, mixed cropping and increased fertilizer usage were some of the widely used strategies. Others are shading of the crop, increased used of manure and land fragmentation. This implies that the farmers put in some effort to cope with and/or mitigate the effects of climate change in the study area.

Relationship between the Socio-Economic Characteristics and Adoption of Adaptation Measures to Climate Change by the Respondents

The result of the analysis in Table 3 shows the relationship between the socio-economic characteristics and the adoption of adaptation strategies to climate change by the respondents. The result shows that the log likelihood was 61.130223 and the LR chi 2(9) = 1055. They were both significant (P<0.01). This implies that the socio economic characteristics of the respondents greatly influence their adoption of climate change adaptation strategies. The result shows that the coefficient of age (-0.056) was negative and significant at (P<0.05). This indicates that the older the respondents become, the lesser their probability of adopting climate change adaptation strategies. The coefficient of house hold size was also negative which indicate that when there is increase in the household size, it will lead to a decrease in the adoption of adaptation strategies. This is however not in consonance with the *a priori* expectation. Education and awareness of climatic changes were also significant. The implies that a unit increase in these variables is likely to result to a probability of adopting climate change adaptation strategies by the farmers.

CONCLUSION AND RECOMMENDATIONS

The study established that yam famers in Kuje Local Government Area were aware of the effects of climate change on their crops. They particularly considered the drought and irregular rainfall often experienced as some of the most important effects of climate change. Consequent upon this, they practiced some coping strategies to forestall total crop failure. The socio economic factors that affect their adoption of climate change adaptation strategies include age, level of education, household size and awareness of climate change. To keep the farmers in employment and thus promote agriculture in the area, it is recommended that:

1. Deliberate efforts should be made to educate the farmers about the reality and broad effects of climate change. To this effect; the village level extension services should be reinvigorated.
2. The farmers should have access to weather forecast at all times. This could be through broadcast in their local dialects and finally;
3. Policy issues on climate change should be implemented with the urgency it deserves.

Table 1: Distribution based on the effect of climate change on yam production

Variables	HI	PI	NI	Raw	Mean	Rank
Drought	27	70	7	228	2.28	1st
Irregular rainfall	28	49	23	205	2.05	2nd
High temperature	20	58	22	198	1.98	3rd
Flooding	16	52	32	175	1.75	4rd
Insect pest	8	46	46	162	1.62	5rd
Wind storm	8	42	50	158	1.58	6rd
Resistance weed	3	46	57	158	1.58	7rd

HI= high intense PI= partially intense NI=Not intense

Table 2: Distribution showing coping strategies adopted by the respondent

Variables	%*	Total	Grade
Mulching	83	100	1st
Mixed cropping	74	100	2nd
Increase fertilizer	68	100	3rd
Shading of crop	65	100	4th
Organic manure	62	100	5th
Land fragmentation	48	100	6th
Irrigation	47	100	7th
Planting early matured crop	47	100	7th
Early planting	43	100	8th
Cover cropping	40	100	9th

Source: field survey 2015.

Table 3: Factors influencing adoption of climate change adaptation strategies

Variables	Coefficient	Standard error	t-value
Constant	0.779	1.332	0.58
Gender	-0.228	0.496	-0.46
Age	-0.056	0.027	-2.04**
Education	0.066	0.031	2.11**
Household size	-0.170	0.074	-2.30**
Marital status	0.550	0.435	1.26
Cooperative membership	0.277	0.458	0.60
Farming experience	-0.067	0.083	-0.80
Access to credit	0.547	0.793	0.69
Awareness of climatic change	0.097	0.033	2.86**

*P<0.05 Log likelihood = - 61.130223 LR chi2(9)= 10.55***

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PERCEIVED EFFECTS OF CLIMATE CHANGE AMONG YAM FARMERS IN FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT
The study examined the perceived effects of climate change among yam farmers in the federal capital territory Abuja, Nigeria. Multistage sampling technique was used to select 100 yam farmers for the study. Focus Group Discussion and structured Questionnaire was used to elicit information from the respondents. Data obtained were analyzed using descriptive statistics, 3 point likert scale rating and 5 point likert scale rating. The respondents were within the mean age of 45 years. Farmers major sources of information on climate change were radio and television with means of (2.6) and (2.6) respectively. Farmers perception of climate change on yam production were increased in temperature (mean=4.7), reduced crop yield (mean=4.5), increased frequency of draught t(mean=4.0), increased effect of heat stress on yam (mean=4.7), Intense weed growth (mean=4.2), late tuberisation of yam (mean=4.3), post harvest losses due to climate variability (mean=3.9) and reduction on vegetation cover (mean=3.7). The study recommended that improved agricultural packages developed to help farmer adapt to climate change should be available to rural farmers example use of pest and disease resistance varieties of yam and also serious enforcement of laws and regulations at the local level to prevent indiscriminate bush burning and felling of trees to safeguard the environment.
Keywords: Climate change, perception, Yam farmers

INTRODUCTION
Agriculture is one of the sectors most vulnerable to climate change impact in Africa Falaki *et al*. (2012). Although climate change may affect the agricultural sectors of different countries in different ways, what is clear is that these changes will bring about substantial welfare losses, especially for smallholders whose main source of livelihood derives from agriculture. Across Nigeria, millions of people are already experiencing changing seasonal patterns of rainfall and increased heat.

Climate change as defined by Intergovernmental Panel on Climate Change (IPCC) (2001) as any change or shift in the average weather condition over time has become a global issue in recent times. It manifested in variations of different climatic parameters including cloud cover, precipitation, temperature ranges, sea levels and vapour pressure (FGN 2003). According to Akinnagbe and Irohibe (2014), in most African countries, crop farming is mainly subsistence and rain-fed, but due to climate change frequent and untimely raining affects harvest of produce and thus, food production.

It is evidenced that climate change will have a strong impact on Nigeria-particularly in the areas of agriculture; land use, energy, biodiversity, health and water resources. Nigeria, like all the countries of Sub-Saharan Africa, is highly vulnerable to the impacts of Climate Change (IPCC 2007; NEST 2004). It was also, noted that Nigeria specifically ought to be concerned by climate change because of the country's high vulnerability due to its long (800km) coastline that is prone to sea-level rise and the risk of fierce storms. It is important to identify various effects of climate change in vulnerable communities, which will enable the determination of the extent of risk posed by changing climate on their dominant occupation that is agriculture as well as enhance development, streamlining and up scaling adaptation strategies. This is further necessitated by the fact that the effect of climate change is location specific and these have to be determined in order to develop comprehensive and suitable adaptation strategies which will capture vulnerable communities in developing countries. It was against this background that perceived effects of climate change among yam farmers in federal capital territory were conceived.

Purpose of the study
The general objective of the study is to identify perceived effects of climate change among small-scale yam farmers in Federal Capital Territory, Abuja Nigeria. The specific objectives were to:

i. describe the socio-economic characteristics of the respondents in the study area;
ii. identify the farmer's source of information/awareness on climate change;
iii. determine the farmer's perception of the effect of climate change on yam production;

METHODOLOGY
The study was conducted in Abuja Municipal Area Council of Federal Capital Territory (FCT) Abuja to ascertain the perceived effects of climate change among small-scale yam farmers in Federal Capital territory. Using

multistage sampling technique, Abuja Municipal area council was selected for the study because of its proximity to the researcher and also is one of the major yam growing areas in Federal capital territory in the first stage, in the second stage, five communities namely orozo, karshi, Gugugu, kwoi and Tunga were selected also from the selected area council. The third stage involves the random selection of twenty yam farmers each from the selected communities, giving a total of one hundred yam farmers for the study. Focus group discussion and structured questionnaire were used to elicit information from the respondents. percentages and means were used to analyse objective 1, a 3 point likert scale rating was used to satisfy objective 2 while objective 3 was achieved by the use of 5 point likert scale rating.

RESULTS AND DISCUSSION

Socio-economic characteristics of the yam farmers

The findings in table 1 shows that majority (46%) of the farmers are still at their productive age between the ages of 31-50 years with mean age of 45years. This indicates that the majority of the respondents were within active age for agricultural production. The result is in agreement with the report of Ekwe *et al.* (2006) that most farmers are within the middle-age and vibrant in agricultural production. From the result, the yam farmers had average household size of 10 persons. This indicates that respondents have large household size which will provide adequate labour for farming activities. Household with large size tended to attach greater importance to food security than those with small size. This finding had implication for adoption level of technologies in the study area. It however signified that the farmers had a fairly large household, which could probably supply farm labour. About 61% of the farmers had 1 to 15 years of farming experience, while 38% of them had farming experience of between 16 and 30 years , The mean years of farming experience was 14 years This implied that most of the respondents had been in the farming business for a long time. Years of farming experience were important because management skills improved with experience. Hassan (2008) also indicated that experience in farming increases the probability of uptake of adaptation measures to climate change.

The farmers have different forms or levels of education suggesting that the farmers have some basic literacy, were relatively informed and have some experience in yam production. Education increases one's ability to receive, decode, and understand information relevant to making innovative decisions (Wozniak, 1984). Educated and experienced farmers are expected to be more informed about climate change and respond positively based on their knowledge. This corroborates the work of Maddison (2006) who found that educated and experienced farmers are expected to have more knowledge and information about climate change and agronomic practices that they can use in response to climate change phenomenon. Due to lack of education, a lot of traditional farming practices detrimental to the environment still persist and farmers find it difficult to modify.

Result also indicated that the average farm size was 2.9 ha, an indication that the study covered small scale family managed farm units.

Sources of information on climate change

The results in table 2 shows that the farmers most preferred source of information on climate change were radio and television with average of (2.6) and (2.6) respectively while Newspaper ,extension contact and mobile phones with average of (1.4), (1.6) and (1.3) respectively are not preferred. Radio and televisions were the major avenues through which the respondents sourced information on climate change from. These findings concur with Isife and Ofuoku (2008), who documented that radio, has the highest audience and has the strength of reaching a large population of farmers and other rural dwellers faster than other means of communication. They also noted that television provides farmers with the opportunity of seeing and hearing in the process of learning new ideas. The implication of this finding is that there is need for extension services to rise up to the challenge of information dissemination, (especially as regards the issues of climate change), as this is the central focus of its services. The result from focus group discussion indicated that farmers prefer radio because it was cheaper to use even without electricity.

Perceived effects of climate change on small-scale yam production

The results in table 3 shows that the variables listed were all perceived to be the effect of climate change on small-scale yam production in the study area. They include increase in temperature (mean=4.7), reduced crop yield (mean=4.5), increased frequency of draught t(mean=4.0), increased effect of heat stress on yam (mean=4.7), Intense weed growth (mean=4.2), late tuberisation of yam (mean=4.3), post harvest losses due to climate variability (mean=3.9) and reduction on vegetation cover (mean=3.7).This result is in agreement with the findings of Ayanwuyi et al.(2010) who found out that the dominant impact of climate change include low yield of crop, stunted growth, ease of spread of pest and diseases attack on crops.

Result from focused group discussion shows that high temperature affects yam and makes it to decay and also weeding is one of their major problems because they weed up to five times before harvesting..These are the perceived effect of climate change on yam production.

CONCLUSION

From the findings of this study, it revealed that most of the farmers were aware of climate change. Respondents perceived the effect of climate change to be increasing temperature, reduced crop yield, late tuberisation of yam and increased effect of heat stress on yam etc.. Radio and television were their major sources of information on climate change. It is therefore recommended that system of agriculture and improved agricultural packages developed to help farmer adapt to climate change should be made available to rural farmers. This may include improved varieties of yam, pest and disease resistance yam and also draught tolerant varieties of yam. There should be also serious enforcement of laws and regulations at the local level to prevent indiscriminate bush burning and felling of trees to safeguard the environment.

Table 1: Distribution of respondents on socio-economic characteristics of small scale yam farmers

Variables	Frequency	Percentage	Mean
Age			
>30	5	5	45
31-40	22	22	
41-50	46	46	
51-60	27	27	
Household size			
1-5	19	19	10.5
6 -10	33	33	
11-15	27	27	
16-20	21	21	
Farming Experience (years)			
1-15	61	61	14
16-30	38	38	
31-45	1	1	
Farm Size (hectares)			
1 -2	33	33	2.9
3-4	58	58	
>5	9	9	

Source: Field Survey,2015

Table 2: Mean distribution of farmers Preferred source of information on climate change

Sources of Information	Mean	Overall preference
Radio (n=100)	2.6	Preferred
Television (n=100)	2.6	Preferred
Newspaper (n=100)	1.4	Not preferred
Extension Agent (n=100)	1.6	Not Preferred
Mobile Phone (n=100)	1.3	Not Preferred

*Figures in parenthesis are percentages

* Based on a 3 point scale of most preferred, Preferred and Not Preferred

Table 3: Mean distribution of farmers perception of the effect of climate change on yam production

Perception	Mean	Overall perception
Increase in temperature (n=100)	4.7	Agree
Reduced Crop yield (n=100)	4.5	Agree
Increased Frequency of draught(n=100)	4.0	Agree
Increased frequency of flooding	2.2	Disagree
Increased effect of heat stress on yam (	4.7	Agree
Intense weed growth (n=100)	4.2	Agree
High incidences of pest and diseases (n=100)	2.9	Disagree
Soil erosion (n=100)	2.2	Disagree
Post harvest losses due to climate variability (n=100)	3.9	Agree
Reduction in vegetation cover (n=100)	3.7	Agree
Late tuberisation of yam (n=100)	4.3	Agree

*Figures in parenthesis are percentages

*Based on a 5 point scale of strongly agree, agree, indifferent, disagree and strongly disagree

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PROFITABILITY ANALYSIS AND FISH FARMING SYSTEM PRACTICES AMONG SMALL HOLDER FARMERS IN ABAKALIKI LGA, EBONYI STATE, NIGERIA

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ABSTRACT
The study was on profitability analysis and fish farming system practices among smallholder in Abakaliki LGA of Ebonyi State, Nigeria. A total of 120 respondents were selected as sample size for the study with the use of purposive random sampling technique. Data were collected from the respondents using structured questionnaire and analyzed using descriptive and inferential statistics. The result of the analysis further indicated that 59.1% of the respondents practiced monoculture. The major sources of farm inputs used by open market, personal, ADPs and Fadama while most of them acquired land through leasing and family. The result of the analysis also showed that the fish farmers sourced their finance mainly from financial institutions (45.5%). Furthermore, the result of the research work also showed that fish farming found to be highly profitable in the study area. The result on constraints hindering fish farming showed according to findings included high cost of feed, lack of credit facilities, lack of technical information, shortage of fingerlings, and inefficient pond management (9.4%). Based on findings of the study, the following recommended that; There is need for government intervention through the provision of soft loan that can be easily accessed by the farmers.
Keywords: Profitability, Analysis, Fish Farming, System, Practices, Small holder, Farmers, Abakaliki, Ebonyi, State.

INTRODUCTION
Fish plays a vital role in feeding the world's population and contributing significantly to the dietary protein intake of billions of the populace (Amao *et al.,* 2006). On a global scale, almost 16 percent of total average intake of animal protein was attributable to fish in 1988 (FAO, 1990). The Food and Agriculture Organization (FAO, 1991), recommended that an individual takes 35 grams per caput of animal protein per day for sustainable growth and development. Fish which contributes 36.6 grams per day of net protein utilization in Nigerian homes is still below the recommended requirement by the World Health Organization (WHO) (Amao *et al.,* 2006). However, the animal protein consumption in Nigeria is less than 8 g per person per day, which is far lower than the FAO minimum recommendation (Niang and Jubrin, 2001). Fish and fish products provide more than 60% of the total protein intakes in adults especially in the rural areas (Adekoya, 2004). In developing countries, fish is a highly acceptable food that supplies as much as 40 percent of all animal protein availability of the countries where fish is the main source of animal protein. Moreover, the poor spend proportionally more on fish than on meat or other sources of animal protein. FAO fisheries report (2005) indicates that fish is very important in nutrition, as it provides vital nutrients and source of animal protein especially to the poor who are unable to purchase other more expensive sources such as beef, pork or chicken. The report estimated that capture fisheries feed about 17 million people at an average annual per capital consumption of 10 kg. Antonio and Akinwumi (1991) and Slang (1973) verified that fish allows for protein improved nutrition in that it has a high biological value in terms of higher protein retention in the body, higher protein assimilation as compared to other animal protein sources, low cholesterol content and one of the safest sources of animal protein. Increasing the per caput consumption of fish in any country benefits health. Fish and fish products are known worldwide as a very important diet because of their high nutritive quality and significance in improving human health (Amao *et al.,* 2006).

Objectives of the Study
The broad objective of the study is to investigate on profitability analysis and fish farming system in Abakaliki LGA, Ebonyi state. The specific objectives of this study included to identify the fish farming systems adopt by fish farmers in the study area; examine the cost and return in fish farming in the study area and analyze the constraints to fish farming in the study area,

METHODOLOGY
The study area is Abakaliki Local Government Area of Ebonyi State of Nigeria. In the course of this research work, multi-stage random sampling techniques were employed in selecting the respondents for the study. The local

government area is made up of seven (7) autonomous communities while four (4) were randomly selected and used for the study. Then ten (10) villages were selected from each autonomous communities giving a total of forty villages. Three (3) farmers were randomly selected from each village and this gave a total of 120 fish farmers selected for the study. Both primary data was collected for the study. Primary data was collected using questionnaire that were administered on 120 fish farmers while secondary data were collected from the existing records of the fish farmers. Data collected for the study were analyzed using descriptive statistics frequency distribution, percentage, and inferential statistics of gross margin analysis.
Descriptive statistics such as frequency distribution, percentage were used to analyze objective (i), (ii) & (iii). Gross margin analysis will be used to analyze objective (iii)

Model specification
Gross margin analysis
Gross margin is stated as

GM = TR - TVC - - - - -

Where;

GM = Gross margin (N)
TVC = Total variable cost
TR = Total Revenue

Profit given by

π = GM - TFC

Where

π = Profit
GM = Gross margin
TFC = Total Fixed cost

RESULTS AND DISCUSSION

Types of Fish Farming Systems Adopted
The result of the fish farming systems adopted shows that majority (52.5%) of the respondents adopted intensive fish farming system in the area. It implies that operation practices in the study area is dominated by intensive system. This indicates that fish farming is taken as a main business and the farmers commit a lot of their resources into it. The result also shows that 35% of them were involved in semi-intensive system and only 12.5% of the respondents were involved in extensive method.

Types of Fish Culture Adopted
Data in Table 2, indicates that most (65%) of the respondents practiced mono culture alone while 35% practiced polyculture only. This is similar to what is generally practiced in most region of Nigeria. This can be attributed to the fact that the same species of fish is relatively easy to maintain and require less technical know-how.

Costs and returns in fish farming
Profit is the most important return and this was determined by subtracting the cost of production from the amount received when the stock is sold. Result in Table 13 shows that the total variable cost of fish production was ₦96725 while and total fixed cost was ₦134500 while the total revenue was ₦943750, the profit was ₦712525. This implies that fish farming is profitable since, the total revenue was higher than the total cost of production. This shows that the business is profitable in line with the level of investment and variable cost minimization.

Inputs used in fish production
From Table 4, majority (45.5%) of the respondents sourced their inputs from open market and other farm inputs from personal (18.2%) while others sourced inputs from ADPs and FADAMA (13.6%). This implies that the strategic approaches used by ADPs, FADAMA and ministry of agriculture in distributing farm inputs to farmers are not quite effective.
From the result, it was observed that majority (40.9%) of the respondents lease their farm land for fish production. Land obtained through inheritance had 22. 7% of the responses, while, family and purchase had 31.8% and 4.5% respectively. Result of the analysis showed that (45.5%) of the respondents sourced their capital from financial institutions while 22.7% of them used fund from personal savings while money lenders and borrowing from individuals had 18.2% and 13.6% the responses respectively. Furthermore, it was observed that (50%) of the respondents used hired labour in the study area while 22.7% of them used family labour in carrying out their fish farming activities. The result also revealed that exchange labour and commercial labour had 18.2% and 9.1% respectively.

Constraints to Fish Farming
The survey revealed that there are many constraints hindering efficient production of fish by the fish farmers. The most serious problems in the study included high cost of feed, lack of credit facilities, shortage of fingerlings and

lack of technical information with 81.8%, 72.7%, 68.2% and 63.6% responses respectively. The result of this analysis therefore corroborates the assertion of Ademuyi et al, (2010); who opined that empirical evidence are abound in economic literatures on factors that affect productivity of fish production, including high cost of feed, shortage of fingerlings and training of farm operators and agro-environmental condition.

CONCLUSION

Based on the findings of the study, it is therefore concluded that is a profitable investment considering the size of the business venture. The result of the analysis further indicated that 59.1% of the respondents practiced monoculture. It is evident that fish farming is capable of creating employment, augmenting income and improving the standard of living of the people. The major constraints identified were high cost of feed, lack of credit facilities, lack of technical information, shortage of fingerlings, and so on. Based on the findings of the study, government promotion on fish farming is not adequate therefore there is need for more public enlightenment while providing soft loans for poor farmers.

Table 1: Percentage distribution according to their fish farming systems adopted

Fish farming systems	Frequency	Percentage
Intensive	63	52.5
Semi-intensive	42	35
Extensive	15	12.5
Total	120	**100**

Source: Field Survey, 2016

Table 2: Percentage distribution of respondents according to type of fish culture adopted

Fish culture	Frequency	Percentage
Monoculture	78	65
Poly culture	42	35

Source: Field survey, 2016

Table 3: Gross margin analysis and profitability of cost and returns in fish production

MATERIALS USED	QTY	UNIT	PRICE	TOTAL
VARIABLES COST				**AMOUNT**
Brood stock (fingerlings)	995	Kg	15	14925
Feed cost	7	Kg	5500	38500
Labour cost		Days	11500	11500
Water cost		Litres	5000	5000
Harvesting cost	-	-	7,700	7,700
Lime cost	-	-	4,500	4,500
Fertilizer cost	-	-	6,600	6,600
Miscellaneous	-	-	8000	8000
Total variable cost				96,725
Fixed cost				
Land cost	1	Ha	55,000	55,000
Equipment cost(Depreciation)	-	-	68,000	68,000
Empty bags	-	-	11,500	11,500
Total Fixed Cost	-	-	11,5000	11,500
Revenue				
Sales	992		950	942400
Empty bags	30		45	1350
Total revenue				₦ 943,750

Source: Field Survey, 2016

Table 4: Percentage distribution of respondents according to major source of inputs used in fish farming

Sources of farm inputs	Frequency	Percentage
ADP	3	13.6
Fadama	3	13.6
Ministry of agriculture	2	9.1
Open market	10	45.5
Personal	4	18.2
Farm land acquisition		
Leasing	9	40.9
Inheritance	5	22.7
Purchase	1	4.5
Family	7	31.8
Source of capital		
Borrowing from individual	3	13.6
Personal saving	5	22.7
Financial institutions	10	45.5
Money Lenders	4	18.2
Sources of labour		
Family labour	5	22.7
Hired labour	11	50
Exchange labour	4	18.2
Commercial labour	2	9.1

Source: Field survey, 2016

Table 5: Constraints to Fish Production in the Study Area

CONSTRAINTS	FREQUENCY	PERCENTAGE
High cost of feed	18	81.8
Lack of credit facilities	16	72.7
Lack of technical information	14	63.6
High cost of equipment	11	50
Lack of nets fro harvesting	8	36.4
Inadequate extension service	9	40.9
Inefficient pond management	12	54.5
Shortage of fingerlings	15	68.2
Poor site selection	10	45.5
pond designing and construction	9	40.9
Water shortage	6	27.3

Source: Field Survey, 2016

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EFFECTS OF CLIMATE CHANGE ON OF HONEY PRODUCTION IN UMUAHIA NORTH LOCAL GOVERNMENT AREA, ABIA STATE NIGERIA

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ABSTRACT
Climate change effect is world over and it's the most serious environmental threat facing mankind. The study focused on climate change effect on of honey production and also the challenges caused by climate change. 240 respondents were randomly selected and interviewed through questionnaires. Likert scale and multiple regressions were the major tools of analysis. It was observed that the major effect of climate change was seen in the reduction in yield which has reduced the returns to honey producers. Household size, education, change timing of rain, number of extension visits, decline in productivity and experience were significant variables that had an effect on profits of honey producers in the area. Government should provide metrological instruments and trained more extension workers who will educate the farmers on ways to mitigate the effects of climate change in the area.
Key words: honey production, climate change, apiculture

INTRODUCTION
The greatest challenge that confronts man and societies today and the generations to come is the issue of climate change. Climate change has become the new reality of our time. It brings with it changes in weather patterns that can have serious repercussions for human beings, upsetting seasonal cycles, harming ecosystems and water supply, affecting agriculture and food production.
Nigeria had her fair share of incidents of climate change which was evidenced in the flooding of Kogi, Bayelsa etc in 2012, loss of jobs, crop failures, among many others. Agriculture in Nigeria is rain feed; variability in climate has increased the incidence of crop failure giving farmers a hard time meeting the consumption in the country. Climate change affect all facet of agriculture and honey production is not left out. Due to frequent and intense rainfall as a result of climate change, bees tend to use more honey to survive owning to the fact that there is reduction in the quantity of nectar available due to long and increased intensity of rainfall. This reduces the income of the apiculturist as the quantity of honey harvested is below the expected (Oyerinde *et al*, 2014).
The study analyzed the problems caused by climate change in the study area and determinants of climate change effect on profit honey production.

MATERIALS AND METHODS
The study was carried out in Umuahia north local government area of Abia State because of high concentration of honey producers in the area. Umuahia north local government area is one of the 17 local government areas in Abia state and is also part of the three agricultural zones abia state is divided into namely; Umuahia, Aba and Ohafia. Predominant occupations in the area include farming, civil service, traders and artisans. A total of 240 honey bee farmers were randomly selected for the study. Multiple regression and likert scale were the major tools of analysis used for the study. Likert scale was used to identify the significant problems predominant in the area while multiple regressions was used to estimate the determinants of climate change effect on honey production.
Multiple regression model in its explicit form is stated as:

$$Y= b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7+b_8X_8+\ldots+b_nx_n +e i$$

Y= returns of apiculture farmers in naira; X_1 = level of education of the famer measured in years; $X_{2=}$ gender (male=1 and female=0); X_3 = experience of the farmers measured in years; X_4 = household size measured in numbers; ; X_5 = number of extension visit; X_6 = change timing of rain (yes =1, others =0); $X_{7=}$ perception to the level of rainfall (high =3 ,average =2 and low =1); $X_{8\,=}$ perception to the level of sunlight (high =3 ,average =2 and low =1)

RESULTS AND DISCUSSIONS
Climate change effect in the study area
A 4 point likert scale was used to ascertain descriptively the effects of climate change as perceived by the respondents in the study area. Scores were given to the responses as high = 4, average = 3, low = 2, none = 1. The mean point was calculated and used to determine whether a factor was significant or not. The mean point of 2.5

was used as the decision rule. Any factor which has a mean less than 2.5 will be assumed not to have a significant effect of climate experienced in the study area and any climatic effect greater or equal to 2.5 is assumed significant.

The result from Table 1 shows that reduction in yield, reduction in farm income, reduction in storage quality, and reduced production cycle were significant effect of climate change in the study area. Prolonged production, destruction of wild life, and premature ripening of fruits were not significant.

Reduction in yield was the most significant with a mean score of 2.94. Reduction in farm income was 2nd with the mean score of 2.78; reduction in storage quality of produce with a mean score 2.62 was 3rd while prolonged production process was 4th with 2.54 mean score. By this result, it could be concluded that reduction in yield was the major challenge faced by the farmers in the area. This is no surprise as agriculture in Nigeria is rain feed and change in timing of rain fall has a devastating effect on production. This invariably will lead to reduced income and little to no storage facilities in the area is not helping at all. Anyoha *et al* (2013) observed that farmers complained on the reduction in yield as a result of climate change which have affected their profit and in some cases eaten deep into their capital as bills will not stop coming profit or no profit.

Determinants of climate change effect on honey production returns

The semi log regression model was chosen as the lead equation based on the value of the R^2 0.670 which indicates that 67 percent of the total variation in the dependent variable was due to the variability of the independent variables and the number of significant variables. The model is statistically fit based on the value of the F-statistics (2.754) which indicates that the model is significant at 5 percent.

Household size, education, change timing of rain, number of extension visits, decline in productivity and experience were significant variables that had an effect on profits of apiculturist while Sex, rainfall and sunlight were not significant variables affecting the subject matter.

Household size was negatively significant to the returns of honey production at 5% probability level. The higher the household size the more honey consumed which reduces the quantity sold for profit. Also, feeding, school fees, health care etc of the large household depletes the profit. Climate change affects the returns at the farmers disposal as high frequent of rainfall reduces the activities of the bees and this affects the quantity of honey produced which in affects returns. Household labour is not needed as the bees do virtually everything themselves and large household sizes means more responsibilities which reduces profit as concurred by Mbah, 2012 who argued that bloated household size means high responsibility which imposed pressure on the returns of honey producers.

Education was positive and significant at 1% probability level. Apiculture is complicated and not so easy to practice because people are afraid of been stung by bees. Education plays a crucial role in educating the farmer on safe practices, management styles, harvesting, which helps increase the profit of the farmer as he is grounded in apicultural practices. Education enlightens the farmer on the effect of climate change and ways or adaptations he can use to reduce its effect on profit.

Change timing of rain had a negative relationship with profit of honey producers and was significant as 10% probability level. Worker bees gather food during dry seasons and they feed on them during the rainy season. When there is change and frequent rainfall the bees will not leave the hive to source for food and will feast on stored honey there by reducing the quantity of honey harvested which will in turn reduce the quantity sold for profit. Change timing of rain is caused by climate change which reduces the returns of the farmer as bee will not leave the hive in search of pollen under the rain.

Decline in productivity as caused by climate change was significant at 10% probability level and negatively related to returns. Due to frequent and intense rainfall as a result of climate change, bees tend to use more honey to survive owning to the fact that there is reduction in the quantity of nectar available due to long and increased intensity of rainfall. This reduces the income of the apiculturist as the quantity of honey harvested is below the expected. Oyerinde *et al*, 2014 shared the same view.

Experience was positively related to the returns of honey farmers at 10% level of significant. . Experience has taught most of the farmers on the various farm management practices and techniques that could be used in the face of anticipated climate change in the area. Farmers with experience tend to make more profit as they ride the experience curve given that the means of tackling the problems are reasonably known to them. This was line with the findings of onubuogu *et al* (2013).

CONCLUSION

Results from the study showed that Household size, education, change timing of rain, number of extension visits, decline in productivity and experience were significant variables that had an effect on profits of apiculturist. The major climate change challenge in the study area was evidenced in reduction in yield which has affected the standard of living in the area. Government should provide weather measuring equipments to ministry of agriculture and ADP. Meteorologists should be recruited to handle these equipments and educate extension workers and farmers on its use and other weather related facts and Government should emphasize on the "Going green" concept. This implies the use of environmentally-friendly equipment, machines, infrastructure, and technology that produce less of the GHGs.

Table 1: Perception of climate change effect in the study area

	None	Low	Average	High	Total	Mean	Rank
Decreased soil	109 (109)	51 (102)	49 (147)	31 (124)	240 (482)	2.01	6
Premature ripening of fruits	118 (188)	42 (84)	44 (132)	36 (144)	240 (478)	1.99	7
Reduced production cycle	61 (61)	52 (104)	64 (192)	63 (252)	240 (609)	2.54	4
Prolonged production	46 (46)	87 (174)	65 (195)	42 (168)	240 (583)	2.43	5
Reduction in yield	29 (29)	56 (112)	55 (165)	100 (400)	240 (706)	2.94	1
Reduction in farm income	63 (63)	26 (52)	51 (153)	100 (400)	240 (668)	2.78	2
Reduction in storage quality	57 (57)	50 (100)	60 (180)	73 (292)	240 (629)	2.62	3
Destruction of wild life	141 (141)	14 28	32 96	53 212	240 477	1.99	7

Source: Field survey 2015

Table 2: Effects of climate change on the performance of apiculture

	Exponential	Double log	Semi -log +	Linear
Constant	82645.939 (1.224)	8.471 (5.547)***	9.378 (20.035)***	17470.492 (0.898)
G.ender	11363.656 (1.043)	0.306 (1.241)	-0.25 (0.206)	1315.141 (0.265)
Household size	-27767.419 (-1.481)	-0.499 (1.177)	-0.835 (-2.816)**	-1487.151 (-1.118)
Education	20810.590 (1.808)*	-0.499 (-1.689)*	0.048 (4.168)***	2184.922 (3.479)**
Change timing of rain	-10682.627 (-3.072)**	0.171 (0.708)	-0.105 (-1.741)*	3735.629 (1.868)*
Extension visits	-8157.987 (-0.890)	0.104 (0.562)	-0.071 (-1.841)*	-3018.120 (-1.502)
Rainfall	17199.250 (2.224)*	0.388 (2.217)*	0.065 (1.385)	1728.427 (0.892)
Sunlight	-7711.949 (-0.975)	-0.245 (-1.368)	0.009 (0.204)	-642.206 (-0.354)
Decline in productivity	1192.437 (1.395)	0.446 (2.306)*	0.548 (2.403)*	-1518.292 (-0.767)
Experience	-20881.499 (-1.397)	0.255 (0.755)	0.013 (1.802)*	178.060 (0.578)
R^2	0.478	0.534	0.670	0.451
R^2 adjusted	0.229	0.426	0.493	0.339
F - ratio	(2.008)*	(2.513)*	(2.754)**	(2.687)**

Source: Survey data, 2015. ***,** *and** statistically significant at 1%, 5% *and*10% respectively

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PATTERN AND DISTRIBUTION OF RAINFALL IN AFIKPO NORTH LOCAL GOVERNMENT AREA OF EBONYI STATE, NIGERIA: IMPLICATION FOR GLOBAL WARMING AND CLIMATE CHANGE

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ABSTRACT
The purpose of the field work was to observe and generate data on the pattern and distribution of rainfall in Afikpo North Local Government Area (LGA) of Ebonyi State for 2015. The L.G.A. is made up of Twelve (12) Autonomous Communities out of which Ten (10) were randomly selected. Research Assistance (RAs) were needed for the field work and Two (2) RAs were purposively selected from the Ten (10) randomly selected Autonomous Communities to give Twenty (20) RAs. Some instruments, among which was a Self-designed recording instrument, were used in the exercise and data were collected and analyzed using frequency Tables and graphs. The result will help to suggest to farmers on how to plan their farming activities in order to among others, minimize losses of farm produce on the farm. Some of the results showed that there was absence of the usual "August break" in the month of August and heavy downpours were experienced between the months of August and October and there was absence of the usual "double maxima" in the months of July and September of the two years. Recommendations, among others, were that farmers should delay planting and commence crop planting after about 4-5 weeks after the first set of rains, they should not allow crops, as has been the usual practice, to dry-up in the farms between the months of September and October to reduce losses of farm produce in the farm.
Keywords: Global warming, climate change, rainfall pattern, agriculture.

INTRODUCTION
The mainstay of Nigerian Economy since independence according to Bureau of Public Enterprise (BPE) (2004), is agriculture, as it accounts for 38% of the non-oil foreign exchange earnings and employs about 70% of the active labour force of the population. Agriculture offers Nigeria the most cost-effective path to growth and development. With its ever extending value chains, agriculture provides jobs to over 60% of the working population, and if well-harnessed could be a sustainable springboard for the much awaited industrialization (Moghalu, 2012). This is because the produce from agriculture when exported to foreign countries earns the country foreign exchange with which acquisition of the necessary items or materials for the industrialization of the nation is made.

For agriculture to be sustainable, there is the need for a favourable climate as an all important ingredient or input in agriculture. The effect of climate, a major requirement in agricultural production need not be over emphasized. This is in consideration of the crucial roles of its various elements, especially rainfall, in relation to agricultural production.

Rainfall, a very essential element of climate has numerous implications for agricultural production of a place (Oga, 2014). This is because its nature (time of commencement in a given period, amount, duration, intensity and distribution) to a very large extent determines the type of and level of agricultural practices and production of a place. According to Emedo *et al* (1995), much of the water for Agricultural production comes from rainfall. Where rainfall is well distributed and in adequate amount, growth and productivity of crops like yam, cocoyam, cassava, plantain, corn, rice and tree crops like rubber, kola-nut, oil palm, citrus, among others, is guaranteed.

According to Nwite *et al* (2007, Oga, 2014) the most important element of climate is rainfall, the amount that falls, how it falls e.g steadily over several days or suddenly in torrential downpours, hence its effectiveness i.e how much of it is available for use by plants. Currently, it has been observed, and even available records have shown that the nature (time of commencement, amount, duration, intensity, etc) of rainfall has not been encouraging. There has been a deviation from the natural pattern of rainfall (Nigerian Meteorological Agency (NIMET), 2016). Sequel to the above discouraging scenario of rainfall as a result of Global warming and Climate change, there is a need to chart a path to assist in mitigating their negative effects and this informed the study. The main objective of this study was to observe and generate data on the present trend and distribution of rainfall in the LGA for 2015. The specific objectives were to examine records of rainfall in 2015 in Afikpo North Local Government Area (LGA) of Ebonyi State and assess the trend of rainfall and its distribution in each month of the year.

MATERIALS AND METHODS

The work was conducted in Afikpo North Local Government Area (LGA) of Ebonyi State of Nigeria in 2015. Afikpo North Local Government Area of Ebonyi State is an Agrarian LGA with a good number of the populace engaged in one form of agricultural production or the other mainly at subsistence level. One of the instruments for data collection was a Self designed recording instrument. The instrument showed the days/dates of each month of the year, 2015. The instrument was faced validated by two Agricultural experts in the Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State. The experts suggestions were considered in the final design of the instrument. Timing instruments such as Table clock and Wrist Watches were also used
Afikpo North Local Government Area (LGA) is made up of twelve (12) Autonomous Communities. Ten (10) Autonomous Communities were randomly selected for the field work and Research Assistants (RAs) were needed to assist in the work. Two RAs were purposively selected from each of the 10 Autonomous Communities to give a total number of 20 RAs who assisted in examining and recording the parameters considered relevant to the field work.

RESULTS AND DISCUSSION

In Tables 1 and 2 and 3, information available therein show that all the months of the year experienced rainfall except for the month of December.
With regards to duration of rainfall, this was experienced more between the months of August and October for the year covered.
In relation to heavy/moderate rainfall, there were few numbers of heavy rainfalls which lasted for long hours and with much impact between the months of August and October. In terms of moderate rainfall, there was high record of moderate rainfall in the year, 2013. The highest peak of rainfall for the year, 2013 was recorded in the month of August, that of the year, 2014 was recorded in the month of October and that of 2015 in the month of September. There were sharp drops in rainfall after the month of September in 2015. These observations are contrary to popular opinion.

Implications for Agricultural Production

Prior to incidence of Global Warming and Climate Change, available records, information from Focus Group (FG) discussions and personal experiences show that the usual rainfall pattern and distribution in South East zone of Nigeria where Afikpo North Local Government Area of Ebonyi State is located experienced on the average six (6) months of rainfall from the month of April to September with "double maxima" (two peaks of rainfall) in the months of July and September.
But currently, this part of the zone hardly experiences on the average four (4) months of well distributed rainfall. This is evident in Table 1. Also available records, information from (FG) discussions and personal experience have also shown that the rains now commence early in the years between the months of February and March and suddenly disappear thereafter. The rains start again in the month of May increasing gradually in frequency, duration and intensity which fluctuate and with heavy downpours with much impact between the months of August and October. This pattern of rainfall and distribution is not favourable for both crops and livestock production. In a situation where rainfall is expected to last for six (6) months and only about four (4) months of rainfall which are not well distributed in the months of the year may be available, may not augur well for agricultural production. Consequently, crops are not cultivated at the appropriate time. This position is supported by Anam *et al.* (2015) who stated that the rain does not fall in the way it used to, and the crops do not grow the way they used to. With the above trend, some crops such as rice, maize, yam, cassava, etc that require much water to thrive well may suffer, especially between the months of May and June. There may also be absence of crops cultivated early in the year such as early maize due to inadequate rainfall and late cultivated crops such as late maize due to excessive downpours during the later part of the year (i.e. between the months of August and October). Often when crops are cultivated, the rains may come down heavily between the months of August and October, washing and carrying away plants and animal materials and destroying farm lands.
In most parts of the country, the South-East Zone and the LGA inclusive, some farmers allow un-harvested crops in the farm between the months of September and November to dry up and used as future farm inputs or for home consumption. To this regard, these farmers have suffered losses of such crops as a result of rainfall experienced around this period of the year. According to the field work carried out by Oga and Oga (2011, 2012 & 2013) on the Pattern of Rainfall and distribution in Ebonyi State and the LGA, there has been convincing deviation from the usual pattern of rainfall and distribution in both areas. This position was corroborated by (NIMET, 2016).

CONCLUSION

The practice of agriculture is affected by various factors especially climate. The effect of climate is felt through one of its potential elements, rainfall. The rainfall of a place, to a large extent determines the scenario of agricultural production of the place. Currently, the nature of rainfall in relation to agricultural production in the LGA is not encouraging due to the influence of Global warming and Climate change. In order that agriculture continues to play its role as the backbone of a nation's economy, global warming and subsequently Climate change, need to be mitigated. Strategies to be employed in this regard include among others, creating adequate awareness to the public and especially to farmers on the realities of Global warming and Climate change, farmers to delay cultivation of crops to about 4-5 weeks after the first set of rains which now occur early in the year and farmers to avoid setting fire on cut down vegetation on the whole farm but to pack them at strategic places probably on the farm to rot away over time. On the basis of the findings, adequate awareness should be created on the realities of global warming and climate change both for the farmers and public consumption.

Table 3: Monthly Summary of Rainfall in Terms of Frequency, Duration, among others in 2015
Source: Field Work, 2015

Months of the year, 2015		Rainfall		No of times of rainfall in each month	Duration of rainfall in hrs/mins in each month		No of times of moderate rainfall in each month	Frequency of Heavy rainfall in each month	Frequency of windy days in each month	No of sunny days in each month		No of moody days in each month	
		Yes	No		Hrs	Mins				Very sunny day	Not very sunny	Very moody	Moody
1	Jan	✓		2	1	20		2					
2	Feb	✓		4	3	25	2	2		16			
3	Mar	✓		1	-	25		1		20	5		
4	Apr	✓		4	2	5	2	2		6	25		
5	May	✓		12	10	25	8	4					
6	Jun	✓		5	9	5	6						
7	Jul	✓		8	5	45	4	2		2			9
8	Aug	✓		11	8		5	4					13
9	Sep	✓		13	19	40	6	6					5
10	Oct	✓		3	6	40	3	2					
11	Nov	✓		5	4	15	5						
12	Dec												

Summary of duration of rainfall in hours in each month of the year, 2014

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

SUB-THEME VI:

AGRICULTURAL EXTENSION, AGRICULTURAL COMMUNICATION, VOCATION IN AGRICULTURAL

REPOSITIONING AGRICULTURAL EXTENSION SERVICES IN THE FACE RAPIDLY EVOLVING INFORMATION AND COMMUNICATION TECHNOLOGIES

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ABSTRACT
The study was a survey type of research. Primary data was collected using questionnaires and interviews. The sample size for the survey was 100. Questionnaire responses were analyzed using frequency distribution tables and percentages. Results from the survey showed that Information and communication technologies (ICTs) had positive impacts on extension services in Nigeria since year 2000 boom of use of ICTs. It was also deduced from the survey that there are strategies that could aid improved use of ICTs in agricultural extension in Nigeria and top most on the list was creation of awareness of ICTs tools' uses and benefits in rural areas where majority of farmers reside. The study further highlighted strategies that should be adopted should stake holders want to reposition agricultural extension services delivery in Nigeria in a rapidly changing world.
Keywords: Extension, ICT, evolving, repositioning, effective

INTRODUCTION
Effective communication of agricultural information to farmers is crucial in achieving optimum efficiency in agricultural extension administration and practice in Nigeria, Okeke et al (2015). Agricultural extension is the means through which information of various sorts from relevant agencies are disseminate to the farmers. Arokoyo, (2006) submitted that there was no doubt , that the effective use of information and communication technologies have the potentials of enhancing the performance of Nigeria's extension services,, as it will allow for pluralistic flow in an agricultural innovation system to ensure effective and efficient sharing and exchange of information, knowledge,, and skills among stakeholders.
In a changing world, and with technologies evolving rapidly, it becomes imperative for stakeholders to reposition agricultural extension services delivery, keying into the evolution of these ICTs in other to attain maximum utilization and enjoy its full benefits.
The broad aim of the research was to suggest strategies for repositioning agricultural extension services in Nigeria in the face of rapidly evolving information and communication technologies. The specific objectives of the study however included:
1. To identify the ways extension services delivery in Nigeria could be improved due to use of ICTs tools.
2. To determine ways of improving use of information and communication technologies in agricultural extension services delivery.
3. To identify strategies that could be adopted to help reposition agricultural extension services in the face of rapidly evolving information and communication technologies.

MATERIALS AND METHODS
The population of the survey comprised of agricultural extension officers in Abia state of Nigeria. 120 Agricultural extension officers were randomly sampled, 40 from each of the three agricultural zones in Abia State. Hence 120 questionnaires were distributed to the sampled population. However, 100 questionnaires were properly filled out and returned bringing the sample size to 100.
Where-; n = 100.
Primary data was collected using structured questionnaires and interview of randomly selected respondents within the sampled population. Secondary data was sourced from review of related literature. Questionnaire responses were analyzed using frequency distribution tables and percentages.

RESULTS AND DISCUSSION
Table 1 shows the improvements that came to agricultural services delivery in Nigeria since year 2000 boom of ICTs tools and usage. The results herein identified the improvements which included that farmers rather than wait for extension agents' visits, now get immediate and rapid responses through telephone calls, text messages and instant messages (98%), quick and effective information dissemination and feedback (90%), Improved extension delivery technologies (82%), and Improved networking and collaboration and easier research technologies (78%).

Other improvements stated by the respondents included reduction of cost and stress associated with extension delivery (75%), increased access to global best practices, leading to large scale production (70%), and finally they respondents also stated that use of projectors now makes workshops easier, as farmers are shown technologies real time and on the spot (65%).
Result from table 2 reveals that top on suggestions made by respondents towards the improvement of use of ICTs in extension services delivery included creation of awareness of ICTs tools' uses and benefits in rural areas where majority of farmers reside (98%), improving overall access to ICTs tools (95%), capacity building on use of ICTs for both extension agents and farmers, especially rural farmers (90%), and subsidizing customized ICTs tools to be accessed by farmers (82%). Other strategies outlined in table 2 are, improving quality and service delivery of ICTs backbones and infrastructures like Mobile Network services, GSM services, and power supply, among others (65%) and finally Government polices to checkmate services providers and ensure the deliver on services (60%).
Strategies to help reposition agricultural extension services to cope with rapidly evolving ICTs.
From the responses gathered from interview of key stakeholders within the sampled population revealed that in other to reposition agricultural extension services in the face of rapidly evolving ICTs the following strategies need to be adopted;

1. As attention of majority of mobile telephone users are shifting from voice calls to mobile data services like instant messaging (whatsapp, blackberry messengers, yahoo messengers et cetera) and video calls (skype, ovoo, etc);
1. Agricultural extension officers should be trained on proficient use of these mobile data services.
2. Farmers who have the capacity to learn the act of using these mobile data services should be trained as well.
3. Extension officers can create groups with their farmers within these instant messaging platforms where information sharing and collaboration will take place.
4. Agencies, departments, research institutes and other stakeholders should ensure the host, service and update websites, which should be updated regularly.
5. Stakeholders should make use of twitter accounts so that farmers who have the technical knowhow can follow them and keep to date with information as they are updated in real time.
6. Social media with all these attaining potentials should be fully utilized in agricultural extension and information dissemination.
7. Seminars, lectures, workshops and symposia should be;
1. Conducted using state of the art ICTs to ensure that farmers are shown technologies either on slides or screens.
2. Audio and video conferencing should be incorporated during these capacity building sessions.
3. Stakeholders can partner with telecommunication companies and ICTs tools vendors to manufacture and distribute to farmers customized devices which can help in forming virtual communities and prompt transfer of information and technology.
4. Lectures on farming methods, processing, value addition and packaging can be posted to YouTube for global audience.
5. Bulletins, guides, magazines, journals, proceedings and periodicals aside from being printed on paper should also have online copies for wider reach and global patronage.
6. Agricultural extension departments should launch blogs on the internet.
7. Television and radio viewers and listeners these days are endeared to cable televisions and online radio platforms rather that local television and radio stations, therefore, efforts should be made to air agricultural programs on cable televisions and online radios. Production of these agricultural programs should be done using state of the art digital cameras and editing software and devices.

CONCLUSION
In this age of ICTs boom, the role of efficient and effective dissemination of agricultural information and delivery of extension services to farmers falls on information and communication technology tools. With the help of these ICTs tools farmers are able to receive prompt information about availability of inputs, weather forecasts, forecasts of impending disease or pest outbreak, farming methods, market prices, and technological innovations and so on. Common ICTs tools used by extension workers include Radios, Televisions, Telephones, print media etc. The study identified that ICTs tools had a massive positive impact on agricultural extension services since the year 2000, and further mapped out ways of improving the use of ICTs tools in agricultural extension services. The study acknowledges that ICTs tools are evolving rapidly hence outlines strategies to help reposition extension services delivery in Nigeria in other to cope with these rapid evolutions and achieve maximum utilization.

Table 1: Improvements in extension services delivery due to use of ICTs

Response	Frequency	Percentages (%)
Rather than wait for extension agent's visits, farmers now get immediate and rapid responses through telephone calls, text messages and instant messages.	98	98
Use of projectors now makes workshops easier, as farmers are shown technologies real time and on the spot.	65	65
Increased access to global best practices, leading to large scale production	70	70
Reduction of cost and stress associated with extension delivery	75	75
Ensures quick and effective information dissemination and feedback	90	90
Improved extension delivery technologies	82	82
Improved networking and collaboration and easier research technologies	78	78

Source: Field data, 2016.

Table 2: Suggestion to improve use of ICTs in extension services delivery

Suggestions	Frequency	Percentages (%)
Capacity building on use of ICTs for both extension agents and farmers, especially rural farmers.	90	90
Improved access to ICTs tools.	95	95
Creation of awareness of ICTs tools' uses and benefits in rural areas where majority of farmers reside.	98	98
Improved quality and service delivery of ICTs backbones and infrastructures like Mobile Network services, GSM services, Power supply, among others.	65	65
Subsidizing customized ICTs tools to be accessed by farmers.	82	82
Government polices to checkmate services providers and ensure the deliver on services.	60	60

Source: Field data, 2016

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SOCIO-ECONOMIC FACTORS AFFECTING ADOPTION OF SOYABEAN (*Glycine max.* L) PRODUCTION TECHNOLOGIES AMONG FARMERS IN RANO LOCAL GOVERNMENT AREA OF KANO, NIGERIA

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ABSTRACT

Soybean (Glycine max. L) is now an important cash crop produce in many localities due to its promising performances and productivity in arid areas especially in soils with poor fertility status. There is need for an increased in production with an advent of new varieties that adapt to many ecological characteristics and high yielding; with this, there is need for improved production technologies to meet up with current production trends in the world. The sampling procedure was based on multi-stage random sampling technique in which three districts were selected at the first stage, four villages at second and third stages respectively making a total of 12 villages sampled and 15 respondents were selected from each of the villages, thereby giving a total of 180 respondents as the sample size for the study. The results show that the adoption of improved technologies among the farmers was at low due to low extension agent's participation, lack of finances, poor sources of inputs and so on. Meanwhile efforts should be geared towards campaigning of adopting technologies.

Keywords: Socioeconomic, adoption, soyabean, technology, farmers

INTRODUCTION

Soybean originated from the people's republic of china, other major producing countries include, U.S.A, Brazil and Argentina as it was also introduced to Nigeria in 1908 as reported by (Misari and Idowu, 1995). Soybean (*Glycine max* (L) Merrill) is an important leguminous food crop grown all over the World (Muoneke, 2007). World production of Soybean is estimated at over 300 million metric tons, cultivated in over 100 million hectares with an average yield of 2000kg per hectare (FAOSTAT, 2014). The crop can be successfully grown in many states in Nigeria using low agricultural input. Soybean cultivation in Nigeria has expanded as a result of its nutritive and economic importance and diverse domestic usage. It is also a prime source of vegetable oil in the international market. The world experienced shortage of oil seeds immediately after the World War II which accelerated the drive for increased Soybean production in Nigeria (Dugje *et al*., 2006). Soybean production in Nigeria has expanded as a result of its nutritive, economic and diverse domestic usage and versatility. The crop can be grown successfully in many states of Nigeria using low agricultural inputs (Idrisa, 2009). In the traditional Soybean growing areas, it is most commonly intercropped with cereal crops such as maize, sorghum and millet (Adeniyan and Ayoola, 2006). Soya bean is consumed as food (milk), used for production of edible oil, animal feeds, soybean cake (Awara) and for industrial purposes. Research efforts to improve the existing Soybean varieties, to expand and increase production in Nigeria were initiated in different research institutes from the mid 1970's (Misari and Idowu, 1995). The International Institute for Tropical Agriculture (IITA) conduct research work on Soybean in the 1970's which this has made substantial effort to improve the production output of the crop (Abdullahi,2004). Notable among the good varieties of soybean produced in Nigeria includes: TGX 1955-3F, TGX1955-4F, TGX 1987-62F, TGX1448-2E, TGX1904-6F, TGX1830-2E; and TG X 1485-2E-ID, (Adeniyan and Ayoola, 2006). Idrisa (2009) reported that, with the development of improved varieties, commercial production of soybean has expanded beyond its "traditional home" (Benue, Kaduna, Niger and Plateau) states. . Nigeria is the largest producer of soybeans in West Africa, and cultivation has increased due to its nutritive and economic importance, and the diverse domestic usage. It is also compatible with other common arable crops (Raji, 2007). It is now produced in other states, such as Bauchi, Borno, Jigawa, Kano, Kebbi, Kwara, Nasarawa, Oyo, Sokoto, Taraba and Zamfara states. As reported Rogers, (1993) improved technology is the systematic application of collective resources to solution of problems through the assertion of control over nature and all kinds of human processes. This underlined the rational for the use of improved production technology in the development of agricultural resources to make a better living. Dugje *et al.*, (2006) reported that the agronomic practices which are recommended for soybean production in Nigeria comprises of site selection, land preparation, planting time, spacing and seed rate, fertilizer application, weed control, pest and disease control, harvesting and storage. Yet the adoption of the recommended practices for improved production technologies for soybean production is relatively low (Ani and Undiandeye, 2001). Therefore, it was found imperative to assess the socio-economic factors affecting the adoption of soybean production technologies among soybean farmers in Rano Local Government Area of Kano State.

MATERIALS AND METHODS

The study was carried out in Rano Local Government Area (LGA) of Kano State, Nigeria. The LGA is located between latitudes $11^0 33' 26$"N and longitudes $8^0 35' 00$"E of the equator; therefore, it lies on the Eastern part of the Sudan Savanna zone of the state, KNARDA (Kano State Agricultural Development authority, 2009). The study area covers a land area of 520 km^2 with a population of 145, 439 (National Population Commission, 2006). The study area has dominant features of the dry savanna of Nigeria with two main seasons: the wet and the dry season. The wet season usually starts from June and ends in October with an annual rainfall varying from 200mm in the north to 650mm per annum with an annual average temperature of 29 ^{0}C to 42 ^{0}C (KNARDA, 2009). Soybean cultivation is one of the emerging agricultural activities in the area. There is also significant husbandry of small ruminants as a means of food security and a livelihood practice. The sampling procedure was based on multi-stage random sampling techniques. Among the five selected districts of the study area (Kumurya, Gwamma, Barkum, Kulluwa and Gurjiya), three districts were randomly selected (Kumurya, Barkum and Gurjiya) at the first stage. At the second stage, four villages were randomly selected from each of the three districts, making a total of 12 villages sampled. At the third stage, 180 respondents were selected from each of the villages, thereby giving a total of 90 respondents as the sample size for the study. The data for this study was collected by the use of well structured questionnaires. The questionnaires contain two sections viz: the background information and technical questions. The data for the study was explored through the application of descriptive and inferential statistical tools. The descriptive statistics that was used to summarize the data were percentages and frequencies count.

RESULTS AND DISCUSSION

The socio-economic characteristics of the respondents were examined with respect to their gender, marital status, age, farm size, household size and level of education as presented in Table 1. The study shows that majority (62.20%) were male, while female constitutes only 37.80% of the respondents. This implies that gender was a significant factor in agriculture, because of its vital role in determining farming activities in the study area. In addition, 68.90% of the respondents were married and were in their economically active and productive age (30-49years) representing 71.10% in the study area. This confirms with the report of Amaza *et al.*, (2007) that most of the Nigerian farmers were between 30 and 50 years of age. Also in the same table, it was shown that 57.80% of the respondents cultivated less than one hectare of farmland, while 37.80% cultivated between 1 and 2 ha of farmland and only 4.40% cultivated above 2 ha of farmland. This was in agreement with that of Oriole (2009) who indicated that most of the soybean farmers in Nigeria were small scale farmers, who cultivate less than 3 ha of farmland. The result further shows that most (24.20%) of the respondents had household size of 5-9 members. The implication could be that provision of farm labour could not be a problem among the respondents. On the level of education, the result shows that most (41.10%) of the respondents had formal education. This implies that the respondents could apprehend the improved technologies being disseminated to them. The findings was not in agreement with that of Apata *et al.*, (2010) and Tiwari (2010) who asserts that most of the Nigerian farmers have no formal education. Table 4 shows the constraints against adoption of improved soya bean production technologies by respondents. The result indicated that the majority (54.40% and above) of the respondents agreed that all the variables were constraints to adoption of improved Soybean production technologies with the exception of unavailability of market for produce with 24 respondents representing 35.60%. Notable among the constraints were poor extension services (75.60%), lack of credit facilities (71.10%), and high cost of fertilizer (72.20%). Poor extension services confirm the report by Tiwari (2010) that one of the major constraints of farmers was poor access to extension services. This implies that adoption level of the respondents could be affected negatively. Constraints of credit facilities were also one of the major factors affecting the respondents. This was in agreement with that of Oriole (2004) who stressed that unless credit facilities are provided to small scale farmers, otherwise majority of them are seriously handicapped in adopting new and profitable farm technologies. The high cost of fertilizer among others was also a major constraint. The implication could that the respondents were unable to purchase the input as a result of the high price associated with the commodity (64.40%). However, the result reveals that majority (64.40%) of the respondents disagreed that unavailability of market for produce was a constraint. This could be as a result of the fact that market for Soybean was readily available in the study area.

CONCLUSION

The study indicated that the adoption level of soya bean production technology was on the average in the study area. The socio-economic factors which positively affect the adoption of soybean production technology were sources of information, farming experience and educational level of the respondents. However, the major constraint against the adoption of the technologies include poor extension services, lack of credit facilities and high cost of inputs such as fertilizer, chemicals etc. Based on the findings of the study, the following recommendations were made that; Agricultural extension services should adequately be provided to respondents on soybean production technologies in the study area; Input support services in the form of credit facilities, fertilizer and chemicals should be provided with a view to enhancing adoption of soybean production technologies; Encouragement should be made to form soybean cooperative societies by respondents in order to take advantage of government policies and programmes and lastly awareness campaign should be embark by mass media to encourage farmers to patronise IITA in purchasing of high quality seeds or to open a substation within the axis of the area

Table 1: Distribution of Respondents by Socio-economic Characteristic (N = 180)

Socio-economic Variables	Frequency (No)	Percentage (%)
Gender		
Male	112	62.20
Female	32	37.80
Age (Years)		
30 & below	22	12.20
30 – 39	52	28.80
40 – 49	76	42.30
49 & above	30	16.70
Marital Status		
Married	124	68.09
Single	46	25.06
Widow	10	5.50
Farming Size (Ha)		
Below 1	104	57.80
1 – 2	68	37.80
Above 2	8	4.40
Educational Status		
Primary education	44	34.00
WAEC/SSCE/TC	16	35.00
Tertiary Education	34	10.00
Adult Education	24	13.30
None	64	35.50
Household Size (Number)		
Less than 5	74	41.10
5 – 9	76	42.20
10 – 15	24	13.30
16 – 20	4	2.20
Above 20	2	1.00

Source: Field survey, 2016.

Table 2: Extent of Adoption of Improved Technologies by Respondent (N = 180)

Technologies	**Adoption**		**Not Adopted**	
	Frequency(No)	Percentage(%)	Frequency(No)	Percentage(%)
Improved seeds	94	52.20	86	47.80
Planting time	102	56.70	78	43.30
Fertilizer application	86	47.80	94	52.20
Spacing	84	46.80	96	53.30
Weeding frequencies	70	38.90	110	61.10
Use of chemicals	58	32.20	122	67.80
Harvesting time	124	68.90	56	31.10

Source: Field survey, 2016.
* Multiple responses exist, hence % > 100

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ASSESSMENT OF RADIO USE FOR AGRICULTURAL INFORMMATION TOWARDS INCREASING FARMERS' PRODUCTION IN DAWAKIN KUDU LOCAL GOVERNMENT AREA OF KANO STATE, NIGERIA

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ABSTRACT

This paper assesses the use of radio in receiving agricultural information for agricultural production in Dawakin Kudu Local Government Area of Kano State, Nigeria. A total number of 60 respondents were randomly selected by choosing four farmers from each ward within the fifteen wards in the area. Interview scheduled was used to collect relevant data from the respondents. The instrument used for data collection validated and subjected to reliability test. Descriptive and Inferential statistics (chi-square) were used to analyze data collected. Results showed that majority of the farmers were males, mostly 50 years and below in age with little formal education. Although most of the farmers acquired agricultural information through radio but some had to depend on friends and Extension Agents (EAs) for agricultural information. Farmers' productivity increased by up to 64.8% through the use of radio and some farmers still claimed not having significant improvement in their farming activities through the information from radio. Despite the advantages for the use of radio in generating agricultural information, some farmers identified some problems which include among others, lack of call-in programs on agricultural matters, cost of regular changes of the battery and some programs were not designed to suit farmers' interests. Furthermore, Chi-square analysis showed that only age and level of education had significant relationship with the use of radio. It can be concluded that radio is a useful source of agricultural information but it needs improvement in the areas of service delivery with a view to overcoming the types of programs and creating innovative call-in programs for asking questions.

Keywords: radio, agriculture, information, production.

INTRODUCTION

Radio is powerful communication tool. It has proved to be the most effective media in promoting agriculture and development in rural areas, particularly as a tool for the delivery of quick information. We are living in a world that is saturated by mass media with our environment brimming with data and information (Hutchings and Matthews, 2008). International Food and Agriculture Programme (IFAP, 2004) asserted that about 80 percent of the population who live in rural areas of developing nations depend directly on agriculture for their livelihood. In recent decades, the widespread use of the mass media has resulted in heightening the level of public knowledge in different fields (Buren, 2000). Among the diverse mass media, radio, due to its wide and vast range of listeners, have had an outstanding position particularly with regard to informal teaching, and is considered the best cultural and educational media (Tancard and Verner, 2005).

Rural farmers in Dawakin Kudu Local Government Area of Kano State are not noted to produce enough food, probably due to some constraints that lead to lack of access to timely and up-to-date information which would have enabled them to achieve optimal yield from their farmlands. Lack of access to basic agricultural knowledge and information by rural farmers in Dawakin local government area of Kano State which may be as a result of certain constraints has made these farmers to stick to their old traditional methods of farming system and animal husbandry practice, hence resulting in poor crop and livestock productivity. Information and knowledge are very vital in agricultural development of any community and where they are poorly disseminated as a result of certain constraints, the community's agricultural development becomes highly impeded (Obidike 2011). Therefore, this study is designed to investigate the effects of radio to farmers in Dawakin Kudu Local Government Area of Kano State in accessing agricultural information. Nowadays, access to education, information, knowledge, and communication plays a vital role in the individual and social life as well as human development and inclination towards growth. As a pre-requisite of knowledge, information, recognition and awareness are among the most efficient factors in reaching human development (WSIS, 2005). In Nigeria, the studies conducted by Arokoyo (2003) showed that radio is the major source of information for the farmers of this country.

The broad objective of this paper is to assess the use of Radio on agricultural information to farmers in Dawakin kudu Local Government area. However, the specific objectives are to;

1. describe the socio-economic characteristics of the farmers in the study area,
2. examine the relationship of socioeconomic factors on the use of radio for agricultural information, and
3. identify the major problems affecting the use of radio as a source of agricultural information

METHODOLOGICAL PERSPECTIVES

Study Area

The research work will be carried out in Dawakin Kudu Local Government Area. It is located at latitude 10^0 30N and longitude 7^0 40E and 10^0 35E in the Sudan Savanna of agro ecological zone of Nigeria. Dawakin Kudu lies in South Eastern part of Kano State with a total land mass of $59km^2$. It has a population of 265,950 (census 2006). Dawakin Kudu district shares boundaries with Warawa to the East, Bunkure to the South, Wudil South – East, Kura South – West, Kumbotso to the North – West and lastly Gezawa by the North. (NIPOST.2009).

Sample Size

Random sampling was used in selecting the study sites and respondents. Dawakin Kudu has fifteen (15) wards which are as follows; Dabar kwari, Dan bagina, Dawaki, Dosan, Gano, Gurjiya, Jido, Tamburawa, Tsakuwa, Unguwar duniya, Yanbaru, Yankatsari, Yar gaya and Zogarawa. Four (4) farmers were selected from each ward as respondents of the ward, making a total number of 60 respondents. The respondents were "Full Time Farmers" that are engaged in crop and/or livestock production.

Methods of data collection and Analysis

The data was collected from primary source through which interview was conducted with the help of a well-designed questionnaire as instrument for data collection. Each objective raised for the study will have specific questions under it. The analytical tool adopted for this research was descriptive statistics and X^2 (chi square). Data was collected from the farmers and was analyzed using percentage and frequency distribution to achieve objective 1, 2 and 4 while X^2 will be used to answer objective 3.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Farmers

Socio – economic characteristics play an important role in providing clear picture of the social and moral activities of the farmers. Socio-economic status highlights the age, marital status, gender, level of education, farm size and household size of the farmers.

Gender has great influence in terms of job engagement most especially in the northern part of Nigeria in which some works were mostly assigned or preferred by one gender over the other. Majority of the farmers (91.7%) were males while only (8.2%) were females. This implies that males use radio more than females in the study area for acquiring information on agricultural activities. The finding disagreed with Okoro (1996) who reported that all the marketers in the area were male probably due to normal and societal values of the study area. The age distribution shows that farmers within 20-30yrs were the majority with 26.7% followed by 25% which are in the range of 42-52, 23.3% were within 31-41, and then 16.7% were within the range of 53-63, only 8.3% were found to be within 64-74. This work disagreed with Maji *et.al* (2012) who stated that farmers age having 44% were the majority with 41-50 years of age. Age plays a significant role in acceptance of any innovation. It is believed that young farmers are ready to accept innovation while old do not accept innovation easily. Marital status can be considered as the level responsibility of an individual. Result shows that married farmers were found to be the majority (95%), while singles were 5%. This implies that majority the respondents (95%) had one form of responsibility or another. This study is in line with that of Ugwuja (2011) who reported that 88.7% of the farmers were married. Educational level in this finds the number of years of formal schooling. The results showed that more than half of the respondents (55%) had primary education, while only 18% had obtained secondary education. This indicates that the level of education of the respondents was low, with none of them having tertiary education. The educational status of the respondents may not likely affect their use of radio as means of receiving agricultural information. This was mainly due to the fact that most of the agricultural programmes broadcasted over the radio were in the farmers' language for better understanding.

Radio Ownership and Frequency of Listening to Agricultural Programs

The result implies that almost all the farmers (90%) owned radio in the study area while only 10% of the farmers had no radio. By relating this with the age of the farmers, it is identified that the farmers that fall within the range of 50 and above do not own radio. When considered the frequency at which the farmers listened to agricultural programs on radio, it was observed that 46.3% of the farmers listen to agricultural programs through the radio monthly, followed by 27.8% that listen to the such programs weekly, while 22.2% listen to the programs fortnightly and the least with 3.7% listen to the programs daily. This implies that majority of the listeners were youth and listened to other programs more than agricultural related programs. But with recent call-in –radio programs on agriculture, the use of radio in receiving agricultural information would likely be used.

Proportion of increase in productivity with the use radio

This is said to be the proportion on how agricultural information received through radio enhance the productivity of the famers

The result shows that the information gathered from the radio programs help the farmers in their productivity. Majority (64.8%) of the farmers responded with increase proportion of 0-30%, 25% of the farmers with proportion of 31-60%, 6.7% of the farmers with proportion of 61-100%.

Results of the X²-Test, Based on the relationship of socio economic factors on the use of radio for agricultural information

The results of the chi-square showed whether the use of radio has relationship on the socio economic factors of the farmers. Age and level of education are the factors to be determined for this test.

Hypothesis:

Ho: There is no significance difference in farmers' levels of education for the use of radio in agricultural production.

Ha: There is significance difference in farmers' levels of education for the use of radio in agricultural production.

Decision:

The null hypothesis is rejected, because Chi-square calculated is greater than Chi-square tabulated at 5% level of significant. Therefore, the Ha is accepted which says there is significance difference in farmers' levels of education for the use of radio in agricultural production. This means that farmers' levels of education plays role in the use of radio in the area.

Hypothesis:

Ho: There is no significance difference in farmers' age for the use of radio in agricultural production.

Ha: There is significance difference in farmers' age for the use of radio in agricultural production.

Decision:

Ho is rejected, because Chi-square calculated is higher than Chi-square tabulated. Therefore, Ha is accepted which says, there is significance difference in farmers' age for the use of radio in agricultural production.

CONCLUSION AND RECOMMENDATIONS

The importance of radio agricultural programs cannot be over emphasized due to its contribution to increase in the whole sector of agriculture. On the basis of the finding of this study we can conclude that the farmers were using the agricultural information they received through radio although the use of radio is associated with some problems, such as giving room for asking questions.

From the study it is clear that, some farmers were aware of some recommended solutions despite the problems of using the radio in receiving agricultural information. The following are the recommended in order to achieve the objectives of using radio as a source of receiving agricultural information.

1. Formal education should be taught to the youths which will increase the use of radio in the area.
2. Agricultural programs on radio should be scheduled to suit the peculiarities of its catchment audience.
3. Call-in programs should be introduced.
4. The radio stations should provide well trained presenters to be hosting the programs.

TABLES

Table 1: Distribution based on proportion of increase in productivity

Distribution	Frequency	Percentage (%)
0 – 30 (%)	35	64.8
31 – 60 (%)	15	27.8
61 – 100 (%)	4	7.4
Total	54	100

Survey: Field survey, 2015

Table 2: Distribution based on farmers' levels of education for the use of radio in agricultural production

Level of education	Users	Non users	Grand total
Qur'an	$11^{(14.4)}$	$5^{(1.6)}$	16
Primary/Qur'an	$32^{(29.7)}$	$1^{(3.3)}$	33
Secondary/Qur'an	$11^{(9.9)}$	$0^{(1.1)}$	11
Total	54	6	60

Degree of freedom = 4

Number of questionnaire (n) = 60, Chi-square calculated = 11.03, Chi-square tabulated at 5% = 5.99

Values in parenthesis are expected.

Table 3: Distribution based on farmers' age for the use of radio in agricultural production

Age	User	Non user	Grand Total
20 – 30	$16^{(14.4)}$	$0^{(1.6)}$	16
31 – 41	$13^{(12.6)}$	$1^{(1.4)}$	14
42 – 52	$14^{(13.5)}$	$1^{(1.5)}$	15
53 – 63	$10^{(9.0)}$	$0^{(1.0)}$	10
64 – 74	$1^{(4.5)}$	$4^{(0.5)}$	5
Total	54	6	60

Degree of freedom = 4
Number of questionnaire (n) = 60
Chi-square calculated = 30.41 Chi-square tabulated at 5% = 9.49, Values in parenthesis are expected.

Table 4: Distribution based on constraints

Constraints	Frequency	Ranking
No room for asking Questions	37	1
Battery expense	12	4
Extension visits	20	2
Not based on farmers interest	15	3

Source: Field Survey, 2015 multiple response

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EXTENDING ADAPTED YAM MINISETT TECHNOLOGY TO FARMERS FOR SEEDYAM PRODUCTION USING DEMOS: LESSONS LEARNT

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ABSTRACT
Adapted Yam Minisett Technique (AYMT) for clean seedyam production was demonstrated in 146 locations to farmer groups by 4 NGOs in Nigeria in 2015 under the Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project. The YIIFSWA Project aims to raise the productivity of 200,000 farmers in Nigeria and Ghana by 40% in 5 years with a multiplier plan for 3 million farmers in 10 years. Scarcity of clean seedyams is the greatest constraint to increased yam production and the yam minisett technology was developed to address this constraint. Demonstration plots of 300 m^2 or 400 m^2 were manually prepared as ridges or mounds.. Clean seedyams were cut into 40g setts and treated with a mixture of 100g of Mancozeb 80%WP and 70ml of Chlorpyrifos 48% EC in 10 litres of water and cured overnight. The setts were planted between May and July on the crest of the seedbed and spaced 30cm apart. The NGOs were treated as blocks while seed treatment constituted the treatments. Data were collected for sprout count, yield and yield components and subjected to ANOVA for RCBD while differences in means were estimated using SED. Treated minisetts gave 43% more sprouts and 48% higher fresh tuber yield of clean seed yams than untreated minisetts. NGOs that strictly observed recommended cultural practices had higher yields than those who did not. The lessons learnt are that treating minisetts with recommended chemicals before planting, planting at recommended spacing of 30cm and planting during May /June would give highest clean seedyam yields.
Keywords: Adapted, yam, minisett, seedyam and technology

INTRODUCTION
The greatest constraint to increased yam production in Nigeria was identified as scarcity or high cost of seed yams (Okoli et al. 1982, Ikeorgu and Igbokewe, 2003, Ironkwe et al. 2007). That was what led to the development of the yam minisett technique in the early 80s (Okoli et al. 1982). After several years of extending to farmers, Ogbodo, 1985) reported that adoption rate was still below 40%. This was what led NRCRI Umudike to go back to the drawing board and reviewed the minisett recommendation. According to Ikeorgu et al. (2000), the recommendation was made more elastic such that farmers who desired large seed yams as planting material could use minisett sizes between 35g to 50g. Those who desired many but smaller seed yams could stick to 25-30 gram setts, which is the original recommendation.
However, it was discovered that the ADPs who had the mandate to extend the yam minisett technology to the grassroot farmers did not diligently carry out this function. This was more so after the World Bank loan for this purpose was exhausted and extension agents were unable to visit farmers due to lack of mobility or fuel to power their motorcycles. The result was that until 2011, several rural communities in the Nigerian yambelt had not even heard about the yam minisett technology.
The Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project, currently being funded by Bill and Melind Gates Foundation (BMGF) was started in 2011 and aims to increase the productivity of 200,000 rural farmers in Ghana and Nigeria by 40% in 5 years with a 10 year projection of reaching 3 million farmers (Maroya et al. 2014). To be able to increase ware yam production, clean seedyams must be readily available to farmers. We chose to train farmers to produce their own clean seedyams rather than ask them to buy from local markets. This was what informed the use of Adapted Yam MInisett Technique (AYMT) in which farmers chose what size of minisett to use in producing their desired seedyams. This paper reports the lessons learnt from 146 demos carried out by farmers groups in 4 NGO in Nigeria under the YIIFSWA project in 2015.

MATERIALS AND METHOD
Four Non-Governmental Organizations (NGOs): Justice, Development and Peace Movement (JDPM) Oyo Oyo State; Arimathea Foundation for Development (AFD) Lafia, Nasarawa State; Missionary Sisters of the Holy Rosary (MSHR) Idah, Kogi State and Small Holder Oil Palm Farmers' Multipurpose Cooperative Society (SHOP). Umuasua Isuikwuato, Abia State (Table 1) carried out these demos in 146 locations in 2015 through their farmer groups. Each farmer group of between 20 and 30 members manually prepared a 20m x 20m or 20m x 15m demo plot in either ridges or mounds, depending on their prevailing land preparation method. Clean seedyams of farmer preferred cultivars, were purchased from the open market and sorted before cutting into 40 g minisetts setts. The setts were treated with a combination of 100g Mancozeb 80% WP (fungicide) and 70ml

Chlorpyrifos 48% EC (insecticide) in 10 litres of water and cured overnight. The treated setts were planted between third week in May and early July. Minisetts were planted on the crest of ridges (or mounds) and spaced 30cm apart so as to achieve a plant population of about 33,000 plants/ha. We asked the farmer groups to plant 15 ridges with treated minisetts and 5 ridges with untreated minisetts. Where the manually made ridges were too fat, double rows of minisetts were planted on the crests and also spaced 30cm apart, both within and between rows so as to achieve the desired plant population.

All other cultural practices were carried out according to recommendations by Aighewi et al. (2014) and NRCRI (1983). Although most farmers usually intercrop yams with maize and other crops, we specifically instructed that for the purpose of this demo, the minisetts should be planted sole. Some farmer groups used herbicides to control weeds while others weeded manually. The seedyams were harvested between December 2015 and January 2016. Data were were collected on number of sprouted minisetts at 15 weeks after planting, number and weight of seedyams per unit area, for treated and untreated minisetts. T-test for paired data was used to assess the effects of treated and untreated minisetts. Means were compared using SED.

RESULTS AND DISCUSSION

1. Minisett sprouts

The number of sprouted minisetts achieved in treated and untreated demo plots expressed in percentages, are presented in Table 1. Plots where minisetts were treated with recommended chemicals had about 43% more sprouted minisetts than untreated plots. Among the NGOs, there was a higher percentage (75%) of sprouted minisetts in JDPM demos than the other 3 NGOs (68%). However, percent mean sprouted minisetts in demos in the other 3 NGOs did not differ. There is a strong indication from this result that to achieve high minisett sprouts, the farmer must treat the setts with appropriate chemicals.

2. Number of seed yams

The number of seedyams harvested from demo plots of treated and untreated yam minisetts conducted by farmer groups from 4 NGO YIIFSWA partners in 2015, are presented in Table 2. The number of seedyams in treated demo plots was 41.5% higher than those in untreated plots. Significantly more seedyams were harvested by farmer groups in AFD than the other NGOs. Number of seedyams

harvested by MSHR and SHOP did not differ but were higher than those harvested by JDPM. The reason for this observation is obvious. AFD planted at 30cm as recommended and carried out most husbandry practices timely. JDPM had 6 weeks of drought in May/June and therefore planted late into July. But some farmers in JDPM planted at 50cm on ridges because they thought 30cm was too close. Also, MSHR farmers planted at 50cm on ridges and this drastically reduced the plant population per unit area. Although SHOP farmers treated all their minisetts with recommended chemicals and planted double rows, some of the farmers left the treated setts for up to 2 weeks because they had not prepared their seed plots. This reduced the number that sprouted and consequently, the seed yan yields.

3. Weight of seedyams harvested.

The weight of seedyams (t/ha) harvested from treated and untreated demo plots of farmer groups from 4 NGO YIIFSWA partners in 2015, are presented in Table 3.

The result followed the trend fir number of harvested seed yams and showed that treated plots gave 48% higher seedyam yield than untreated plots. However, in MSHR there were no tuber yield differences between treated and untreated plots. This could be due to a number of reasons. Some farmers treat all their setts but still demarcate some ridges as untreated while others selected the head region and planted in untreated plots. The head region has little problem in sprouting whether treated or untreated.

CONCLUSION AND LESSONS LEARNT

When a farmer follows the recommendations for seedyam production using the minisett technique, he will have high seedyam yields. The lessons learnt from this on-farm demo trial to validate the minisett technique could be summarized as follows:

1. To achieve hugh yields of clean seedyam, you must treat the minisetts with recommended chemicals.
2. After treating with chemicals, the setts must be planted not later than 48 hours.
3. Planting at 25cm or 30 cm on the crest of 1m ridges ensures you achieve 40,000 or 33,000 plants/ha, respectively. Where your ridges are spaced wider than Im apart, you could plant double rows of minisetts so as to achieve optimum plant population.
4. Planting the treated setts between end of May and end of June gives higher clean seedyam tubers than later planting.
5. Positive selection to ensure you plant only clean setts is very critical for production of clean seedyams at the end of the planting season.

Table 1: Percent sprouts achieved from 164 demo plots of treated and untreated minisetts conducted by farmer groups from 4 NGO YIIFSWA partners in 2015

YIIFSWA NGO partner	Number of demo plots in 2015	% sprouted minisetts	
		Treated	Untreated
1. Arimathea Foundation for Development (AFD) Lafia, Nasarawa State	39	68.00	42.10
2. Justice, Development and Peace Movement (JDPM) Oyo, Oyo State	27	75.00	39.10
3. Missionary Sisters of the Holy Rosary (MSHR) Idah, Kogi State	55	68.00	41.80
4. SHOP Farmers Coop. Society Ltd, Umuasua Isuikwuato. Abia State	25		All were treated
		67.60	
Total number of demos	146		
Means		69.65	40.45

SED for means in treated setts = 3.47
SED for means in untreated setts = 3.05
SED for means treated vs untreated = 3.57

Table 2: Number of seedyans (x 1000/ha) produced from treated and untreated yam minisett demo plots of farmer groups from 4 NGO YIIFSWA partners in 2015

NGO YIIFSWA partner	Seedyam number (x1000/ha)		Total seedyam number
	Treated plots	Untreated plots	
AFD	22.16	14.44	36.60
JDPM	8.71	4.00	12.79
MSHR	14.55	10.23	24.56
SHOP	19.97	All treated	19.97
Mean	16.34	9.56	

SED for Treated and untreated demos =2.15
SED for NGO demos =5.86

Table 3: Weight of seedyams (t/ha) harvested from treated and untreated demo plots of farmer groups from 4 NGO YIIFSWA partners in 2015

NGO YIIFSWA Partners	Fresh seedyam tuber tields (t/ha)		Total seedyam yuber yield (t/ha)
	Treated plots	Untreated plots	
AFD	3.92	3.15	7.07
JDPM	2.80	1.04	3.84
MSHR	1.81	1.83	3.64
SHOP	6.71	All treated	6.71
Mean	3.81	2.00	

SED for treated and untreated demos = 0.72
SED for NGO partners = 2.66

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SOCIO-ECONOMIC FACTORS AFFECTING PERCEPTION OF HIV/AIDS EFFECTS AMONG FARMERS AND EXTENSION PROFESSIONALS IN ABIA STATE, NIGERIA

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ABSTRACT

Factors affecting root and tuber crop farmers perception of HIV/AIDS effect of agricultural activities in Abia State, Nigeria was identified. A total of 180 (One hundred and eighty) questionnaires were administered to the respondents in the study area. Data was collected and analyzed using descriptive statistics and chi-squared statistical techniques. Result shows that majority of farmers were females (51.1%) while majority of extension professionals were males (59.9%). Marital status, level of income and education access to ICT and family doctor, professional bodies and sources of information were factors positively affected their perception while location and age were significant at 1% respectively and negatively related to perception of farmers and extension professionals of the effect of HIV/AIDS on agricultural production, processing and marketing. Farmers and extension professionals perceived reduction in the size of land cultivation and increase in price of food as major effect of HIV/AIDS on agricultural production. It was recommended that extension professionals should see HIV/AIDS as one of the challenges facing agricultural extension services and play an "empowerment" role as it affects agriculture to improve HIV/AIDS learning, knowledge sharing and information management among farmers, rural dwellers, as well enhance agricultural production.

Keywords: **Root and Tuber, farmers, HIV/AIDS, extension, processing**

INTRODUCTION

Acquired Immune Deficiency (AIDS) is a condition where the defence "Immune system of persons infected with human immune virus" (HIV) is totally destroyed and which ultimately leads to untimely death (Akpabio, 2005).
Most agricultural operations in Nigeria are driven by human labour. Moreover, labour intensive farming systems with low level of mechanization and agricultural input use are particularly vulnerable to the effect of HIV/AIDS as the economic return to labour tends to be low (Ajeh, 2008). The epidemic further leads to a weakening of rural institutions in their capacity to deliver extension services and has undermined the effectiveness of natural agricultural policies (Topouzis, 2006).
Nigeria, with an estimated population of 144 million has above 6million people living with HIV/AIDS and HIV prevalence rate of more than 540% (Ayeogenika, 2008) (Hlanzel, 2008) reported that more than 800, 000 people have died in Nigeria due to HIV/AIDS and over 80% of infection in Nigeria are through sexual transmission while other modes are through blood transfusion and mother to child transmission. The mandate of agricultural extension services of the National Root Crops Research Institute, Umudike is the dissemination of relevant research information through the use of various extension methods to provide technical/vocational training to farmers, students and agro-based industrialists on specialized areas, like HIV/AIDS as it affects agricultural production.
The mandate of agricultural extension services has always been human resource development with the aim of increasing food production through the introduction of improved agricultural technologies. The challenge currently posed by the AIDS epidemics to agricultural extension are quite unusual as it affects both staffs and clientele (Akpabio, 2005) However, the challenges remains what can be done by extension professionals and other stakeholders to effectively bridge the HIV prevention gap particularly in Abia State where the HIV prevalence rate has continued to increase progressively overtime (ABSACA, 2010). There are several preventions and behaviour change activities that can increase people's awareness and knowledge about HIV/AIDS, they are : Training and Workshops; HIV counselling and testing (HCT) services; production and distribution of strategic behavioural change (SBC) information education and communication IEC materials; Blood safety; condom programmes; community theatre and prevention of mother to child transmission (PMTCT) (ABSACA, 2010). The main objective of the study is to determine the socio-economic factors affecting farmers and extension professional perception of the effect of HIV/AIDS on agricultural activities in Abia State. The specific objectives are to describe the socio-economics of the respondents in the study area.

METHODOLOGY

Abia State is a State made up of 17 LGAs and three Agricultural zones namely, Aba and Ohafia. The State has a population density of 364 persons per square kilometre (NPC, 2006). Agriculture is the major occupation of the people especially in rural areas involving 70% of population. A total of 180 (One hundred and eighty) questionnaire was administered across the selected LGAs (Osisioma, Ummuneochi, Ikwuano, Umuahia South, Umuahia North, Bende and Ugwunagbo) descriptive statistics and Chi-squared were used to analyze the data.

RESULTS AND DISCUSSION

Result obtained from analysis of data is presented in line with the study's objectives.

Table 1.0 Shows that majority of the farmers were females (51.1%) while majority extension professionals were males (59.9%). Thus more women were involved in farming activities while more males were extension professionals. This agrees with Nwakor(2010) that women are usually involved in the most labour-intensive farming activities in Abia State.

Table 2 reveals that 89% of the farmers and 66.7% of the extension professionals were married. This shows that the respondents are responsible, well experienced and productive to do farm work.

Table 1.2 shows that the level of income, marital status and level of education are at 1% significantly and positively related to farmers and extension perception while age and location are significant at 1% and negatively related to the farmers and extension professionals perception. Access to ICT was at 5% and positively related to the farmers perception and significant at 1% and positively related to extension professionals perception, indicating that as access to ICT increased perception of farmers and extension professionals increase. Extension professionals are agents of information communication technology to farmers on adoption of new agricultural technologies and other related issues. Effects on agricultural activities were positively or negatively determined by the factors.

CONCLUSION AND RECOMMENDATIONS

It is concluded that the extension professionals had a higher knowledge and perception of the effect of HIV/AIDS on agricultural activities than farmers in Abia State. Otherwise, farmers' effectiveness, innovativeness and empowerment depend mainly on how committed and knowledgeable the extension professionals are to impact.

Based on the findings of this study it is recommended that both farmers and extension professionals should be encouraged, mobilized, trained and empowered on how to deal with HIV/AIDS related issues as it affects agricultural activities.

TABLES

Table 1: Distribution of respondents according to gender

	Root & Tuber crops farmers		Extension professionals	
Gender	(F)	%	(F)	%
Male	44	48.9	49	59.9%
Female	46	51.1	41	43.1
Total	**90**	**100%**	**90**	**100%**

Source: Field data 2012.

Table 2: Distribution of respondents according to marital status

Marital Status	Farmers	Extension professional		
	(F)	%	(F)	%
Single	10	11.1	30	33.3
Married	80	88.9	60	66.7
Total	**90**	**100%**	**90**	**100%**

Source: Field data 2012

Table 1.2: Logit model results of the socio-economic factors affecting farmers and extension professionals perception of the effect of HIV/AIDS on agricultural activities.

FARMERS				EXT.PROFESSIONALS		
Parameter	**Estimate**	**Std error**	**t-value**	**Estimate**	**Std error**	**T-value**
Sex	0.005	0.048	0.111	0.268	0.435	0.615
Age	-0037	0.002	-16.891 xxx	-0.126	0.042	-3.011 xxx
Marital status	0575	0.075	7465 xxx	1.640	0.549	2.989 xxx
Household size	-0.004	0.012	-0.326	-0.142	0.113	-1.264
Income	0.000	0.000	35.467	0.004	0.001	37.38 xxx
Access to ICT	0.194	0.076	2.568 xxx	2.810	0.583	4.823 xxx
Location	-0.621	0.071	-8.701 xxx	0.357	0.432	0812
Education	0.037	0.005	7.465	0.102	0.031	3.258 xxx
Power supply	-0.018	0.002	-9.556 xxx	0.038	0.012	3.247 xxx
Prof. Bodies	0.070	0.055	1.272	0.913	0.636	1.437
Family doctor	0.096	0.058	1.654 x	1.464	0.558	2.624 x
Knowledge level	0.874	0.099	2.1014 xxx	1.493	0.1701	2.843 xxx
Intercept	-2.039	0.128	-15.809 xxx	2.300	1.537	1.496
Pearson Goodness fit						
Chi-square			2400.786 xxx	6122.365 xxx		
Df			56	72		

Source: Field data 2012

Statistics: Probit>Chi_2= 2400, 786 and 6122.365.

Df 72 and 56. xxx = Significant at 1% level, xx =5%, x 10% level

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ASSESSMENT OF SOURCES OF INFORMATION USED BY FISH FARMERS IN EPE LOCAL GOVERNMENT AREA OF LAGOS STATE

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ABSTRACT
The study assessed sources of information used by fish farmers in Epe local government area of Lagos State. Data were collected using structured interview guide administered to 116 fish farmers using a multi-stage sampling procedure. The Results showed that the mean age of the farmers was 42years, majority (66.4%) were males, and 11.2% had no formal education. The average household size was 6 persons with mean income of ₦50,413.79k per month while the mean farm size was 3.00 plots. Results further revealed that half (50.0%) of fish farmers did not make use magazines as their sources of information. However, majority (93.1% and 90.5%) of the fish farmers used their personal experience and farmers' cooperative society as their sources of information respectively. Pearson product moment correlation (PPMC) revealed significant relationships between fish farmers' age ($r = 0.031$, $p <0.05$); household size ($r = 0.001$, $p < 0.01$); years of experience ($r = 0.001$, $p < 0.01$) and their sources of information used. It was recommended that fish farmers should form a functional cooperative society to enhance financial stability of their members so as to reduce effects of constraints hindering their access to information.
Key words: Assessment, Sources, Information and fish farmers

INTRODUCTION
The role of information in enhancing agricultural development cannot be over emphasized in agriculture. Information is vital for increasing production and improving marketing and distribution strategies (Oladele, 2006). Access to information is very essential on fish farming technologies, construction and management, breeds and spawning, processing, storage and marketing and financing thereby increased productivity of fish farmers (Ofuoku, et al, 2008). In Nigeria, fish production is not only important as a source of protein, but it also can be used to bring about institutional changes. These changes can offer access to production assets and resources, which can help to empower the poor and directly promote their livelihood (Obeikezie, 1999). Lagos State, in Nigeria is a state with a lot of fishery potentials in the areas of artisanal and fish farming. If a state in the country has adequate information about production increase in fishery and the potential to produce enough fish for the populace, the issue of malnutrition and adequate food supply which is a crucial problem will reduce drastically. The specific objectives are to describe the socio-economic characteristics of fish farmers in Epe Local Government Area of Lagos State; ascertain sources of information used by fish farmers in the study area; determine whether fish farmers have access to information on the needed areas of fish farming in the study area; identify possible benefits derived from information used by fish farmers and investigate factors affecting fish farmers' access to information in the study area.

METHODOLOGY
The study area is Epe Division of Lagos State in South western Nigeria. Epe is located on the latitude 6'31°N and longitude 4°E and lies North east of Lagos Metropolitan area. Multi-stage sampling procedure was used to select fish farmers from the list of fish farmers' association, Lagos State branch. Epe local government was purposively selected due to the concentration of fish farmers in the area. Based on the information received from the Department of Agriculture and Natural Resources, there are about twelve (12) registered fish farmers' associations. Some include Anibire Earth pond fish farmers, Allahu Lateef fish farmers' association, Gold water fish association and so on. Moreover, 50% of the members of association were selected from the total number of registered fish farmers in each association giving a total of 116 fish farmers. Descriptive statistics were used to analyse the objectives while inferential statistics such as Pearson Product Moment Correlation (PPMC) and Chi-square test were used to analyse the hypothesis.

RESULT AND DISCUSSION
Socio-economic characteristics of fish farmers
Table 1 indicated that the mean age of respondents was 42years. Some (31.9%) of the fish farmers were middle aged which ranges from 41 – 50years, while very few (1.7%) were old which were not active in farming. This

implies that the people who were involved in fish farming were young and agile than old and inactive ones. Most (66.40%) of the respondents were male while most (69.00%) of them were married. This implies that fish farming was being handled majorly by male farmers. Some (28.00%) of fish farmers had secondary education completed and few (20.00%) had secondary education uncompleted. This implies that most of the fish farmers in the study area have some level of educational attainment. Majority (95.69%) of the fish farmers had their household size ranging from 1 to 10 persons with mean of 5 persons/household. The relative large size could serve as a source of farm labour. Most (67.24%) of the fish famers earned income of less or equal to ₦50,000:00 per month. This implies that the respondents can still be categorized as average income earners while the mean farm size was 4plots. Most (68.10%) of the fish farmers cultivate between 1 – 3plots of land, with very few (2.58%) of them cultivating more than 6plots. Also, a slight above average (50.86%) of the fish farmers had less or equal to 5 years of fish farming experience while very few (3.45%) of them had between 21 to 25 years of fish farming experiences. This implies that very few of the respondents had more experiences which can improve their production.

Fish Farmers' Sources of Information

The results in Table 2 showed that majority (93.1% and 81.0%) of fish farmers got their information from personal experience and friends/Neighbour/Relatives respectively while above average (56.0% and 55.2%) of the fish farmers did not get their information through libraries and internet facilities respectively. This is an indication that most of fish farmers might not be aware of use of modern technologies as their sources of information. Okunlola (2009) corroborated this assertion while stating that awareness is the first stage of adoption before the respondents developed interest in the technology and later decided on adoption.

Access to Information by Fish Farmers

Result in Table 3 revealed that majority (92.2%) of the fish farmers had access to market information while some (30.2%) of the fish farmers do not have access to information on fingerlings ecological disasters. Market information was of extreme important to fish farmers.

Benefits Derived from Information Used by Fish Farmers

The results in Table 4 showed that majority (90.5% and 88.5%) of fish farmers attested to the fact that increased productivity and access to newly improved technologies respectively were benefits to be derived when they are well equipped with regular information on fish farming whereas few (16.4%) were of the contrary opinion that increased income could not arise as a result of constant use of information regarding fish farming. This implies that quite a large number of fish farmers believed in the possible benefits which could be derived when fish farmers make use of regular information.

Constraints Affecting Access to Information by Fish Farmers

The result in Table 5 revealed that majority (73.3%) of the fish farmers could not have access to information due to high cost of materials in a severe manner while above average (53.4%) of them had no access to information due to inconsistent visit of extension agents in a mild intensity. Whereas, few (14.7%) of the fish farmers did not have connectivity and knowledge on how to operate the internet as a threat. This implies that the influence of these constraints on how fish farmers have access to information could be rated as medium effect.

Relationship between socio-economic characteristics of fish farmers and sources of information used.

Result indicated that significant relationship existed between age (r = -0.200), household size (r = -0.297), years of farming experience (r = -0.317), sex (χ^2 = 12.448) marital status (χ^2 = 122.552), educational level attained (χ^2 = 28.724), occupation (χ^2 = 154.603) and sources of information used. This implies that fish farmers' age and household size determined the sources of information used. This means that fish farmers who are youth could have a greater patronage of sources of information used. Thus, utilization of sources of information depends on farmers' age status.

CONCLUSIONS AND RECOMMENDATIONS

Fish farming in the study area is dominated by male and they are in their active age. Fish farmers have some level of educational attainments. Majority of fish farmers had their information from personal experience and friends/Relatives. It was recommended that fish farmers should form a functional cooperative society to enhance financial stability of their members so as to reduce effects of constraints hindering their access to information; extension agent-farmer ratio needs to be improved upon so that regular and prompt visits could be made.

Table 1:Distribution of fish farmers based on socio-economic characteristics of fish farmers

Variables	Definitions	Distributions
Age	Actual age of respondents	Average age=42years
Sex	Sex of respondents as male or female	Male (77); Female (39)
Marital status	Marital status of respondents	Married (69.00%)
Educational status	highest educational level	Secondary education completed (28.00%)
		Secondary education uncompleted (20.00%)
Income	Area of land used for fish farming	Average = ₦50,413:79

Table 2: Distribution of fish farmers based on sources of information used

Sources of information	Yes	No
Personal Experience	108(93.1)*	8(6.9)
Workshop/Seminar	91(78.4)	25(21.6)
Friends/Neighbors/Relatives	94(81.0)	22(19.0)
Ministry of Agriculture	63(54.3)	53(45.7)
Magazines	58(50.0)	58(50.0)
Newspapers	79(68.1)	37(31.9)
Extension Officers	90(77.6)	26(22.4)
Local Government Offices	95(81.9)	21(18.1)
Non-Government Organization	95(81.9)	21(18.1)
TV broadcast	74(63.8)	42(36.2)
Radio Broadcast	68(58.6)	48(41.4)
Internet	52(44.8)	64(55.2)
Traditional Rulers Community	62(53.4)	54(46.6)
Journals	52(44.8)	64(55.2)
Libraries	51(44.0)	65(56.0)
Bulletins/Posters	77(66.4)	39(33.6)
Professional Colleagues	89(76.7)	27(23.3)
Customers	96(82.8)	20(17.2)
Religion Organization	71(61.2)	45(38.8)
Cooperative Society	105(90.5)	11(9.5)
Total	**116**	**100.0**

*Figures in parentheses are percentage

Table: 3 Distribution of fish farmers based on access to information needs

Variables	*Access	* No access
Feeding operation	101(87.1)**	15(12.9)
Feed Formulation	89(76.7)	27(23.3)
Fingerlings Ecological Disaster	81(69.8)	35(30.2)
Drugs	88(75.9)	28(24.1)
Equipment	93(80.2)	23(19.8)
Water Treatment	88(75.9)	28(24.1)
Disease control and Prevention	87(75.0)	29(25.0)
Storage	97(83.6)	19(16.4)
Market information	107(92.2)	9(7.8)
Total	**116**	**100.0**

*Multiple responses recorded **Figures in parentheses are percentage

Table 4: Benefits Derived from Information Used by Fish Farmers

Benefits	Yes	No
Increased income	97(83.6)*	19(16.4)
Increased productivity	105(90.5)	11(9.5)
Access to newly improved technologies	103(88.8)	13(11.2)
Increasing food supply	100(86.2)	16(13.8)
Adequate and useful motivate fish farmers	103(88.8)	13(11.2)
Assist farmers to take decision concerning use and management of their resources	105(90.5)	11(9.5)
Total	**116**	**100.0**

*Multiple responses recorded **Figures in parentheses are percentage

Table 5: Distribution of fish farmers based on factors affecting access to information

Factors	Severe	Mild	Not severe
High cost materials	85(73.3)*	27(23.3)	4(3.4)
Lack of irrelevant materials in offices and libraries	47(40.5)	38(32.8)	31(26.7)
Inconsistent visit of extension agents	36(31.0)	62(53.4)	18(15.5)
Format of presentation/poor communication by extension agents	39(33.6)	59(50.9)	18(15.5)
Illiteracy	54(46.6)	43(37.1)	19(16.4)
Language barriers between extension agents and fish farmers	42(36.2)	56(48.3)	18(15.5)
No connectivity and lack of knowledge on how to operate the internet	53(45.7)	46(39.7)	17(14.7)
Lack of extension trust and participation of fish farmers association or society	40(34.5)	48(41.4)	28(24.1)
Total	**116(100.0)**	**116(100.0)**	**116(100.0)**

*Figures in parentheses are percentage

Table 6: Test of relationship between selected personal characteristics of rural nursing mother and indigenous family planning practices used

Variables	r	Pvalue	Decision
Age	- 0.200	0.031*	S
Household size	-0.297	0.001**	S
Years of Farming Experience	-0.317	0.001**	S
	χ^2		
Marital status	122.552	0.000*	S
Sex	12.448	0.000*	S
Occupation	154.603	0.000*	S
Educational level attained	28.724	0.000*	S

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ASSESSMENT OF ACCEPTANCE OF TECHNOLOGY COMPONENT OF NRCRI'S COCOYAM REBIRTH INITIATIVE AMONG RURAL WOMEN FARMERS IN ABIA STATE

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ABSTRACT
The study assessed the acceptance of Cocoyam rebirth initiative of National Root Crops Research Institute Umudike as strategy for increasing food production among the rural women farmers in Abia State. The aim of the study is to evaluate the component technologies of cocoyam rebirth of NRCRI that has been transferred to farmers in Abia State. These technologies are: cocoyam minisett technology (Goken-rapid multiplication), cocoyam value addition technology (Cocoyam crisps and flour), and cocoyam processing and storage technology. The multistage sampling technique was used in selection of 120 respondents. Primary data were collected by the use of questionnaire; data collected were analyzed with descriptive statistics such as frequency table and mean. The result showed that 70 percent of rural women farmers participated in cocoyam minisett technique, while 69 percent participated in processing/ value addition of cocoyam, more so about 60 percent of women participated in the storage technology. The result further showed high level of participation in production technology of NRCRI Cocoyam Rebith initiative. Theses includes Planting of 7g setts of Cocoyam (Cocoyam minisett technique), (x=3.89), 20cm x 1m planting spacing (x=3.7), Crop mixture with tree crop (x=3.51) and May – June planting time (x=3.27), which were all above the critical mean point score of 3.0. Also the Women farmers participated actively in sub- value addition technology component of NRCRI Cocoyam rebirth initiative because the mean score of the participating rural Women farmers in the technology component (Cocoyam crisps and flour) was 3.81 and 3.67% respectively. More so, the rural women farmers participated actively among the selected sub storage technology component of the project, application of wood ash (x=3.34) and heaping of cormels (3.41).
Keywords: cocoyam, rebirth, technology, participation, farmers, women, rural

INTRODUCTION
Cocoyam is an important carbohydrate staple food in the south Eastern and middle Belt area of Nigeria (Asumugha and Mbanaso, 2002; Eke Okoro *et al* 2005). Cocoyam can be processed into several foods and food products (Hussain *et al* 1984) and also used as food for livestock and as industrial crop for production of alcohol and medicine. Cocoyam is highly medicinal for diabetic patients because it has low starch content, easily digestible, contains protein more than other tubers, convalescents and fortified food for infants (Mbanaso *et al* 2008). Cocoyam is the 3rd most important root and tuber crop after cassava and yam in Nigeria. It is one of the identities of Nigeria. This is because Nigeria has consistently maintained her leadership position as the largest producer of cocoyam in the World. In order to enhance and sustain the productivity of cocoyam, encourage farmers towards participation in cocoyam cultivation and raise their standard of living, a recent effort towards rapid production and enhancement of cocoyam in Nigeria has given rise to the introduction and implementation of cocoyam rebirth project under the cocoyam programme of the NRCRI Umudike and in 2007.

This initiative is a new holistic approach to the perception, research, production utilization and marketing of cocoyam in Nigeria (Chukwu and Nwosu 2008). Among the Igbos, a major tribe in Nigeria, Cocoyam is second to yam in socio-cultural value. For instance in Nenwe communities in Aninri Local Government of Enugu State, Women who are prominent in cocoyam production during the colonial era up to 1970, were conferred with the titles such as `Ekweghe Ede`. This is similar to `Okoji`, Di-ji or `Onyba` titles bestowed on men who are prominent in yam production in the same area. Cocoyam festival is celebrated in some communities in Anambra and Imo States in the Southeast Nigeria (Chukwu *et al*, 2008) Cocoyam rebirth is therefore not just a matter of practicing new technologies but is about adopting a new style of thinking, perceiving and tackling challenges facing cocoyam. Farmers' participation, especially the women farmers who constitute a formidable and significant livewire of peasant farming in Nigeria, to State, Federal and donor sponsored agricultural programme/initiatives is an important factors to sustainable Agriculture in rural Area. Women farmers participation issues are the area of concern at National and local level (Subedi, 2008). Without participation there are obviously no development and no programmme, hence great failure in such programme initiative (Aref *et al* 2010). This study therefore examined the participation and acceptance of NRCRI cocoyam initiative among the rural women farmers in Abia State.

METHODOLOGY

The study was carried out in Abia State; the choice of the study area was informed by its notable position and proximity to NRCRI Umudike. Abia State has a population density of about 2,883,999 persons with a relatively high density of 580 persons per square kilometer, (NPC, 2006). A multi stage sampling technique was used for the selection of respondents. Abia State is divided into 17 administrative blocks called local Government Areas, which is grouped into three (3) Agricultural zones namely: Ohafia, Umuahia and Aba zones. Umuahia Agricultural zone was purposively selected because of the presence and notable position of NRCRI in root crop expansion programme in the zone. Four local government areas (LGAs) were randomly selected from the six LGAs that make up the Agricultural zone. The autonomous communities were selected randomly from each of the four selected LGA making a total of 12 autonomous communities. From the sample frame a random sample of 10 participating women farmers of NRCRI cocoyam rebirth were selected from the twelve selected autonomous communities. This gave a sample size of one hundred and twenty 120 participating women cocoyam farmers. The data collected were analyzed with the use of descriptive statistics (table, frequency, percentage and mean).

RESULTS AND DISCUSSION

Assessments of level of participation of rural farm women in each of the technology component of NRCRI cocoyam rebirth initiative technologies are grouped in to 3 major components according to Okoye *et al (*2009). They are as follows: Goken-rapid multiplication technology production technology, processing and value addition. The result shown in the table below: (a) Rural women participation in production technology component of NRCRI cocoyam Rebirth. The result shows that the participation scores for the different sub-production technology component ranged between 2.79 -4.05. From the result there was high level of participation in production technology among the rural women in Abia State. Also among the selected sub production technology component of cocoyam rebirth initiative of seed multiplication (cocoyam minisett technique had the highest level of participation among the rural women in the study area with a mean score of 3.89. From the table there was an increase in farmers output, income and reduction in cost of planting materials.

(B) Rural women participation in processing/value addition technology component.

From the table result shows that 33.37% and 36.67% of the rural women farmers in the study area always participated in processing/value addition of cocoyam into cocoyam crips, flakes and flour for confectionaries respectively with a mean score of 3.81 and 3.67%. From the result there is an increase in farmers' income.

(C) Women participation in storage technology component:

From the result women participated actively in the storage technology component of cocoyam rebirth with the mean score value of 3.34 and 3.41% which is above the critical mean value (3.0). From the result good storage increase the shelf life of harvested cocoyam.

CONCLUSION

From the result, there is high participation level of production, value addition and storage technology component of NRCRI cocoyam rebirth among the rural women farmers in the study area.

Table 1: Distribution of Rural Women Farmers according to Their Level of Participation in Each of the Technology Component of Cocoyam Rebirth Initiative in Abia State, Nigeria

Technology packages.	Al.	Oft.	Occ.	Sel.	Nev.	total	Mean
(A) Goken-rapid multiplication technology Planting of 7g sett of cocoyam	195 (43.33)	104 (28.89)	27 (10.0)	12 (6.67)	10 (11.11)	348	3.87
Time of planting: May-june	165 (36.67)	48 (13.33)	36 (13.33)	24 (13.33)	21 (23.33)	294	3.27
Planting distance (20cmx1m)	15 (3.33)	264 (73.33)	45 (16.67)	6 (3.33)	3 (3.33)	333	3.7
NPK 20:10:10	120 (26.67)	24 (6.67)	18 (6.67)	30 (16.67)	39 (43.33)	193	2.14
Crop mixture(tree crops)	135 (30.3)	76 (21.11)	75 (27.78)	22 (12.22)	8 (8.89)	316	3.51
Harvesting (8-12months after planting	105 (23.33)	36 (10.0)	33 (12.22)	46 (25.56)	26 (28.89)	246	2.73
(B) Value addition technology	150 (33.33)	112 (31.31)	63 (23.33)	14 (7.78)	4 (4.44)	343	3.81
Flour(for confectionary)	165 (36.67)	76 (21.11)	57 (21.11)	28 (15.56)	5 (5.56)	331	3.67
(C) Storage Technology left unharvested	70 (15.55)	44 (22.22)	30 (11.11)	46 (25.56)	32 (35.56)	222	2.46
Cocing barn-dusted with wood ash	120 (26.67)	72 (20.0)	78 (28.89)	18 (10.0)	13 (14.44)	301	3.34
Heaping	140 (31.11)	80 (22.22)	45 (16.67)	30 (16.67)	12 (13.33)	307	3.41

Source: Field survey Data 2014.
Decision rule 3.0 and above = participation.
Decision Rule< 3.0 = non participation. *n =90*
Figures in parenthesis are percentages.
Total scores = Cocoyam Rebirth Technology Component Raw scores.
Always 5, often 4, occasionally 3, seldom 2, never

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ASSESSMENT OF THE LEVEL OF CROP FARMERS' AWARENESS AND PARTICIPATION IN AGRICULTURAL INSURANCE SCHEME IN ABUJA, FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT

This study was carried out to determine the factors influencing participation of Agricultural Insurance Scheme among food crop farmers in Federal Capital Territory Abuja, Nigeria. Sampling procedure was employed to select a sample size of 100 farmers and structured questionnaire was used to elicit data from the farmers. The data collected from the farmers were analyzed using descriptive statistics. Majority (79%) of the farmers was male and 88% of the respondents fell within the age group 20 – 50 years with a mean of 36 years. Most (71%) of the respondents were married with majority (57%) having a household size of between 6 and 15 people Most (87%) of the respondents are into crop production while 11% into mixed cropping and the remaining 2% into livestock production. 81% of the respondents had farming experience of over 11 years. 86% of the farmers earned over N100,000. On the awareness level, it shows that 63% of the crop farmers were aware of the existence of Agricultural insurance scheme. The study recommended that effective service delivery by insurance service providers should ensure continuity of farmer's participation in agricultural insurance scheme and also participation by farmers who are yet to participate. More sensitization and enlightenment be created and promoted so as to minimize the risk and uncertainties associated with agriculture.

Keywords*:* Assessment, Awareness, Participation, Agriculture, Insurance

INTRODUCTION

Agriculture can contribute to spurring growth reducing poverty as non-agricultural GDP growth (World Bank, 2008). Agricultural production is subject to many risks and uncertainties. Any farm production decision plan is typically associated with multiple potential outcomes with different probabilities. Many risks directly affect farmer's production decisions and welfare. Agricultural producers face many risks in their economic activity due to weather conditions, plant or animal diseases, price volatility, and policies such as agricultural trade liberalization and restrictions on the use of crop protection products (World Bank, 2005). Weather, market developments and other events cannot be controlled by the farmer but have a direct effect on the returns from farming. Traditionally, farmers have managed risks by using less risky technologies of lower but reliably yielding drought-resistant crops; by seeking diversification both in terms of production activities, on-farm and income generating activities off-farm; and by devising informal and formal risk sharing arrangements (Friedberg, 2003).
Ajakaiye (2001) stated that small farmers in many developing countries of the world including Nigeria are trapped in the vicious cycle of poverty. The cycle is characterized by low income which leave them with virtually no saving capital required in their production technology and this consequently amount to the low status accorded to farmers in the society. However, through Agricultural Insurance, farmers can be saved from these losses or damages to crops or the effect can be minimized. Thus, Agricultural Insurance serves as a means of guiding against loss should the insured event occurs. According to Ray (2001), crop insurance can cushion the shock of disastrous crop loss in bad years and helps to ensure a considerable measure of security in farm income over the years.
Agriculture Insurance looks into low risks and uncertainties which can be effectively managed to the advantage of the farmers in the present and also in the future. This can help in stabilizing agriculture and in fact the economy at large. Agricultural Insurance is therefore a necessary part of the institutional infrastructure essential for the development of agriculture which is mainly at high risk enterprise.

Objectives

The objectives of this study are:

1. To examine the socio-economic characteristics of the respondents.
2. To examine the level of crops farmers awareness and participation in agricultural insurance scheme in the study area.

METHODOLOGY

The study was carried out in the Federal Capital Territory located in the geographical centre of Nigeria. It has a land mass of 8,000 km^2 and lie between latitude 9^o 10^1 North of the equator and longitude 7^o 11^1 East (FCT, 2007). It shares boundary in the North by Kaduna State, West by Nasarawa State and South by Kogi State. A two stage sampling procedure was adopted in selecting respondents for this study. In the first stage, communities with farming households namely; Abaji, Gwagwalada, Kuje, Kwali and Nyanya were randomly selected from the five communities with high farming households in the Federal Capital Territory through the instrumentality of a random number table. In the second stage, 100 farmers were randomly selected from the selected communities in proportion to the number of farmers in the communities. Primary data in this study were collected using a well-structured questionnaire. The data collected were analyzed using descriptive statistics.

RESULTS AND DISCUSSION

The socio-economic characteristic of the respondents directly or indirectly affects their farming operations as presented in Table 1. The analysis shows that majority (79%) of the farmers were male while the remaining 21% were female. The differences in the gender participation are due to the fact that the female farmers had no productive resources such as land, credit facilities, amongst others. The results of the analysis of the age distribution of the farmers in the study area reveals that majority of the respondents fell within the age group 20 – 50 years which was about 88% of the total sample, with a mean of 36 years and those that were above 50 years constituted 12%. This finding is consistent with the outcomes of Ohen and Ajah, (2015), who observed that the mean age of crop farmers in their study area was 35 years. This further implies that the sampled respondents are active and are in their prime and possibly more mentally sound to embrace new techniques and innovations regarding minimizing the risk and uncertainty associated with farming activities.

The result of the household analysis of the respondents is also captured in Table 1. The results indicated that 43% of the farmers had household size of less than 5 people. Those with household size ranging from 6 – 10 constituted 48% of the sampled respondents. Most (87%) of the respondents are into crop production while 11% into mixed cropping with the remaining 2% into livestock production. This suggests that the respondents are more disposed to crop production than any farming business such as livestock production and fisheries development.

The analysis also revealed that 39% of the respondents earned less than N100,000, 14% earned between N110,000 and N200,000. Also the table indicated that 12% of the sampled farmers earned between N310,000 and N400,000, while 11% obtained N210,000 – N300,000.

Awareness and Participation of Crop Farmers in Agriculture Insurance Scheme

Table 2 captured the above. The table reveals that majority (65) of the crop farmers did not participate in the agricultural insurance scheme. This implies that the non-awareness of the Agricultural Insurance Scheme by some of the respondents deprived them the opportunity of participating in the Insurance Scheme and invariably denying them the opportunity of grasping the advantages arising from participation. Most of the farmers who participated in the scheme explained that they were compelled to do so by the bank from which they obtained Agricultural loans. This implies that, most if not all, the farmers may not have much knowledge about the existence of such opportunity and risk handling and managing institution. Therefore, this may possibly call for much sensitization and enlightenment. The table also shows that about 63% of the crop farmers were aware of the existence of Agricultural Insurance Scheme.

CONCLUSION

The study examined the level of crop farmer's awareness and participation in agricultural insurance scheme in federal capital territory, Abuja. The socio-economic characteristics of the respondent shows that Majority (79%) of the farmers were male and 88% of the respondents fell within the age group 20 – 50 years with a mean of 36 years. Most (71%) of the respondents were married with majority (57%) having a household size of between 6 and 15 people. Most (87%) of the respondents are into crop production while 11% into mixed cropping and the remaining 2% into livestock production. 81% of the respondents had farming experience of over 11 years. 86% of the farmers earned over N100,000. On the awareness level, it shows that 63% of the crop farmers were aware of the existence of Agricultural insurance scheme. There is need to properly sensitized the farmers on the need and the importance of Insurance policy by government, non-governmental agro-services providers and insurance company. And also the insurance industry should ensure prompt delivery of their services to farmers.

Table 1: Distribution of respondents according to socio-economic

Socio-economic variables	Frequency	Percentage
Age in years		
20 – 30	24	24
31 – 40	46	46
41 – 50	18	18
51 – 60	7	7
Above 60	5	5
Total	**100**	**100**
Gender		
Male	79	79
Female	21	21
Total	**100**	**100**
Marital Status		
Single	24	24
Married	71	71
Widowed	5	5
Total	**100**	**100**
Household Size		
≤ 5	43	43
6 – 10	48	48
11 – 15	9	9
Total	**100**	**100**
Type of farming enterprises		
Crop	87	87
Livestock	2	2
Fish	0	0
Mixed	11	11
Total	**100**	**100**
Annual income		
≤ N100,000	24	24
110,000 – N200,000	14	14
210,000 – N300,000	11	11
310,000 – N400,000	12	12
Above N410,000	39	39
Total	**100**	**100**

Source: Field survey data (2014)

Table 2: Distribution of level of crop farmers according to their awareness and participation in agricultural insurance scheme

Variable	Number of respondent	Percentage
Awareness		
Yes	63	63
No	37	37
Total	100	100
Participation		
Yes	32	35
No	68	65
Total	**100**	**100**

Source: Field survey data, 2014.

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PERCEPTION OF AGRICULTURAL INNOVATION BY SMALL HOLDER FARMERS IN ABOH LOCAL GOVERNMENT AREA OF IMO STATE

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ABSTRACT
The study was carried out to determine the level of perception of agricultural innovations by small holder farmers in Aboh Local Government area of Imo State. Forty respondents were randomly selected for detailed study. Primary data for the study were generated through structured questionnaire and interview schedule, and analyzed with descriptive statistics, such as frequency table and percentage. The study revealed that majority of the farmers were males, who are young and agile, educated with large household sizes. Majority of the smallholder farmers practice bush fallow and mixed cropping systems of agriculture. Also, majority of the farmers adopted three out of the four innovations identified in the area. Modern farm tools and inorganic fertilizer are the most frequently used innovations identified in the area. However, the work of the extension agents should be intensified, to make available information about more new and modern innovations to the rural small holder farmers in order to increase their productivity.
Key words: Small holder, Perception, innovation

INTRODUCTION
One of the major goals of Nigerian agricultural development program and policies is transition from the low productivity subsistence agriculture to a high productivity agro-industrial economy, through improved technology adoption. That is a shift from traditional methods of production to new technological components and, or even new farming systems. (Hassen, 2014). The need to increase agricultural productivity, so as to meet the ever-growing food and agro-industrial demand of an expanding population is an issue of consensus in Nigeria. Sustainable agriculture therefore has emerged as the key issue in the recent past in Nigeria. The concept of sustainability includes the efficient use of resources, resource conservation and enhancement of environmental quality. Agriculture has to be dynamic to be able to respond to the continuous changes in internal and external circumstances under which it operates.

Such circumstances include changes in land resources, soil vegetation and climate, and the needs of the farming families and the growing population. The federal government of Nigeria recognized the need to develop agricultural innovations that are appropriate to Nigerian environment, and has set up a number of agricultural related research institutes to develop innovations appropriate to crops in different ecological zones in Nigeria. According to Toluyemi (1998) small holders farmers constitute about 60% of Nigerian population, and produces about 90% of Nigeria's food. As a huge number of the poor lives in rural areas, and are engaged in small holding agriculture, attempt to address the rural poor are often geared towards improving agricultural practices, as a means of increasing agricultural productivity, by replacing the old method of farming with a modern and more efficient technique of cultivation (Barla 2013) . Adoption of improved agricultural technology is a tool needed to improve sustainable agriculture, a way of reconciling the necessity for sustainability and profitable food production, improve productivity and food security.

Perception has been described as referring to a range of belief, judgments and attitudes (Sledgers 2008). According to Matanmi (1994), a standard classification for describing the perceived attributes to innovations to small holder farmers are somewhat empirically, interrelated, but they are conceptually distinct-relative advantage, potentiality, complexity, divisibility and observability. However, smallholder farmers in Nigeria are always skeptical about the consequences of change in their knowledge, skill and attitude. The smallholder farmers are described as conservatives in their risk aversion tendencies, they tend to have security as being uppermost in their thought and action (Onuoha et al 1999). Specifically, this study seeks to identify the socio-economic characteristics of the respondents, identify type of farm practices and innovations adopted by the respondents.

METHODOLOGY
The study area is Aboh Local Government Area of Imo State. The soil of the area is deep, well acidic and mostly prone to soil erosion and leaching. It has rich agricultural soil, suitable for cultivation of a variety of tropical crops, including the oil palm (*Elaeis guinensis*). A simple random technique was used for the study. A total number of forty (40) household heads were sampled. Data for the study were obtained from primary source, with the aid of structured questionnaire, and interview schedule. The data collected were analyzed using descriptive statistics such as frequency and percentage

RESULTS AND DISCUSSION

Socio-economic characteristics of the smallholder farmers are shown, in table 1.

The results in table 1 show that the farmers have an average age of 49 years. This shows that the farmers are in their productive years, and will be able to do more work. Majority (65.5%) of the respondents were males. This implies that more males engage in farm production in the area. They have average household size of seven persons. The large household size is an indication of availability of family labour. Adegbite et al (2008) stated that large household size in farming communities provide free family labour on the farm. Greater percentage (93.6%) of the farmers were literate .this implies that majority of the farmers can accept and adopt agricultural innovations to increase farm productivity. Educated farmers are expected to be more receptive to improved farming techniques (Okoye et al, 2004). The result also showed that a small number of the farmers in the higher education group are involved in farming in the area.

The results in table 2 showed the frequency distribution of respondents according to innovations adopted. According to the result, 64.5%, 29.0% and 6.4% of the respondents practiced bush fallow, continuous cropping and shifting cultivation respectively, as the soil fertility management systems, with bush fallow being pre-dominant. 93.5% of the farmers in the area practiced mixed cropping, while a minimal number (6.4%) practiced sole cropping. Also, a minimal number of the respondents (9.6%) allow their farmlands to fallow 2-3 years, while a large number (90.4%) keeps their farmland fallow for only 0-1 year. This is because the number of farmlands owned by a farmer is minimal. The result also revealed that large number (45.2%) of the respondents adopted up to three innovations in the area, and a minimal number (12.9%) adopted up to four innovations. This indicates that the farmers need to be more enlightened about innovations. Modern farm tools and inorganic fertilizer, 100% and 90.0% are the most frequently used innovations identified in the area, while pesticide and improved varieties are less frequently used 6.5% and 3.4% respectively. This indicates that the work of the extension agents is needed to encourage the smallholder farmers to use more of the innovations identified in the area, to increase farm productivity.

CONCLUSION

The study revealed that majority of the farmers were males who are agile and educated, with large family sizes. Little percentage of the farmers adopted the innovations identified in the area. The result therefore call for availability of programs that would improve the effectiveness of extension services, to educate and train farmers on how best to apply and use the innovations available for improved crop productivity.

Table 1: Socio-economic characteristics of the smallholder farmers

Age in years	Frequency	Percentage
21-30	5	12.9
31.40	7	22.5
41-50	14	32.2
>50	14	32.2
Total	**40**	**100**
Gender		
Male	28	63.5
Female	12	36.5
Total	**40**	**100**
House hold size		
2-5	10	19.3
6-10	25	67.8
11-14	5	12.9
Total	**40**	**100**
Level of Education		
FSLC	4	6.4
SSCE	22	58.3
OND/NCE	7	19.3
B.SC/HND & Above	3	6.4
	4	9.6
Total	**40**	**100**

Table 2: Frequency distribution of respondents according to innovation adopted

Soil fertility Management System	Frequency	Percentage
Bush fallow	24	64.5
Continuos cropping	12	29.0
Shifting cultivation	4	6.5
Total	**40**	**100**
Cropping Pattern		
Mixed cropping	34	93.5
Sole cropping	6	6.5
Total	**40**	**100**
Units of land owned		
1-3	21	54.8
4-6	16	38.7
>6	3	6.5
Total	**40**	**100**
Follow Period		
0-1	32	90.4
2-3	8	9.6
Total	**40**	**100**
No of innovations adopted		
1	0	
2	16	41.9
3	17	45.2
4	6	12.9
Total	**40**	**100**
Innovations identified		
Modern farm tools	40	100
Inorganic fertilizer	28	90.0
Pesticide	8	6.5
Improved varieties	4	3.5
Total	**40**	**100**

Source: field survey 2010

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FARMERS' APPROACH AND KNOWLEDGE TOWARDS SUN EXPOSURE AND SKIN CANCERS AMONG SELECTED SMALL SCALE FARMERS IN ABIA STATE, NIGERIA

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ABSTRACT
This study was carried out in Abia State of Nigeria. Four agricultural villages were purposefully selected for the study. Sixty farmers were selected from the agricultural villages. Simple and well-structured questionnaires, oral interviews and site visits were used to collect data for the study. The result shows that majority of the farmers were females. The result equally shows that the farmers did not have sufficient information thus poor knowledge of sun exposure and the consequential skin cancer. The farm activities the farmers most often get involved in were clearing, and harvesting. This has the tendency of exposing them to direct sun. Also most of the farmers make use of fertilizer to enhance the growth of their crops. The result also shows that none of the farmers agreed to have had or suffered any form of skin cancer. Base on the on the result it was recommended that the farmers should be assisted to procure protective clothes such as wide brim hats, clothes made from close knit fabrics which can protect their skin and scalp from ultraviolet radiation.
Keywords: Sun, exposure, skin, cancer

INTRODUCTION
In this part of the world (Nigeria) a lot of farmers do not practice mechanized agriculture because of high cost of these machines and other factors. This means that most farmers carry out their farm practices manually and therefore spend more man hours on carrying out farm activities like slashing, bush burning, ridging, planting, weeding, fertilizer application and down to harvesting in the open fields. These farmers equally trek long distances from their homes to farm on their farm lands and do same while coming back. This whole process of farm activities and trekking are done under the scourging rays of the sun. Although many of the farmers live their houses before sun rise when weather is still cool to get their destination on time, they still work till the sun sets and most of them work till late afternoon before returning back to their homes. This means the expose themselves so much to the scourging rays of sunlight.
This research work intends to look at how these farmers deal with sun exposure and know if these farmers suffer any harm (skin cancer) as a result of this over exposure. This will help to give better understanding of how this can be approached and better knowledge transferred to these farmers with regards to sun exposure and its effects.

MATERIALS AND METHODS
This study was carried out in Abia State of Nigeria. Four agricultural villages were purposefully selected and these include Ikwano, Ngwa, Umuahia North and Umuahia South local government areas. Forty five farmers of ten each were selected from Ikwano, Umuahia North and Umuahia Soth while fifteen farmers were selected from Ngwa village. Simple and well-structured questionnaires, oral interviews and site visits while these farmers where working was used to carry out this research work.

RESULTS AND DISCUSSION
Table 1 shows that majority of the farmers are females numbering thirty while the male farmers are fifteen in number. This shows that we have more female farmers than the male counterparts although during the slashing and ridging process, I observed that it was the male farmers who carried out this particular farm activity. Every other farm activity from planting to weeding to fertilizer application to harvesting was done by the female farmers. From the questionnaires filled and oral interviews, all they farmers know about the issue of sun exposure but do not see it as any harmful threat to their health or life. Rather they see it as part of a normal weather condition they have to work under. They equally see it that working under the sun does not affect their work out put even though it could slow them down but they rather see rainfall as a factor that affects their farm work activities because when is raining, the have to put work on hold but under the sun, the work until tiredness sets in or the are finished for the day. But some of them equally complained that the sunny weather is hotter than what they are used to in the past.
All the farmers said they haven't heard about ozone layer depletion or what it is all about.
All the farmers trekked long distances to their farms and believe it does not in any way affect their work output while working in their farms.
All the farmers said they have never heard of skin cancer before though some said they have heard of the word cancer but not skin cancer.

The farm work activities involves a lot of manual labor from clearing stage to harvesting stage and throughout all this different stages, these farmers do not use or wear any form of Personal Protective Equipment (PPE) to protect themselves and only very few of them change to work clothes when they get to their farms. This exposes them to direct sun rays hitting their skin. Rather the same clothes they wear to their farms are what they wear to carry out their farm work activities and still wear them back home at the end of the day which apart from not protecting them against the sun rays is not hygienically okay.

They make use of fertilizer to enhance the growth of their crops but the disturbing fact here is that they all ticked and said that they use their bare hands to apply the fertilizer to their field crops. This is a dangerous practice that could lead skin irritation or even skin cancer in the long run especially as these farmers do not properly wash their hands with soap in water after the fertilizer application. Some even go ahead to have their meals with their hands thereby ingesting some of this chemicals without knowing it.

All the farmers ticked they have not suffered any form of skin cancer but rather suffer body aches and pains which they believe is as a result of the strenuous activities involved during farm work activities and to this effect, most of them say the just take pain killers.

CONCLUSION AND RECOMMENDATION

The results show that our farmers see sun exposure as part of a necessary weather condition they have to work under and therefore don't believe that it can cause them any serious form ill health. From my oral discussions with them, they have equally not heard of skin cancer and what is all about. Also from the oral conversations and farm site visit I had, it was very obvious that some of them act out of ignorance while others have this I don't care attitude towards protecting their health because they believe something must kill a man be it ill health or disease and therefore see skin cancer as one of those health issues that can kill a man if it really does exist.

I also observed that some of them have this belief that any injury, accident or ill health that occurs to them is as a result of their enemies who don't want their progress or envious of their hard work not because they are not protecting themselves or taking precautions while working. They all held more to their belief especially after I tried to describe what skin cancer looks like when it occurs. They rather likened skin cancer to an illness the call "Acha Ere" in local dialect, and another illness the call "Crossing belt" which they believe is people that hate you use negative spiritual means to inflict this ill health on a person as this sickness leads to one's skin especially the leg decaying gradually.

With regards to PPE, they see it as something that would slow down their work process therefore tagging it lazy man's attitude to work. An example is the wearing of hand gloves during fertilizer application or wearing long sleeve clothing to at least cover their bodies properly. Though some of them complained that wearing some this protective clothing makes the uncomfortable while others complained about sweating a lot while wearing such clothes and would rather not wear clothes because the heat(most of the men agreed on this). With regards to farm shade, they believe the farms are not their homes so once it starts to rain or the sun is too much, they either continue to work under this harsh weather conditions or stop work or trek back home. They all agreed to the idea of at least wearing hats while working to caution the effect of direct sun rays on their heads.

My conclusions are that our local farmers are not aware nor do they believe that sun exposure can cause them any illness called skin cancer. To an extent, some of the farmers believe the word cancer is a curse and not meant for them. They refused the idea of going to hospital for any checkup because they believe that buying *paracetemol* or any other form of pain killers cures them of their body pain because they believe that body pains and aches are the only major ill health they suffer as farmers.

My recommendations for these farmers is for them to try and reduce the amount of time they spend working under the sun. I also recommended for them to work on their farms in the evening times when weather condition is cool and this they didn't agree to because most of them said their farms are farm from their residential homes. Only those that have their small farms in their living compounds agreed to this system.

Wearing of protective clothes such as wide brim hats, clothes made from close knit fabrics which can protect their skin and scalp from ultraviolet radiation. I also suggested long sleeved shirts and trousers which not be really comfortable but they help to protect the skin in extremely hot weather conditions.

Examine of the skin regularly for any unusual changes or suspicious spots on the skin because the unusual signs include any wound sore or patch of skin that won't heal.

To work but at the same time take breaks under a shade when the weather becomes extremely hot.

Table 1:

Farm field farmers	Male	Female	Yes	No
Sex	15	30		
Heard about Sun Exposure			45	0
Heard of Skin cancer before			0	45
Has any of you had symptoms of skin cancer or suffered skin cancer			0	45
Distance to farm fields (btw far and near, all the farmers ticked **far**)			45	0
Do you trek to your farms			36	9
Do you use other means of transportation to go to your farms (vehicle transportation or machine or bicycle ride)			9	36
Does your work activity involve manual labor at the fields			45	0
Do you wear any form of PPE(Personal Protective Equipment) while working			0	45
Do you have work clothes that you change into while you work in your farms			10	35
Are your farm fields sprayed with chemicals (herbicides, pesticides)			8	37
Fertilizer application (almost all officers ticked the use their bare hands for fertilizer application)			45	0
Presence of Farm shades			0	45
Routine medical checkup			0	45

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AN APPRAISAL OF DISSEMINATING CHANNELS IN PROMOTION OF IMPROVED ROOT AND TUBER CROPS TECHNOLOGIES IN BENUE STATE, NIGERIA

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ABSTRACT
The disseminating channels used in promoting root and tuber crops technologies in Benue state of Nigeria were studied using interview schedule and focal group discussion with 30 farmers and 50 students who participated in the programme. Akpa community secondary school Allan and Members of Ojuju cassava farmers' association Okete were purposively studied as major participants. Results of the appraisal showed that Majority of the targeted farmers participated in demonstration plots while agricultural information and inputs diffuse through fellow farmers. benefits derived from the establishment of the Demonstration plots in schools included Practical orientation of students, stimulation of interest in modern agriculture, carrier guidance in agriculture, Identification of different crop varieties and Interaction with scientists. Constraints as observed by teachers/ students included Irregular teachers' salaries, Inadequate number of agricultural science teachers in schools, Exclusion of Agricultural science from compulsory subjects in the state which affected students enrolment for the subject in external examinations. Farmers' varietal quality preferences in order of importance for cassava were high root yield, early maturity and stem yield, while yam had high tuber yield, early maturity and thickness quality when pounded. Based on the findings, it was concluded that the farmer outreach programmes and establishment of the Demonstration plots in schools should be sustained to because of the important roles it plays in Farmer and student productivity.
Keywords: Disseminating Channels, Promotion, Root and Tuber Crops Technologies

INTRODUCTION
The rural dwellers are the producers of agricultural resources of the nations. Information is any message or news, viewed or read or told verbally which add to knowledge, awareness or understanding of some topics. Ifukor (2013). Scientifically information is processed data. It can be loosely defined as that which aids decision making. Channels of information acquisition and dissemination refer to the transfer or exchange of information from person to person or from one place to another. It is an action that produces a reaction, whether positive or negative, communication has taken place. Information sharing is not a one way affair. There must be a sender to transmit the message, and a receiver to make appropriate decisions on how the rest of the exchange should continue. These involved the exchange of ideas, facts, opinion, attitudes and beliefs between people. The ability to communicate and pass on information is a key factor in all cultures whether literate or not. Fayose and Dike (2002) stated that many cultures survived without the written word and effective communication can take place without reading or writing. The apparent influence and resilience of African oral tradition is impressive, but it is of greater importance to the new generation of development practitioners for its theatrical and dramatic form.
Small Holder Farmers live in specific agro-environments. We want to get the right technologies to the right people to help them improve their livelihoods. Most cannot afford high-risk, high-reward behaviors; Bad experiences could shape future adoption behaviors. We need to get the right technologies to the right farmers by being more strategic and business-like in planning for dissemination and monitoring of uptake of agricultural technology Caldwell *et al*, (2013). Moreover, while research is an important element in achieving rural development, its potential contribution can only be realized when other elements are in place. For example, it is doubtful that many farmers will invest in developing land resources without ownership. The incentive framework for the creation and adoption of valuable innovation is also vital. Again, the degree of poor farmers' organizations is crucial here. Only strong farmers' organizations can ensure the adoption and implementation of government policies that reflect their needs and concerns, and create an enabling environment for sustainable production and development.
Without significant adoption, returns on considerable investment in technology development will be very minimal. Realizing that there are benefits accruable in the cultivation of root crops in Nigeria, efforts must be put in obtaining good production level. However, there are lots of constraints in achieving this target. Iyagba (2010)

METHODOLOGY
An appraisal of the disseminating channels was carried out with the aid of interview schedule administered on the participants in the demonsration plots, and school outreach program in Benue State. Akpa community secondary school Allan and Members of Ojuju cassava farmers' association Okete were purposively studied as major

participants in the School outreach, Demonstration plots and Farmer Participatory Trials. Rapid Rural appraisal method was adopted through Focal group discussion using 30 farmers and 50 students who participated in the programme.

Results And Discussion

The result of the appraisal showed that the benefits derived from the establishment of the Demonstration plot in schools included:

- Practical orientation of students
- Stimulate interest in modern agriculture
- Carrier guidance in agriculture
- Identification of different crop varieties
- Interaction with scientists

Constraints- view of teachers/ students

- Irregular teachers' salaries
- Inadequate number of agricultural science teachers
- Exclusion of Agricultural science from compulsory subjects in the state has affected students enrolment for the subject in external examinations

Suggestions/ Comments

- Make agricultural science compulsory
- Supply tractor and implements to familiarize students with them and remove drudgery
- Time of establishment of Demonstration plots and research trials should be made to suit school calendar to facilitate plot maintenance
- Re-introduce young farmers club

Problems identified by Farmers with the cassava and yam production includes:

Cassava

i. Difficulty in identifying of cassava varieties in the field
ii. Lack of mechanization in planting, harvesting and peeling of cassava
iii. Low stem yield/vigour of some pro vit A cassava variety
iv. Scarcity and High cost of improved cassava stem cuttings
v. Low knowledge of market channels and linkages for sale of cassava roots and stems
vi. Mixture of cassava, yam and sweetpotato varieties in the farmers' fields
vii. Loss of cassava stem to fire in the dry season
viii. Harvesting of cassava in the dry season and drying up of the stem cuttings

Yam

ix. Scarcity and low knowledge of Seed dressing chemicals recommended for yam minisett
x. Low knowledge of Proper planting method for the yam minisett
xi. Mixture of yam varieties in storage
xii. High cost of seedyams
xiii. Annual Procurement of seedyams
xiv. Scarcity of yam minisett treatment chemicals
xv. Low knowledge of the practice of yam minisett

Farmers' observation /comments on the effectiveness of the disseminating channels

1. **Demonstration plots, Farmer Participatory Trials and cluster Group Farms**

i. Cassava stem cuttings supplied are not usually labelled, this often leads to mixture of varieties in farmers' fields
ii. Poor crop establishment especially when improved stem cuttings are not delivered to farmers or planted in good time after cutting from the source fields.
iii. The sizes of the demonstration farms are not large enough. It should be at least 1 ha to enable farmer groups have enough starter packs to aid rapid adoption
iv. Plans for the establishment of Demonstration farms should be made early to enable farmers select good plots

2. **Radio and Television programmes**

i. this has been very good both in content and timing
ii. No television programme on agriculture in the area
iii. the critical storage problem of yam should be addressed in the radio programme especially mixture of seedyams in storage

3. **Agricultural Shows, Farmer field days, workshops and seminars**

i. Very few farmers participate in these activities

Results in Fig 1 showed that majority 85% of the farmers participated actively in the demonstration plots while 80% interact with fellow farmers for information and input sharing. Fig 2 revealed that farmers' varietal quality preferences in order of importance for cassava are high root yield, early maturity and stem yield while Fig 3 showed that preferences for yam quality included high tuber yield, early maturity and thickness when pounded.

CONCLUSION

Based on the findings, it was concluded that the establishment of the farmer outreach programs and Demonstration plots in schools be sustained because of the benefits as stated by the student group which included Practical orientation of students, Stimulation of interest in modern agriculture, Carrier guidance in agriculture and Interaction with scientists. Majority of the targeted farmers also participated in demonstration plots while agricultural information and inputs diffuse through fellow farmers. Farmers' varietal quality preferences in order of importance for cassava are high root yield, early maturity and stem yield while yam has high tuber yield, early maturity and thickness quality when pounded.

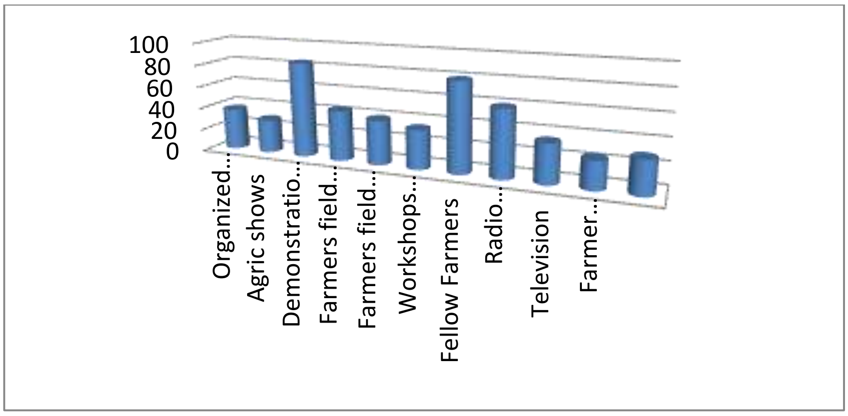

Fig.1: Distribution of respondents according to sources of agricultural information

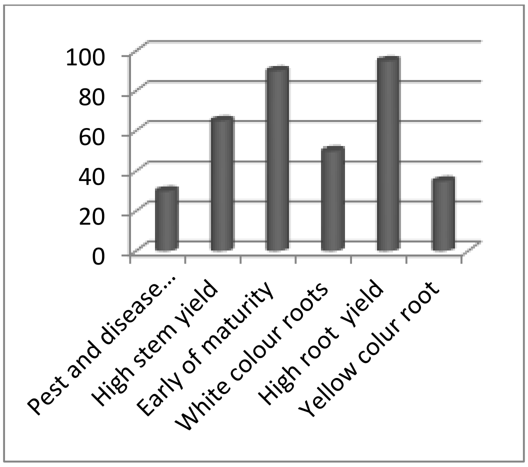

Fig 2: Varietal traits preferences of farmers in cassava

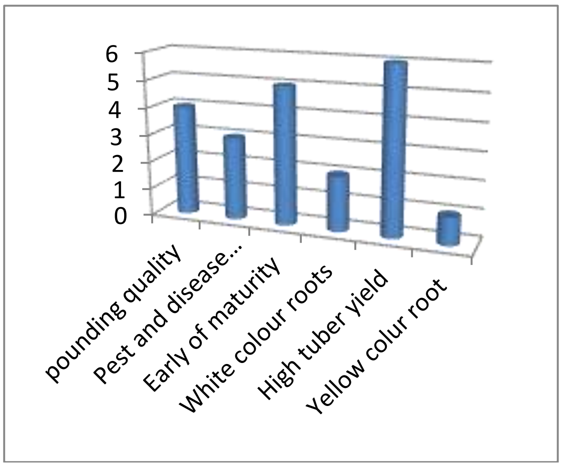

Fig. 3 Farmers Varietal quality preferences of Yam

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OUTREACH ASSESSMENT AND EFFECT OF INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT MICRO ENTERPRISE FINANCING (IFAD) IN ABIA STATE, NIGERIA

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ABSTRACT
the study was on outreach assessment and effects of international fund for agricultural development micro enterprise financing (ifad) in abia state, nigeria. data were collectedusing structured questionnaire and ifad publications. data were analysed with the use of simple statistical tools such as percentages and frequency distribution and the measures of outreach indicators.the result showed that major criteria used by ifad in selecting their beneficiaries were members of cooperative/farmers group, availability of farmland space, being a farners and residency in ifad designated site. in addition, majority of those that reached with ifad microenterprise financing were women. the reason for this could be to improve the economic status of their family and to enable them gain access to new information. however, outreach/participation density in the state was 0.00887.this result suggest that in every 1000 people about nine (9) persons benefitted from ifad microenterprise financing programme.the result shows that there was increase in farm sizes, yield and total returns after beneficiaries access ifad microenterprise financing. these increases could be attributed to effective utilization of ifad microenterprise technologies and extension personnel among the beneficiaries.
keywords: outreach assessment, effect, international fund, microenterprise financing

INTRODUCTION
Agriculture is a key sector in the Nigerian economy (Tasie, 2012). Its importance is particularly glaring in a developing economy like Nigeria where land and labour resources are relatively abundant and the industrial sector is poorly developed (Tasie, 2012). The contribution of agriculture to overall development especially in developing countries like Nigeria include provision of increased food supplies, provision of gainful employment, provision of capital and capital formation, increasing foreign exchange for development and increasing rural welfare. The agricultural sector's contribution to economic growth and sustained rural development remains to be fully exploited (FMARD,2006). The contribution of agriculture to GDP was 64%in 1960, declined to 35% in 1988, and presently, the agricultural sector in Nigeria contributes less than 30% to GDP, with crop production accounting for an estimated 85% of this total, livestock 10%, with forestry and fisheries contributing the remaining 5% (Awotide and Akerele, 2010).
Despite these importance, agricultural production and food supply in Nigeria is still lagging behind, as a result of low utilizations of modern inputs by farmers, unavailability and inaccessibility of farmland as well as non-mechanized nature of the prevailing agricultural production system (Ogbe and Mejeha,2012).
IFAD (2002) opined that causes of food insecurity and famine were not so much failures in food production, but structural problems relating to poverty and to the fact that the majority of the developing world's poor population are concentrated in the rural areas. Therefore in order to improve the national economy, entrepreneurs who are farmers should be supported to expand their scale of production through micro finance (Akpokodje and Olomola, 2000).
Microfinance services, particularly, those sponsored by government have adopted the traditional supply –led subsidized credit approach mainly directed to the agricultural sector andnon farm activities, such as trading trading, tailoring, weaving, blacksmithing, agro-processing and transportation. Although the services have resulted in an increased level of credit disbursement and gains in agricultural production and other activities, the effects were short- lived due to the unsustainable nature of the programme (Iganiga, 2008)
In order to protect marginal and inefficient farmers/entrepreneurs the federal government of Nigeria with respect to food security and agro enterprise development signed agreement To solve these problems, the Federal Government went into a funding agreement with International Fund for Agricultural Development for the funding of small-scale farmers in Nigeria. The International Fund for Agricultural Development (IFAD), a specialized agency of the United Nations, was established as an International Financial Institution in 1977 as one of the major outcomes of the 1974 World Food Conference. The conference was organized in response to the food crises of the early 1970s that primarily affected Sahelian countries of Africa (Tesie,2012).

The conference resolved that an International fund for Agricultural Development should be established immediately to finance agricultural development projects primarily food production in developing countries.
In this context, IFAD was created to mobilize resources for programmes that alleviate rural poverty and improve nutrition. Unlike other international financial institutions which have a broad range of objectives, the Fund has a very specific mandate to combat hunger and rural poverty in developing countries. To achieve this objective, IFAD cooperates and collaborates with government agencies and parastatals such as Agricultural Development Programmes (ADP) and Ministries of Agriculture and Rural Development. IFAD-assisted programmes in Rivers state and Nigeria are generally deemed credible, highly relevant and effective, with positive impact. As a consequence, it is generally accepted that the Fund has a distinct and catalytic role in improving the livelihood of both subsistenceand market-oriented small-holder farmers and producers. This belief is supported by ADP (2005), Mejeha and Nnanna (2010) and Tasie (2008). The broad objective of this study was on outreach assessment and effects of International Fund for Agricultural Development Micro enterprise financing (IFAD) in Abia State, Nigeria.Specific objectives include; determining the Criteria Used in Selecting Beneficiaries by IFAD,Outreach/outreach density of IFAD Micro-financing among respondents and in the state and Effect of IFAD Micro-enterprise financing among Entrepreneurs in the study area

METHODOLOGY

The study was conducted in Abia State, Nigeria with a focus on the outreach and the effect of IFAD microenterprise financing. This study covered a period of eight years (2005-2013). Primary and secondary data were used in this study. The list of beneficiaries was obtained with help of staff of IFAD. From the lists 90 beneficiaries were randomly selected and structured questionnaire were used to collect data from the beneficiaries while the secondary data were got from the IFAD publications and other written documents. Data were analysed with the use of simple statistical tools such as percentages and frequency distribution and the measures of outreach indicators. Outreach of the target beneficiaries in the state using the outreach indicators model. A similar outreach model was used by Lafourcade *et al* andYaron*et al* (1997). The model is shown in equation (1)

$$\text{Outreach level} = \frac{\text{Number of beneficiaries(Male/Female)}}{\text{TargetPopulation for the programme}} \text{--------------(1)}$$

In order to ascertain the extent to which people in the state are involved in IFAD microenterprise financing, outreach/ participation density is used. It is given as follows;

$$\text{Participation Density} = \frac{\text{Beneficiaries (Males/Females) in the programme}}{\text{Total population in the State}} \quad \text{------- (2)}$$

RESULTS AND DISCUSSION

Criteria Used in Selecting Beneficiaries by IFAD

This phase analyzed the criteria used by IFAD to select their beneficiaries. The major criteria considered based on this finding is presented in table 4.10
Table 1 shows the major criteria used by IFAD in selecting their beneficiaries. The Table shows that 100% of respondents selected were farmers that reside in IFAD recognised site and were members of cooperative/farmers group.The reason for this condition could be due to the application of joint liabilities /principles and the ability to monitor the activities of beneficiaries. In addition, membership of cooperation could aid in ease of fund/ other input administration. Furthermore,98% 0f the respondents indicated that the availability of farmland space is another criteria used in selecting beneficiaries. The use of availability of land space could mean a one of the sure way of proving that a benefiting Entrepreneur is ready for business.

Outreach of IFAD Micro-financing among respondents.

The outreach of IFAD micro-financing among the beneficial entrepreneurs was analyzed using the outreach indicator.
The outreach indicator is stated below. This includes number of beneficial clients, % of males and females.
Table 2 shows that 42.64% of the respondents who were reached withIFAD micro enterprise financing were males while 57.36% of those reached with IFAD micro enterprise financing were females. This means that majority of those that benefitted from IFAD microenterprise financing were women. The reason for this could be to improve the economic status of their family and to gain access to new information. In addition,extending micro enterprising financing could also ensure an upscale of their leadership, technical, entrepreneurial and managerial skills.

Outreach Densityof IFAD Micro-financing in Abia State to clients

In order to determine the outreach density of IFAD programme in the state, participation density measure as used by Mejeha and Ogbe (2008) was adopted and the result presented in Table 3
Table 3 show the outreach density which Mejeha and Ogbe(2008) referred to as participation density as another measure of outreach. It is used to estimate the extent to which people in the state are involved in the IFAD microenterprise financing programme in Abia State. The Outreach/participation Density is used to ascertain the

number of microenterprise financing beneficiaries in every 1000 people (males and females) in the State. Table shows that outreach/participation density in the state was 0.00887.This result suggest that in every 1000 people about nine (9) persons benefitted from IFAD microenterprise financing programme. The higher the value of outreach/participation density the more is the outreach achievement. Among the males, the outreach/participation density is less than that of the females. For equal participation density to be achieved; more people in the state should be given credit facility.

Effect of IFAD Micro-enterprise financing among Entrepreneurs in the study area

The effects of IFAD Microenterprises financing among the entrepreneurs in the study area were analyzed using the before and after descriptive model, to show particularly the difference in output.

Table 4revealed the effect of IFAD microenterprise financing among the benefiting entrepreneurs. The result shows that farm sizes increased with a marginal increase of 0.1345ha after accessing IFAD funding. In addition, there was a difference of 2821.02kg after accessing IFAD funding. This value indicates a positive impact of IFAD micro enterprise financing among entrepreneurs. Finally, there was a difference of 526094.46 after accessing IFAD microenterprise financing. Difference in total returns could be due to the utilization of IFAD microenterprise technologies and extension personnel among the beneficiaries.

CONCLUSION

It is concluded that operators of IFAD programme in the state should sustain the use of the programme criteria in selecting clients. This will help keep the programme objectives and goal. Operators of the programme should increase their level of outreach in the state especially among women. This would help in the promotion of food security and economic welfare of the beneficiaries. Finally, IFAD technologies and extension personnel should be used among beneficiaries of the programme.

Table 1: Criteria used in selecting beneficiaries by IFAD

Criteria	Frequency	Percentage
Membership of Cooperative/Farmers group	90	100
Availability of land Spaces	89	98.9
Be a farmer/reside in recognized IFAD programme site	90	100
Total	90	100.0

Source: Field survey, 2016

Table 2: Outreach of IFAD Micro-financing among respondents

Outreach	Frequency	Percentage
Male	10,772	42.64
Female	14,490	57.36
Total	25,262	100.0

Source: CBNRMP, 2014 REPORT

Table 3: Outreach Densityof IFAD Micro-financing in Abia State to clients

Indicator	IFAD Outreach	Population Value	Outreach Density
Male	10,772	1,430,298	0.00753
Female	14,490	1,415,082	0.01023
Total	25,262	2,845,380	0.00887

Source: CBNRMP, 2014 REPORT and NPC, 2006 Gender Population in Abia State

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RADIO, THE MOST EFFECTIVE AGRICULTURAL DISSEMINATION CHANNEL

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ABSTRACT

The study was conducted to ascertain how effective Radio is compared to other communication medium. A simple random sampling technique was used to elicit information from the respondent. Data collected from 260 respondents were analyzed using descriptive statistics. The result of the study shows that radio (74.38%) is the most effective medium for agricultural dissemination because of its unique characteristics and features. Radio is easily accessible, affordable, covers wide range of people within a space of time, mobile and user friendly in nature. It is therefore the best medium for information dissemination in both rural and urban areas.

Keyword: **Radio*, Agriculture, Dissemination, Channel***

INTRODUCTION

Communication has remained a vital tool for human existence and survival. It transmits ideas, feelings and information from one person to the other in form of messages.

Communication can also be said to involve the interchange or exchange of messages in form of ideas or information from and among different categories of people (Nwosu, 1987). In an organization, information flows forward, backwards and sideways therefore communication refers the ways this information flows within the organization. However, a break-down in the communication channel leads to an in-efficient flow of information. For example, if employees are unaware of what the organization expects of them, this could cause employees to become suspicious of motives and changes in the company.

There are different types of communication which includes print and electronic media.

Over the years, Radio has been proven to be the most effective medium of communication due to its effectiveness in reaching a wide audience at a very fast rate. Radio plays an essential role in communication today by remaining available when other communication channels such as the television, Newspaper and Internet are rendered in accessible by weather or other interference.

The production level of the Nigeria farmers depends largely on the kind of information available to them. Therefore, information and the availability of multiple channels of getting vital information are integral part of agricultural development, this is the reason why extension workers use radio for communicating information on new methods and techniques, giving timely information about the control of crops, pest and diseases, weather forecast, marketing news etc and for this purpose, talks, group discussion, folk songs dialogues and dramas are usually organized.

Agriculture has always been a highly knowledge-intensive sector that requires continuous information flow. Therefore, effective extension services, education and communication services are probably some of the key strategies for sustaining agricultural growth, strengthening food security and combating hunger and malnutrition.

METHODOLOGY

The study was conducted in Abia State. Abia State is one of the thirty six states of the Federal Republic of Nigeria. The state is located in the South East gro-ecological zones of Nigeria and lies approximately between longitudes $7^{0}00`$E and $8^{0}00`$E and latitude $4^{0}45`$N and $6^{0}17`$N of the equator (NPC, 2006).

The study was conducted in 3 local government areas of Abia state, namely Umuahia North, Umuahia South and Aba North simple random sampling techniques was used to select 88 respondents from Umuahia North, 80 respondents from Umuahia South, 86 respondents also from Aba North, making a total number of 260 respondents for the study. Data was collected from the respondents through well structured questionnaire and interview schedule. Data collected was analyzed using descriptive statistics like frequency, percentage and means.

RESULTS AND DISCUSSION

Table 1 which is the socio-economic characteristics in the three Local Government Area (Umuahia North, Umuahia South and Aba North) ranges from 50 years and above (91.73%) while the youth are the lowest from the age of 21-30 years with 2.06 percentages.

The highest number of farmers in the three local government areas are married (57.85%) this is because most married people need to farm in order to provide for the family and they use their children for labour mostly, this makes the number of farmers that are married to be higher than others. The lowest is single (8.26%) because a good number of them do not have children to use for labour.

Table C shows that most of the farmers are literate (40.08%) this is because most of them do not have certificate to work as civil servants and they resolve to farming while the lowest is tertiary, with (10%) because few of them at the university are farming in order to help pay their school fees.
Table 2 which is the distribution of respondent on sources of information revealed that radio is the highest used medium for getting information, (74.38%) this is because radio is easily accessible, affordable, mobile, covers a wide range of people in diverse medium while the internet is the lowest (4.13%) because most of the farmers are illiterate and do not have access to internet, could not read and could not operate the system or computer.

CONCLUSION

In summary, the study reveals that radio is the most effective agricultural dissemination channel in Abia State as disclose in Table 2 earlier, farmers in Abia State have complete access to agricultural information and lots more through radio because of its affordability, accessibility, mobility, wide range coverage etc. radio is therefore important and useful in reaching out to farmers as well as constitute methods of notifying them of new development and emergencies. It is equally important in stimulating farmers' interest in new ideas and practices. Radio also provides to an illiterate valuable instructions and education in agriculture, health population control, sanitation and other aspects of daily life.

Table 1: Distribution of respondents according to socio-economic characteristics

Age (Years)	Frequency	Percentage (%)
21-30	5	2.06
31-40	6	2.47
41-50	9	3.71
50 and above	22	91.73
Marital status		
Single	20	8.26
Married	140	57.85
Divorced	15	6.19
Widow	35	14.46
Widower	32	13.22
Level of education		
Primary education	35	14.46
Secondary education	25	10.33
Tertiary education	10	4.13
Adult education	75	30.08
No education	97	40.08

Table 2: Distribution of respondents on sources of information

Sources of information	Frequency	Percentage (%)
Radio	180	74.38
T.V	20	8.26
Newspaper	12	4.93
Internet	10	4.13
Extension agents	20	8.26

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FACTORS INFLUENCING ADOPTION OF IMPROVED CASSAVA PROCESSING TECHNOLOGIES BY WOMEN IN AKOKO - EDO LOCAL GOVERNMENT AREA OF EDO STATE, NIGERIA

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ABSTRACT
This study analyzed the factors influencing adoption of improved cassava processing technologies by women in Akoko-Edo Local Government Area of Edo State. Random sampling technique was used to select 121 women cassava processors for the study. Descriptive statistic and multiple regression used to analyze the data. The result revealed that 66.1% of the women cassava processors were about 60years old, 46% had secondary education, 64% had no extension contacts and 72.7% of the respondents belonged to co-operative societies. The mean level of adoption was revealed to be high with an average of 2.7. The study also revealed that age, processing experience, affordability, compatibility and complexity significantly influenced adoption with an R^2 value of 0.83. It was therefore recommended that cassava processors should utilize their memberships in cooperative societies by organizing joint contributions to assist themselves financially in order to increase their level of adoption.
Keywords: Adoption, cassava processing technologies, Edo State.

INTRODUCTION
The process of increasing the efficiency of agricultural production through improved agricultural technologies depends mainly on the extent to which farmers can incorporate improved agricultural practices (technologies) into their farming operations (Sasore, 2005). It has been commonly shown that acceptance of new farming practices takes place over time (Nweke, 1994). When a new farming practice is introduced in a community, not all people adopt it at the same time. Some farmers, no matter what, would continue to practice traditional agriculture and therefore, are inevitably poor such as adoption of cassava processing techniques by women in Edo State (Nweye, 1990).
Due to the important roles women play in economic development, one would expect that pride is accorded to women in the nation's development programme. Rather, available evidence suggests that women access to resources such as improved agricultural technologies remains severely limited (Oyewole*et al*., 1986). Consequently, they are faced with problems of under production and inadequate transportation for their farm produce. Although, significant breakthroughs have been achieved worldwide in the area of improved food processing technologies, but Nigerian women still rely on traditional methods of processing ((Nweke*et al*., 2004). For instance, traditional processing methods of cassava are so laborious that a number of improved cassava processing technologies have been put in place to reduce the drudgery of traditional processing methods. Thus, this study was designed with the general objective of analyzing the factors influencing women's adoption of the improved cassava processing technologies in Akoko-Edo local government area of Edo State.

METHODOLOGY
This study was conducted in three villages (Ibillo, Lampese and Ojirami) in Akoko-Edo Local Government Area of Edo State. The Local Government has an area of 1.371km^2 and a population of two hundred and sixty two thousand, one hundred and ten (262,110) people (NPC, 2006). The projected figure for 2015 is four hundred and twenty two thousand, three hundred and sixty two (422,362). Akoko-Edo was chosen because it is an agricultural area where women are largely involved in cassava processing business. A reconnaissance survey was conducted in the study area. The sample frame of women who were using the improved cassava processing technologies in the three villages under study was 1,206 comprising of 418 in Ibillo, Lampese 362 and Orjirami 426. In each of the sample frame of the three villages, 10% of the women cassava processors were randomly selected comprising of 42 in Ibillo, 36 in Lampese and 43 in Ojirami amounting to a total sample size of 12
Descriptive statistics (percentages and frequency distribution) was used to describe socio-economic characteristics of the respondents, determine the level of adoption, and identified the constraints encountered by the women processors using improved cassava processing technologies in the study area. Multiple regression analysis was used to determine the socio-economic factors that affected the women's adoption of the improved cassava processing technologies in the study area. The explicit regression equation is given as:
$Y = a + b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7+b_8X_{8+}e$. Where;
Y = is the number of technologies adopted by the respondents.
X_1 = Age (in years)
X_2 = Years of schooling

X_3 = Processing experience (in years)
X_4 = Extension contact (number of extension visits)
X_5 = Membership of cooperative societies (number of years spent)
X_6= Affordability of technologies
X_7 = Compatibility of technologies
X_8 = Complexity of technologies
X_1 to X_8 = Independent variables as defined in the general and explicit equations above
b_1 to b_8 = Regression coefficients of X_1 to X_8
a = constant term
e = error term
Three-point scale was used to determine level of adoption. The mean level was obtained by adding together 1+2+3=6, which was divided by 3 to get a mean score of 2. Therefore, mean score equal or above the cut-off mean of 2 was regarded as high and mean score lower than 2 was regarded as low

RESULTS AND DISCUSSION

The results in Table 1 revealed that, majority (66%) of the respondents belonged to the age group of 41-60 years. These age groups could be regarded as the economically active group in which their energies could be utilized for productive purposes. Similarly, majority (46%) of the respondents had secondary years of schooling which implies that there was the possibility of understanding the adoption and usage of improved cassava processing technologies by the respondents in the area. The study also revealed that, majority (53%) of the respondents had been in cassava processing from 6-10 years which implied that cassava is one of the major crops cultivated by people in the area and cassava processing is the predominant occupation of the women as a result of their long stay in the business. The result showed that, majority (64%) of the respondents never had any extension contact. This implied that the performance of the extension agents in the area was poor. This agreed with the report of sasore (2005), that women processors had little or no contacts with extension agents in his paper presented in 2005. The study revealed that 73% of the women cassava processors had spent 10years and above in cooperative societies. This implied that the respondents had been involved in one co-operative society or another for a long time.
The result in Table 2 showed the mean of mechanical grater (3.83), power screw dehydrating press (3.83), mechanical sifter (3.28), gari fryer (1.56), and stitching machine (0.84). These findings indicated that the levels of adoption of mechanical grater, power screw dehydrating press and mechanical sifter were high while the levels of adoption of gari fryer (toaster) and stitching machine were low. This implied that the general level of adoption of improved cassava processing technologies was high with an average of 2.7.
In Table 3, multiple regression analysis revealed that five factors had significant influence on adoption which were age, processing experience, affordability, compatibility and complexity. It was found that age (.019) affordability (.021) and Compatibility (.044) had significant influence on adoption at 1% level of probability, while processing experience (.025) and Complexity (.010) had significant influence on adoption at 10% and 5% level of probabilities respectively. The result of this study therefore showed that the cumulative contributions of these variables to the adoption of improved cassava processing technologies had coefficient of determination (R^2) value of 0.83. This implied that all the variables together, explained about 83 percent of the total variability in adoption.

CONCLUSION

The result of this findings revealed that adoption of improved cassava processing technologies comprised of young literate women processors who had long years of experience in cassava processing, had few contacts with extension agents and belonged to one cooperative societies. Level of adoption was high with an average mean of 2.7. The results showed that age; processing experience, affordability, compatibility and complexity were the most important factors that influenced adoption of improved cassava processing technologies in the study area.

RECOMMENDATIONS

i. Women processors should utilize their membership of cooperative societies effectively by contributing together in order to assist themselves financially
ii. Government should provide the women processors with grants to enable them purchase privately owned improved processing technologies.
iii. Government should carry out sensitization programmes to educate the women about the uses of improved processing machines especially Stitching machine and Toaster in order to improve their level of adoption.

Table1: Distribution of respondents according to their socio-economic and institutional characteristics (n=121)

Variables	Frequency n = 121	Percentage
Age (Years)		
21-40 (young)	32	26.5
41-60 (middle)	80	66.1
61-80 (old)	9	7.4
Years of schooling		
Never attended school (0yr)	7	5.8
Primary school (6yrs)	42	34.7
Secondary school (6yrs)	56	46
Tertiary school (2-5yrs)	16	13
Processing experience (years)		
6-10	64	52.9
11-15	40	33.1
16-20	15	12
21-25	2	1.7
Extension contact (number of visits)		
0	77	64
1-2	24	19.8
3-4	20	16.5
Co-operative societies (years spent)		
1-5	10	8.3
6-10	88	72.7
11-15	21	17.4
16-20	2	1.7

Table 2: Respondents level of adoption the improved cassava processing technologies

Technologies	Weighted mean	Level of Adoption
Mechanical grater	3.83	High
Power screw dehydrating press	3.83	High
Mechanical sifter	3.28	High
fryer (toaster)	1.56	Low
Stitching machine	0.84	Low

Table 3: Multiple regression result of factors influencing adoption of improved cassava processing technologies by women processors

Variables	Regression coefficient	SE	t-Value	Level of sig
Constant	-0. 201	0.249	-0.807	.422
Age X_1	0.019***	0.005	3.998	.000
Years of schooling X_2	0.010	0.009	1.100	.274
Processing experience X_3	0.025*	0.013	1.889	.061
Extension contactX_4	-0.002	0.033	-0.076	.940
Co-operative societiesX_5	0.014	0.017	0.828	.409
Affordability X_6	0.021***	0.005	4.204	.000
CompatibilityX_7	0.044***	0.005	8.230	.000
Complexity X_8	0.010**	0 .005	2.119	.036

R =.910, R^2 = 0.83, *=1% level of sig, **= 5% level of sig, ***=10% level of sig

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ASSESSMENT OF THE JOB PERFORMANCE OF FRONTLINE EXTENSION WORKERS IN IMO STATE AGRICULTURAL DEVELOPMENT PROGRAMME (ADP)

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ABSTRACT
An assessment of the job performance of frontline extension workers in Imo State Agricultural Development Programme (ADP) was asses in 2015 with the aid of questionnaire. The three (3) zones that constitute Imo ADP were covered on the study. All frontline extension workers in Imo ADP formed the sample for the study. Data was analyzed using frequency counts, percentages and correlation analysis. Result showed that the respondents were rated highest on regular attendance to forthrightly training. About 36.11% were in the ages of 41 and 50 years, while majority of them were male. Also about 75% of the respondents were married with household size of 4 and 6 members. About 26.85% had HND as their level of formal education while 1 and 10 years was observed as their years of extension experience. Correlation result showed no significant relationship between personal characteristics and job experience, hence acceptance of the hypothesis. It is recommended that respondents should be encouraged and motivated to put in more effort to boost their job performance in Imo State ADP.
Keyword: Assessment, job performance, extension, workers, ADPs

INTRODUCTION
Agriculture is the major and most certain path to economic growth and sustainability. The importance of agriculture cannot generally be over-emphasized in Nigeria and Imo State in particular. Agricultural extension plays an indispensable role in the process of raising agricultural productivity and small holders' welfare. It has been described as the Kingpin in the process of technology generation, transfer and utilization (Nahdy, 2002).
Nigeria can be said to be a county with an extension system in constant evolution. The search for permanent panacea to the problems relating to technology generation, transfer and utilization/diffusion brought the ideal of Agricultural Development Project in 1975. The success recorded in the first and second implementation of ADP led to the full implementation of ADPs in all the States in Nigeria (Unanma *et al*, 2004). The ADP had employed the Training and Visit (T&V) system of managing the extension service in Nigeria. Frontline extension workers are the Block extension supervisors and the extension agents who execute the T&V system of managing the extension service in Nigeria. The introduction of Unified Agricultural Extension Service (UAES) was introduced in 1991.
Under UAES, frontline extension workers are assigned the responsibility of informing, advising and teaching farmers new and improved agricultural practices as well as providing feedback under them every forthrightly on a fixed day within the week with a view to disseminating production recommendations to them. He/she attends Forth Right Training (FNT) meeting where farmers responsibility of the frontline extension workers to encourage the farmers to try recommended practices. Despite, all these efforts by government, the agricultural sector in Nigeria has not achieved the desired result. Some of the reason that is attributable to this includes: inadequate funding, inadequate technology development, high extension to farmer ratio and lack of functional infrastructure in the rural areas (Nwachukwu and Ekwe, 2011).
Furthermore, due to poor agricultural productivity seen in Imo State and Nigeria in general led to the study of job performance of frontline extension workers to ascertain how far they have discharged their duties. Specifically, frontline extension workers personal characteristics will be described, job performance assessed and relationship between personal characteristics and job performance ascertained. The hypothesis, there is no significant relationship between some selected personal characteristics and job performance of frontline extension workers was tested.

MATERIALS AND METHODS
The population for the study was all the frontline Extension Workers in Imo State Agricultural Development Programme (ADP). All the three agricultural zones that constitute Imo ADP were covered in the study. Data for the study were drawn using questionnaire. A simple random sampling technique was used to select respondents for the study. To assess the performance of the respondents, each sampled respondents were rated by his immediate supervisor on a five-point likert rating. The five point on the scale were 1= very low, 2= low, 3=average, 4= high and 5= very high. The mean performance score for the respondents was calculated by dividing

the total performance score by the number of respondents. The job performance level was computed by dividing the grand mean score with the different performance variables on the questionnaire. Frequencies, percentages, mean scores and correlation analysis were used to analyze data collected in the study. Statistically significant relationship for correlation was tested at 0.01 probabilities.

RESULTS AND DISCUSSION

The personal characteristics of frontline extension workers are presented in table 1. Majority of the respondents were in the age range of 41-50 representing 36.11 percent of the sampled respondents. 61.11 percent were male, while 75 percent of the respondents were married. HND was observed as the level of formal education with household size of 4 and 6 members representing 26.85 and 45.37 percent respectively. Years of extension experience ranged between 1 and 10 years representing 54.63 percent of the sampled respondents.

Data in table 2 shows the mean scores of different job performance variable of frontline extension workers in Imo State ADP. The job performance level as computed was 4.11, out of the 10 job performance variables 6 fell above the performance level which shows that their job performance were rated slightly above average. This finding conforms with earlier study by Ekumankama *et al*, 2007, who found that job performance of EAs in Imo State ADP were rated average.

Result from table 3 showed that there was no positive relationship between personal characteristics and job performance of frontline extension workers in Imo State ADP. Since the correlation coefficients were negative. The hypothesis of no positive relationship between personal characteristics of frontline extension workers and the performance in Imo ADP was therefore accepted.

CONCLUSION

From result of the study, we therefore conclude that frontline extension workers in Imo State ADP were rated slightly above average. We can also conclude that their personal characteristics do not in anyway increase the job performance. Since the performance was rated slightly above average, it is recommended that they should be encouraged and motivated to put in more effort to boost their job performance in Imo State ADP.

Table 1: Distribution of frontline extension workers according to their personal characteristics

Variables	Frequency	Percentage (%)
Ages (years)		
21 – 30	14	13.89
31 – 40	22	29.63
41 – 50	29	36.11
51 – 60	16	20. 37
Sex		
Male	50	61.11
Female	31	38.89
Marital status		
Married	60	75
Single	15	19.52
Widow	6	7.42
Level of formal education		
FSLC	-	-
SSCE	15	18.52
OND/NCE	17	20.99
HND	24	29.63
First degree	14	19.44
Higher degrees	11	12.96
Household size		
1 – 3	29	32.41
4 – 6	39	45.37
7 – 10	10	15.74
11 and above	3	3.70
Years of extension experience		
1 – 10	48	54.63
11 – 20	25	34.26
21 – 30	5	6.17
31 and above	3	3.70

Source: field survey, 2015.

Table 2: Assessment of job performance level of frontline extension workers

Job performance variable	Mean performance score
1. Regular and timely supervisory field visits	4.17
2. Holding block/cell meetings as scheduled	4.22
3. Regular and timely attendance to Forth Nightly Training (FNT)	4.70
4. Review of FNT production recommendations during block/cell meetings	4.15
5. Diagnosis and proffering of solutions to field situation	3.89
6. Full knowledge of subject matter	4.19
7. Vetting of EAs /BESs diaries on making scheduled field visits	3.93
8. Covering of block/cells without ZEO/BES supervision in a month	3.81
9. Establishment of 1 (one)SPAT in a month without supervision	3.89
10. Encouraging adoption of technologies by farmer (s) group.	4.11
Grand mean (X) job performance score	**41.06**
Job performance level	**4.11**

Source: field survey, 2015.

Table 3: Relationship between some selected personal characteristics and job performance of the frontline extension workers.

Some selected personal characteristics of the respondents	Job performance
Age (X_1)	- O.06
Sex (X_2)	- 0.21
Level of formal education (X_3)	- 0.36*
Household size (X_4)	- 0.11
Years of extension experience	- 0.12

Correlation analysis at 0.01 levels (2-tailed).

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DETERMINANTS OF SOIL CONSERVATION TECHNOLOGIES ADOPTION IN ABAKALIKI LGA, EBONYI STATE

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ABSTRACT
This study was carried out to evaluate determinants of soil conservation technologies adoption in Abakaliki LGA, Ebonyi State. A multi-stage sampling technique was used to select one hundred and twenty respondents. Data for the study were collected using structured questionnaire. The result of multiple regression analysis revealed that age, educational status, household size, farm size and farmers training were the major determinants of adopting soil conservation technologies in the study area. Again, the result also revealed that cover cropping, alley cropping proper land preparation, agro-forestry, application of manure, re-vegetation and minimum tillage were soil conservation technologies adopted by farmers in the area. Based on the findings of the study, some recommendations were proffered.

Keywords: D**eterminants, soil, conservation, technologies, doption**

INTRODUCTION
In Nigeria, Land degradation is one of the major challenges in agricultural production, especially in eastern part of the country. According to Pagiola, (1999) and Shiferaw *et al.*, (2009) land degradation in the form of soil erosion, deforestation, overgrazing, salinization and alkalization contributes significantly to low agricultural productivity and low income. The implication is that food insecurity and poverty will increase in the country especially, eastern part of the country. Prager and Posthumus(2010) stated that soil degradation can have serious negative impacts on agricultural production and the environment. Gebremedhin, (2004); Takie, (1999); FAO, (1985) pointed out the causes of land degradation include such factors as population pressure on resources; poverty; high costs or limited access of farmers to fertilizers, fuel and animal feed; insecure land tenure; limited farmer knowledge of improved integrated soil and water management measures; and limited or lack of access to credit.In order to protect soil resources from erosion, considerable efforts should be made to ensure the life continuity in the future in the area. World Bank (2007) asserted that achieving sustainable pathways out of the downward spiral of land degradation and poverty requires that farmers adopt profitable and sustainable land management practices, or pursue alternative livelihood strategies that are less demanding of the land resource. In eastern Nigeria, soil conservation is considered to be of top priority not only to maintain and improve agricultural production but also to achieve food self-sufficiency.Recognizing the seriousness of soil erosion problems and the necessity of improving soil fertility and increasing agricultural productivity. As a result, the achievement of soil and water conservation measures is below the expectation and the country loses tremendous amount of fertile top soil and, threat of soil degradation is alarmingly broadening. This is partly attributed to the biophysical, socio-economic, institutional and policy factors.The introduction and implementation of soil conservation programs and technology adaptations need to consider the socio-economic, physical, institutional and agro-ecological factors affecting farmer's willingness to adopt and use these technologies. So, the rehabilitation of land degradation is extremely important since the livelihoods of many Nigerians are entwined with land resources.

Objectives of the study
The broad objective of the study was toassess determinants of soil conservation technologies adoption in Abakaliki LGA, Ebonyi State
Specifically, the objectives are to:
i analyze determinants of soil conservation technologies on adoption among small holder farmers
ii identify the adopted soil conservation technologies.

METHODOLOGY
The study is Abakaliki Local Government (L.G.A) of Ebonyi State. In the course of this research work, multi-stage random sampling techniques were employed in selecting the respondents for the study. Stage I: Four (4) communities were selected out of the total of seven (7) communities thatmade up the study area. Stage II: Five (5) villages each in the four selected communities were selected to make a total of 20 villages used for the study. Stage III: Finally, twenty (20) villages selected, six (6) farmer respondents each were randomly picked to given the total of 120 farmer respondents.

Data for this research was collected from primary data. The primary data was collected using structured questionnaires and interview schedule for the sake of illiterate farmers. For the purpose of the study, descriptive and inferential statistics. Regression analysis was used to analyze the objective one. Likert scale was utilized for objective two. In accordance with this study, the model is specified effect of socioeconomic characteristics of farmers on their level of adoption in Abakaliki local Government Area of Ebonyi State.
The regression Model is specified thus
$Y = f(x_1, x_2, x_3 \ldots x_n)$ … Implicit form
$Y = a_o+a_1x_1+a_2x_2+a_3x_3 \ldots\ldots a_5x_5$ + et. Explicit form
Where Y = credit utilization
X_1 = Age (years)
X_2 = Educational Status (years)
X_3 = Household Size (number)
X_4 = Farm size(ha)
X_5 = Farmers Training
et = error term

RESULTS AND DISCUSSION

Determinants of Soil Conservation Technologies Adoption among Small Holder Farmers

Result of multiple regression analysis (table 1) shows that the coefficient of determination (R^2) was 0.826 (82.6 %) and adjusted R^2 was 0.0803 (80.3%), this means that about 82.6% variation on the dependent variable was influenced by the combine effect of the independent variable (X1 –X5). The high value of R^2 82.6% signifies that the independent variable had positive effect on the dependent variable and important variable where not omitted from the regression model used. Age of the farmers had a positive coefficient and was significant at 5% level of significance. This is true because younger farmers would be more accommodative to new technology and would invest in new and long term innovations. Education status of the farmers took a positive sign and statistically significant at 1% probability level. This implies that there was high level of adoption on soil conservation technologies among the educated farmers in the catchment than less educated ones. The *a prori* expectation was met because educated farmers are presumed to have exposure to modern technologies and innovation and are more receptive to new ideas and more willing to adopt. The coefficient of farm size found to be positively signed and also statistically significant at 1% level of significance. From the result, farm size found had a positive influence on adoption of soil conservation technologies in the area. Household size bore positive sign and statistically significant at %% level of probability. Therefore household size of the farmers would influence the decision of farmers to adopt the decision of farmers to adopt the soil conservation measure give family labour is the whole supplier of the required labour for undertaking the farming and soil conservation operation. Farmers training had a positive influence and statistically significant at 1% level of significance. This is a major determinant in soil conservation technologies adoption especially with respect to prior resource farmers who are not educated.
From the result of the analysis, it was observed that cover cropping, alley cropping , proper land preparation, agro-forestry, application of manure, compost, re-vegetation and minimum tillage with the following mean score of 3.2, 3.1, 2.9, 2.8, 2.7, 2.6, and 2.5 respectively. This implies that they will be increase in agricultural productivity and high level of income among the small holder farmers in the survey.
Table 4 indicate that the cause of soil erosion were intensive cultivation (X=3.2) overgrazing (X=3.0), Heavy rainfall (X=2.9), deforestation (X=2.7), over population (X=2.6) and lack of modern farm tools (X=2.5). This supported findings of Addisu et al, (2015). The implication is that they would be increase in low agricultural productivity including food insecurity and poverty.

CONCLUSION

Based on the findings of the study it was concluded that age, educational status, household size, farm size and farmers training as a major determinants of adopting soil conservation technologies in the study area. Again, the result also revealed that cover cropping, alley cropping proper land preparation, agro-forestry, application of manure, re-vegetation and minimum tillage were adopted in the farmers as the major soil conservation technologies.

RECOMMENDATIONS

Based on the findings of the study the following recommendation was made;

1. Government agencies and NGO's shouldcarryout sensitization for the farmers to form groups to benefit from institutional credit facilities to enhance adoption of soil conservation technologies.
2. There is need for organizing seminars, workshops and conference which will enhance the knowledge of farmers on oil conservation technologies
3. Extension agent should always visit the farmers and educate the on what to do and what not to do.

Table 1: Determinants of soil conservation technologies adoption among small holder farmers

Variable	Variable name	Reg.co efficient	Standard error	T value
Y	Level of adoption	1.751	0.833	2.101*
X_1	Age	0.0408	0.216	1.893**
X_2	Educational status	0.040	0.205	0.194*
X_3	Farm size	0.279	0.239	1.637*
X_4	Household size	0.222	0.136	0.553**
X_5	Farmers training	0.531	0.208	0.676*

Source: field survey, 2016.

Table 2: Determinants of soil conservation technologies adoption among small holder farmers.

Variable	Variable name	Reg.co efficient	Standard error	T value
Y	Level of adoption	1.751	0.833	2.101*
X_1	Age	0.0408	0.216	1.893**
X_2	Educational status	0.040	0.205	0.194*
X_3	Farm size	0.279	0.239	1.637*
X_4	Household size	0.222	0.136	0.553**
X_5	Farmers training	0.531	0.208	0.676*

Source: field survey, 2016.

R^2 = 0.826
Adjusted R^2 = 0.803
Standard error of the estimate = 0.95301
Durbin Watson= 1.959

Table 3: Adopted soil conservation technologies

Adopted soil conservation technologies	Mean score	Remark
Application of manure	2.8	Accepted
Agro- forestry	2.9	Accepted
Alley cropping	3.1	Accepted
Cover cropping	3.2	Accepted
Re-vegetation	2.7	Accepted
Making ridges	2.5	Accepted
Minimum tillage	2.6	Accepted
Proper land preparation	3.0	Accepted
Compost	2.8	Accepted

Source: field survey,2016.

Table 4: Causes of Soil Erosion

Variables	Mean score	Remarks
Deforestation	2.7	Accepted
Heavy Rainfall	2.9	Accepted
Overgrazing	3.0	Accepted
Lack of modern farm tools	2.5	Accepted
Over population	2.6	Accepted
Intensive Cultivation	3.2	Accepted

Source: field survey, 2016.

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DETERMINANTS OF IMPROVED AGRICULTURAL PRACTICES ADOPTION BY SMALLHOLDER YAM FARMERS IN EZZA NORTH LGA, EBONYI STATE, NIGERIA

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ABSTRACT
This study investigated the determinants of the adoption of improved agricultural practices in yam production by small holder farmers in Ezza North LGA, Ebonyi State. A Multistage purposive sampling techniques was employed to select a total of 120 respondents. The primary data were collected for the study through structured questionnaire and interview schedule organized for illiterate farmers in the study area. The result of the analysis also identified mixed cropping (8.6%), crop rotation (8.5%), improved land preparation and planting yam seeds (7.9%) and others as improved agricultural practices adopted by the respondents. The research work also revealed factors influencing the adoption of improved agricultural practices such as access to improved farm inputs, access to farm land, availability of extension service, level of education, access to credit facilities, farming experience, low interest rate and access to information and training. The result also indicated that government policies and economic factor, personal factor, and institutional factor were the major constraints militating the farmers to adopt the improved agricultural practices. Based on the findings of the research work, some recommendations were proffered.
Keywords: Determinants, Improved, Agricultural Practices, Adoption, Smallholder

INTRODUCTION

Yam production is one of the main agricultural activities in West Africa, and the region contributes between 90% and 95% of world production (FAO, 2006). In Nigeria, yam is the most important food crop in terms of output value. It plays a key role in guaranteeing household food security. The yam sector in Nigeria is definitely important for household and national income as well as food security. Yam **(Discorea *spp*)** is an important tuber crop in Nigeria where it is produced as food and cash crop (Asumugha and Eluagu, 1991). Agricultural technology plays a vital role in enabling agriculture to become more productive and sustainable. Sustainable agriculture is an agricultural system adapted to a particular area so that crop and animals production do not decline over time and are reasonably stable over normal fluctuations of weather (Donahune and Troch, 2003). The improved agricultural practices are innovations, genetic improvement, mechanized farming equipment, improved and high yield varieties, integrated pest management control, soil mapping, precision dosing of fertilizer, agricultural advisory systems, post harvest technologies, efficiency in land use among other and including ICT facilities, can play an important role in agricultural development. The efficiency in the use of technology generated and disseminated depends on effective communication which is the key process information dissemination (Harper *et al.*, 1990). Angawu (1992) reported that improved agricultural technologies disseminated to farmers in Enugu State, Nigeria include harvesting of yam, storage in barn, pest control in food crop farm, site selection/bush clearing/packing, weeding of early season crops, disinfections and restocking of day-old chicks, early maize cultivation, and improved soil conservation in food and cash crops. Low improved agricultural practices by most small-holder farmers, described level of increase in agricultural productivity has been difficult to achieve. The use of agricultural technologies affects the rates of increase in agricultural output (Ekpere, 1994). It also determines how the increase in agricultural output impacts on poverty levels and environmental degradation. Therefore, the focus of recent research has been to find better agricultural practices. Increased technology development and adoption can raise agricultural output; hence improved household food intake improved. Food intake can also improve the functioning of the human body and the performance of a healthy, normal life which will increase work output (Caswell *et al.*, 2001) Agricultural technology development is an essential strategy for increasing agricultural productivity, achieving food self-sufficiency and alleviating poverty and food insecurity among small holder farmers in Nigeria.

Onwueme, (1982) stated that despite the major agricultural research breakthroughs, adoption of the improved agricultural technologies to farmers is a major challenge for both researchers and technology transfer agencies. He opted that the low utilization of improved technologies by smallholder yam farmers may be a factor responsible for their sub-optimal production levels. Declining crop yield among the small-holder yam farmers is probably because the improved production technologies and innovations are not reaching the farmers or that they are not being adopted. Feder and Slade (1984) stated that agricultural innovation diffusion is largely affected by information available on the innovation, relative to its adoption.

Objectives of Study

The broad objective of the study is to identify the determinants of the adoption of improved agricultural technology practices in yam production by small scale farmers in Ezza North Local Government Area, Ebonyi state.

The specific objectives are to:

i. identify the existing improved agricultural practices among the yam small scale farmers;
ii. examine the determinants of the adoption of improved agricultural practices by smallholder yam farmers;
iii. identify the constraints associated with yam farmer's adoption of improved agricultural technology practices.

METHODOLOGY

The research was conducted in Ezza North Local Government Area of Ebonyi State, Nigeria. The farming activities they engage in are crop farming-oil palm, yam, cassava, rice, rubber, rice, mango, okra, cocoyam while the livestock farming include-fish farming and animal husbandry.

Multistage purposive sampling techniques were adopted to select a total of 120 yam farmers that were used for the study. The first stage involves the random sampling of (10) Agricultural Extension circles (communities) in the study area. In the second stage, were four sub-circles (villages) were randomly selected from each of the ten (10) circles (autonomous communities) selected in stage 1, a total of 40 villages were selected in this stage. Finally, three (3) contact yam farmers were purposely selected from each of the selected (villages). Therefore, a total hundred and twenty (120) yam farmers were used for the study.

The data for the study were collected primary data were used for the study. The primary data were collected using a well structured questionnaire and oral interview schedule

Data obtained for this study were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequency, table and percentages were used in analyzing objective I, II and objective III were analyzing using factor analysis

RESULTS AND DISCUSSION

Improved Agricultural Practices Among the Yam small holder farmers

Data in Table 1 indicate that the improved agricultural practices adopted by yam producer include mixed cropping (8.6%), crop rotation (8.5%), improved land preparation and planting yam seeds (7.9%), inorganic manure (fertilizer) (7.9%), organic manure application. (7.7%), alley cropping (7.5%), cover cropping (7.3%), site selection/bush burning/ packing (7.3%), improved yam seed varieties (6.8%), harvesting of yam and storage in barn (6.9%), disease control (6.3%), green manure (5.6%), and tuber multiplication technology (yam minisett) (5.1%). It implies that yam small scale farmers have adopted mixed cropping and crop rotation as a major improved agricultural practice in the study area. According to Ekumankama (2000), mixed cropping especially yam and cassava based mixtures are traditionally practiced in many farming systems in the eastern region of the country. It is worthy of note that level of improved agricultural practices adoption by farmers is high. As a result of high improved agricultural practices employed by most small scale farmers, the desirable level of increase in agricultural productivity with be achieve.

Determinants of the adoption of improved agricultural practices by yam small scale farmers

The analysis of the data collected shows the factors influencing adoption of improved agricultural practices include; access to improved farm input (13%), availability of extension services (12.9%), access to farmland (12.9%), level of education (12.7%), access to credit facilities (12.6%), farming experience (12.3%), Low interest rate (12.1%) and access to information and training (11.5%). This is true because the availability of subsidized improved farm inputs would serve as the basic motivating factor for technology adoption. The positive relationship of educational level and farming experience as a factor of technology adoption implied that adoption of improved agricultural practices tended to be accepted by experienced farmers as they understand the importance of technologies in farming.

Constraints Associated with yam small scale farmers in adopting the improved agricultural practices

Table 3 shows the varimax rotated constraints limiting and adopting the improved agricultural practices among yam small scale farmers. The data obtained in the based on the responses of the respondents. In this regards, the variable were grouped into three (3) major constraints, namely; factor 1 (Government , Policies and Economic factor), factor 2 (Economic and personal factor),and factor 3 (institutional factor). Factor 1 was named due to the variables that loaded high under it. They include; government inconsistent of policies (0.814), lack of credit facilities (0.660) and lack of awareness of improved practices (0.332). After critical consideration, factor 2 was named economic and personal factor because the variable that loaded high under it related to economic and personal factor. These include; high cost improved farm inputs (0.790), and lack of interest (0.712). Under factor 3, the identified constraining variables were; lack of extension service (0.803), poor infrastructure (0.649), and Government inconsistent of policies (0.509) which was named institutional factor.

CONCLUSION

The study showed that access to improved farm input, access to farm land, availability of extension service, level of education, farming experience, access to credit facilities are the most significant determinants of the adoption of improved agricultural practice in the study area. Factor analysis was utilized to determine the constraints limiting the adopting improved agricultural practices and it was observed that government policies, economic factor, personal factor and institutional factor were found as the majority constraints affecting adoption of improved agricultural practices in the study area.

Based on the findings of this study, the following recommendations were made;.

I. Government should work with the farmers and involve them in distribution of necessary improved farm input for agricultural production.

II. Extension agent should be trained and empowered to educate farmers on how to use different improved agricultural practices.

III. The government should consider granting incentives and assistance to the agricultural sub-sector and to the farmers in form of credit as these would enable them take action to use improved agricultural practices.

Table 1: Percentage distribution on improved agricultural practices among the yam small holder farmers

Improved Agricultural Practices	Frequency(n=120)	Percentage
Alley cropping	82	7.5
Green manure	61	5.6
Crop rotation	93	8.5
Mixed cropping	94	8.6
Cover cropping	80	7.3
Organic manure application	84	7.7
Inorganic manure (fertilizer, NPK)	86	7.9
Integrated pest management	62	5.7
Improved yam seed varieties	75	6.8
Minimum tillage	10	0.90
Improved land preparation and planting yam seeds	87	7.9
Harvesting of yam and storage in barn	76	6.9
Site selection/bush clearing/packing	80	7.3
Disease control	69	6.3
Tuber multiplication technology (yam minisett)	56	5.1

Source: Field survey, 2016.
Multiple Response Recorded*

Table 2: Percentage distribution of the determinants of the adoption of improved agricultural practices among yam small scale farmers

Determinants	Frequency	Percentage
Access to improved farm input	91	13
Level of education	89	12.7
Access to credit facilities	88	12.6
Availability of extension services	90	12.9
Low interest rate	85	12.1
Farming experience	86	12.3
Access to farm land	90	12.9
Access to information and training	81	11.5

Source: Field survey, 2016.

Table 3: Varimax rotated factor matrix on constraints limiting with yam small-scale farmers in adopting the improved agricultural practices

Variable code	Variable name	Factor1 govt. policies and economic factor	Factor2 economic and personal factor	Factor3 institutional factor
Vol. 1	Government inconsistent of policies	0.814	-0.105	0.509
Vol. 2	Lack of credit facilities	0.660	0.151	-0.075
Vol. 3	High cost of improved farm inputs	-0.163	0.790	-0.104
Vol. 4	Lack of interest	0.238	0.712	0.216
Vol. 5	Lack extension Service	-0.270	-0.015	0.803
Vol. 6	Poor infrastructure facilities	0.113	0.160	0.649
Vol. 7	Lack of awareness of improved practices	0.332	-0.183	0.052

Source: field survey, 2016

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SOCIO-ECONOMIC FACTORS INFLUENCING THE ADOPTION OF SIMPLE AGRICULTURAL TECHNOLOGY IN KWARA STATE, NIGERIA

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ABSTRACT
The study examined the socio-economic factors influencing the adoption of simple agricultural technology in Kwara State. 154 farmers were purposefully selected at random in 2 LGAs (Ifelodun and Irepodun) for this study. Data were collected by means of questionnaires and analyzed using descriptive and inferential statistics. The result revealed that about 58.5% of the respondents are within middle age, 72.7% are literate which implies that they are in a better position to be aware of, understand, comprehend and adopt simple agricultural technologies. The study also revealed that about 67.5% of the respondents did not belong to any farmer/cooperative organization. The multiple regression result indicates that the coefficients of sex and cooperative society, relevant, aspiration were found to be influencing the adoption of simple agricultural technologies at 1% and 5% level of significant. Poor finishing, publicity, feedback and extension were identified as constraint to adoption of these technologies. It was concluded that the respondent's interests in adoption of simple agricultural technology is high because it contributed to increase in their livelihood, income and make their work faster and efficient.
Keywords: Socio-economic, Adoption, Agriculture, Technologies, Farmers

INTRODUCTION

In Nigeria, farms and farmlands have become smaller and fragmented due to increase in population growth rate. This increase in population has outstripped growth in agricultural output thereby resulting in low productivity which may be attributed to low adoption agricultural research results and technologies that can increase farmer's productivity.

Technology adoption means different things to different people. To some, technology adoption is viewed as a consistent process, the key to enabling hesitant users to successfully adopt and use technology. Adoption of any innovation is not a one step process as it takes time for adoption to complete. The duration of adoption of a technology vary among economic units, regions and attributes of the technology itself. Therefore, adequate understanding of the process of technology adoption is necessary for designing effective agricultural research and extension programmes.

According to Rogers (1983), adoption of technology can be viewed as a 5-step process. The 5 steps are:

Awareness: Potential users learn enough about the technology and its benefits to decide whether they will use the new technology or not.

Assessment: Potential users evaluate the usefulness and usability of the technology, and the ease or difficulty of adoption.

Acceptance: Potential users weigh the advantages/disadvantages and decide whether to acquire and adopt or use the technology, or decide not to adopt the technology.

Learning: Users develop the skills and knowledge required to use the technology effectively and may search for further information about it.

Usage: Users demonstrate appropriate and effective use of the technology to its fullest potential.

Erebor (2001) highlighted some factors affecting the rate of adoption of technology as follows:

Level of education: The more educated a farmer is, the higher the rate of adoption of new technology. It will take a longer time for an illiterate farmer to accept new ideas in farming.

Attitude of the farmer: Most farmers that develop positive attitude toward new technologies are more likely to succeed than those that do not respond at all.

Financial status of a farmer: Experience has shown that wealthy farmers are ever willing to accept and experiment in new farming technologies than very poor or peasant farmers.

Size of the farm: The bigger the farm, the higher the rate at which a farmer will be willing to accept new ideas and the smaller the farm, the lower the rate of adoption of new technology.

Presence of extension worker: The presence of extension worker within the farming community may help the individual farmer to accept the new ideas or techniques in farming.

Result of demonstration plots: The result from demonstration plots, particularly, if it is a good one will promote the acceptance and adoption of the innovation but when the result is not good, farmers will abandon the whole idea concerning the technology.

However, the rate of adoption of technologies is very low due to the unwillingness of the farmers to take risk of using new technologies with the fear that it will lead to losses or reduction in output. In view of the above, it becomes imperative to intensify efforts on adoption of research results and technologies for sustainable development and farmer's profitability through adoption of superior technologies and research packages. It is against this background that, this study sought to provide answers to the following research questions: what are the socio economic characteristics of the farmers? and how can the socio-economic characteristics of farmers influence the adoption of simple agricultural technologies?

METHODOLOGY

This study was carried out in Ifelodun and Irepodun Local Government Areas (LGA) of Kwara State, Nigeria. The major source of livelihood and occupation of the people in the area is farming (KWSMI, 2002 and Mohammed, 2008). A multi stage random sampling technique was used. Ten (10) communities were purposively selected in the study area. Second stage involved randomly selection of 154 farmers who serve as the sample frame. The data used for this study was basically primary data. This involved the use of an interview schedule with a structured questionnaire administered to the farmers. Descriptive statistics such as frequency, percentage and mean were used to analyzed the socio-economic of respondents while the regression analysis was used to determine the relationship between farmers socio-economic factors in relation to adoption of simple agricultural technologies. The model is express implicitly as:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8)$

where:

Y = adoption of simple agricultural technologies

X_1 = age of farmers

X_2 = Sex

X_3 = Marital status

X_4 = Experience

X_5 = Family size

X_6 = Source of Information

X_7 = Educational status of farmers

X_8 = Association among farmers

RESULTS AND DISCUSSION

The findings from the study indicated that the adoption of simple agricultural technologies is majorly in the hands of the female. About 58.5% of the respondents are within middle age and they are expected to be energetic, mentally alert, actively involved in processing activities. The study further revealed that the average household size of the respondents was 4 implying that they have enough family labour to contribute to agricultural production. This revealed positive relationship between family size and adoption. The data on educational status revealed that majority of the respondents about 72.7% are literate this implies that they are in a better position to be aware of, understand, comprehend and adopt simple agricultural technologies. It is also established from the study that majority of the respondents are full time farmers and farming is their major source of income. About 67.5% of the respondents did not belong to any farmer/cooperative organization. The implication is that potential of social network has not been fully utilized.

The multiple regression result indicates that the coefficients of sex and cooperative society, relevant, aspiration were found to be influencing the adoption of simple agricultural technologies at 1% and 5% level of significant. Poor finishing, publicity, feedback and extension were identified as constraint to adoption of simple agricultural technologies.

CONCLUSION

Agricultural development depends, to a great extent, on the willingness and ability of the farmers to make use of the new technologies. The findings in this study clearly shows that the respondent's interests in adoption of simple agricultural technology is high because it contributed to increase their livelihood, income and make their work faster and efficient. The contribution of a technology to economic growth can only be realized when and if the new technology is widely used. The result from the findings of the research work shows clearly that the level of adoption of simple agricultural technologies as evident from the respondent's is remarkable.

Table 1: Socio-Economic Characteristics of the Respondents

Variables	Frequency	Percentage (N=154)
Gender		
Male	60	39.0
Female	94	61.0
Age		
<20	4	2.6
21-30	28	18.2
31-40	46	29.9
41-50	44	28.6
Marital Status		
Single	24	15.6
Married	120	77.9
Widowed	6	3.9
Divorced	4	2.6
Household Size		
<3	50	32.5
4-6	62	40.3
7-10	42	27.3
Number of Children		
<3	64	41.6
4-6	80	51.9
7-10	10	6.5
Educational Status		
No Formal Education	42	27.3
Quranic Education	4	2.6
Primary Education	30	19.5
Secondary Education	62	40.3
Tertiary Education	6	3.9
Not Specified	10	6.5
Main Occupation		
Farming	100	64.9
Civil Servant	10	6.5
Student	8	5.2
Artisan	18	11.7
Trading	18	11.7
Source of Fund		
Farming	84	54.5
Trading	22	14.3

Source: Field Survey, 2015

Table 2: Multiple Regression Analysis

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t-value	Sig.
(Constant)	0.012	0.271		0.046	0.964
Sex (X_1)	0.246	0.111	0.277	2.204**	0.033
M-Status (X_2)	-0.120	0.085	-0.164	-1.406	0.167
H-Hold (X_3)	0.036	0.034	0.093	1.047	0.301
Edu_Level (X_4)	0.007	0.019	0.032	0.375	0.710
Co-op. Society (X_5)	0.267	0.087	0.319	3.066*	0.004
Relevant (X_6)	0.251	0.082	0.426	3.068*	0.004
Aspiration (X_7)	0.115	0.055	0.143	2.098**	0.042
Fast & Con (X_8)	0.304	0.080	0.457	3.803*	0.000
Preference (X_9)	0.524	0.105	0.554	5.005*	0.000
Experience (X_{10})	-0.011	0.009	-0.169	-1.261	0.214
Age (X_{11})	0.185	0.068	0.450	2.725*	0.009

*significant at 1%, **significant at 5%, R^2=0.78

Source: Field Survey, 2015

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ADOPTION OF ICTS AMONG MALE AND FEMALE FARMERS IN OHAUKWU LOCAL GOVERNMENT AREA OF EBONYI STATE, NIGERIA

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ABSTRACT
The study assessed adoption of ICTs among male and female farmers in Ohaukwu Local Government Area of Ebonyi State. Multi-stage random and purposive sampling techniques were used to select 120 respondents, comprised of 60 male farmers and 60 female farmers respectively. Primary data which were collected with the aid of a structured questionnaire were used for the study. Data were analyzed using descriptive statistics. The result of the study showed that male and female farmers have different levels of awareness on the available ICT facilities in the study area, however, the male farmers have higher level of awareness on ICT facilities such as radio (70%), mobile phone (90%) and television (60%) as against female farmers whose awareness level is more on mobile phone (80%) and radio set (53.3%). Moreso, the result indicated grand means of $\bar{X} = 2.45$ *and* $\bar{X} = 2.35$, *which are below the cut-off point of 2.5 for both male and female farmers respectively, suggesting that although the male farmers appear to have higher level of adoption of ICT facilities than their female counterparts, the overall adoption level is low. The test hypothesis attested to the significance difference between the male and female farmers on their extent of adoption of ICT facilities in the study area. The male and female farmers accepted that some factors influenced their decision to adopt ICT facilities into farming operations. However, these factors influenced the male farmers more than the female farmers. The study recommends provision of ICT support infrastructures at the rural area by the government, inclusion of gender mainstreaming ICTs programmes into extension service delivery to improve male and female farmers' knowledge and skills for effective adoption of ICTs; and formation of cooperative society to enable farmers pull their resources together to acquire modern ICTs in order to effectively harness the opportunities offered by facilities in agricultural production.*
Keywords: **Adoption, Farmers, Male, Female, ICT Facilities.**

INTRODUCTION
That ICTs play an important role in African development is now well documented. For instance, the use of telephone services because of its wider access has engendered social inclusion through employment generation and improvements in social services including fishing and farming practices has been documented (de Silva, Ratnadiwakara and Soysa, 2009; Jensen, 2007). Access to ICTs (such as telephones) has helped to remove barriers of isolation of individuals, enhance their chance of economic inclusion and thus 'provide diverse avenues for women's social, political and economic empowerment (UNDAW, 2003). However, most of these studies have shown uneven forms of the benefit that accrue to men and women from social engagement and economic participation, particularly to those living in remote rural areas in developing countries (Mottin-Sylla, 2005). The gender disaggregation based on nationally representative data on ICT access and usage is extremely limited but essential to verifying or challenging underlying assumptions about access and utilization of ICTs, gender equity and development. Most of the studies in recent years on women's access and usage of ICTs argued that there is a significant gender divide, particularly in developing countries. A study carried out in 2005 by the Gender and ICT Network, reveals that, globally, women's chances to benefit from the advantages of the information society are one third less than men's (Mottin-Sylla, 2005).

A number of studies in recent years have sought to understand gender similarities and differences in access and usage of ICTs. Gender and technology studies have found that men and women adopt and use technology differently (Gefen and Straub, 1997; Venkatesh and Morris, 2000). Men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use (Venkatesh and Morris, 2000). However, men and women may view the same mode of communication differently. Ironkwe (2011) argued that gender deals with the social relationship between men and women and how these relationships are negotiated in the production of goods and services. However, it is important to note that such gender relationship exist among farmers with respect to access to ICTs. Farmers' personal characteristic and socio-economic status, which are determined by gender related factors, constitute critical factors in technology utilization process (Chukwu, 2007).

Moreso, in the past decades, there was little sex disaggregated data to demonstrate disparities between men's and women's access and use of ICTs, although no one contested that was the case. Despite various attempts to quantify the digital divide along gender line in recent time, it seems there is little or no rigorous and consistently empirical verifiable data, beyond very limited census-type data by national statistical offices, on which to assess the progress made towards determining gender specific factors influencing the adoption of ICTs in farming activities. It is against this backdrop that this study was embark upon to assess influence of gender on adoption of ICTs among farmers in Ohaukwu L.G.A of Ebonyi State, Nigeria. Specifically, the objectives were to: identify existing ICTs and farmers awareness in the study area; assess the extent of adoption of ICTs among the male and female farmers; and ascertain factors that influence the adoption of ICTs among male and female farmers in the study area. The study hypothesized that there is no significant difference between the levels of adoption of ICTs among female and male farmers in the study area.

METHODOLOGY

The study was carried out in Ohaukwu Local Government Area (L.G.A) of Ebonyi State. The Local Government Area is one of the thirteen (13) Local Government Areas of Ebonyi State. It is made up of fourteen (14) autonomous communities and three (3) clans. Its Headquarter is located at Ezzamgbo which is 13km away from the state capital. The area has a land area of 517 km^2 and a total population of 19, 6337 peoples (NPC, 2006). Geographically, the L.G.A lies within latitude 4^0N and Longitude 8^0E of Ebonyi State.

The mean temperature is between 27^0C and 28^0C and the prominent climatic seasons are rainy season, lasting from April to October, and dry season, lasting from November to March (Nwagbo and Onuchekwa, 1988). The vegetation of the area is the derived Savanna type. Farming constitute the major occupation of the people found in the area, though significant number of the population engaged in non-farm occupation such as civil and public services, building and construction, trading and transportation among others. Major crops grown in the area include yam, cassava, vegetable, maize, oil palm, and sweet potatoes.

Multi-stage sampling involving random and purposive sampling techniques were used to select a total of 120 respondents comprised 60 male and 60 female farmers. Primary data were used for the study, which were collected through the use of structured questionnaire and interview schedule. Descriptive statistics of frequency table, percentage and mean were used to analyze objective I, while mean score derived from 4-points Likert scale was used to analyze objectives (ii) and (iii). The null hypothesis was tested using t-test statistics.

RESULTS AND DISCUSSION

To determine the existing ICT facilities in the study area, a list of the facilities were provided for the respondents to check and indicate the available facilities based on their level of awareness.

The result in Table 1 shows that male and female farmers have different level of awareness on the available ICT facilities in the study area. However, it was observed that male farmers have higher level of awareness on the availability of ICT facilities such as radio (70%), mobile phone (90%) and television set (60%) as against female farmers who are aware of mobile phone (80%) and radio set (53.3%). The higher awareness level among male farmers is not unconnected with the patriarchy society, which allows men as the head of the households to make decision concerning the entire household in addition to capital assets acquisition through inherit and other cultural means. This practice hinders women access to information on productive assets. However, the high awareness of the farmers on ICT facilities such as mobile phone and radio more than other ICT facilities is because of its wider coverage of its network, reach and affordability. In addition, the ease with which mobile phone can be used and the positive impact in terms of facilitating quick access to communication must have influence its high awareness. The finding collaborates that of Ezeh (2013), who reported that over 95 percent of the farmers in Southeast, Nigeria testified to the existence and awareness of radio, mobile phone and television.

To ascertain respondents' extent of adoption to existing ICT facilities, a list of ICTs were provided for the respondents to indicate their extent of adoption.

Table 2 shows the mean score distribution of male and female farmers based on their extent of adoption of ICTs in the study area. The result shows the grand means were below the cut-off mean ($\bar{X} = 2.45$) and ($\bar{X} = 2.35$) for both male and female farmers respectively. This suggests that although the male farmers appear to have higher extent of adoption of ICT facilities than their female counterparts, however, the farmers' overall extent of adoption is low. The analysis indicates that the most ICT facilities adopted by the male farmers were mobile phone ($\bar{X}$ = 2.89), radio ($\bar{X}$ = 2.80), television ($\bar{X}$ = 2.77), cassette recorder/player ($\bar{X}$ = 2.70) and newspapers ($\bar{X}$ = 2.65), while the female farmers adopted more of mobile phones ($\bar{X}$ = 2.70), radio set ($\bar{X}$ = 2.64) and television ($\bar{X}$ =2.54) facilities in the study area. Similar finding has been reported by Ezeh (2013), who observed that farmers in Southeast, Nigeria adopted ICTs such as radio, television and phones to a reasonable extent in their farming activities. The poor extent adoption of ICTs may be attributable to the low level of access and cost associated with ICTs adoption in addition to absent of ICTs support facilities such as electricity. Moreso, the study reveals that farmers access and utilize more of conventional ICTs for obtaining agricultural information than the contemporary ICTs. This is consistent with Adejo and Haruna (2009). This situation has grave consequent for agricultural production in Ohaukwu LGA of Ebonyi State and Nigeria in general. According to Nchuchuwe (2012), the problem of underdevelopment in agricultural sector of Nigeria and sub-Saharan African countries is attributable to the inability of a large portion of her population to access and effectively deploy ICTs for agricultural development.

Data in Table 3 reveals that the t-values for male and female farmers on their extent of adoption of ICT facilities were 25.756 and 27.187 respectively, which is less than the t-tab of 2.042. This implies that male farmers have higher extent of adoption of ICT facilities than the female farmers in the study area. Hence, the alternative hypothesis was accepted that there is significance difference between the male and female farmers' extent of adoption of ICT facilities in Ohaukwu LGA of Ebonyi State.

To determine the decision of male and female farmers to adopt ICT facilities, the farmers were provided with the list of possible factors that influence the adoption of ICT facilities. The summary of the result is presented in Table 4. The result in Table 4 shows that both male and female farmers accepted that some factors influenced their decision to adopt ICT facilities into farming operations. The factors that influenced the male farmers were: educational attainment ($\bar{X}$ =2.7), income level ($\bar{X}$ =3.5), affordability of ICTs ($\bar{X}$ =3.32), farm size ($\bar{X}$ =2.67), availability of power supply ($\bar{X}$ =2.63), knowledge of ICTs ($\bar{X}$ =2.95), ease of use ($\bar{X}$ =2.56), compatibility with previous experience ($\bar{X}$ =2.68), relevance of ICTs to farming activities ($\bar{X}$ =2.85), durability of facility ($\bar{X}$ =2.51) and availability of ICTs ($\bar{X}$ =2.74). While female farmers were influenced by educational attainment ($\bar{X}$ =2.62), income level ($\bar{X}$ =3.23), affordability of ICTs ($\bar{X}$ =2.85), availability of power supply ($\bar{X}$ =2.56), knowledge of ICTs ($\bar{X}$ =2.74), ease of use ($\bar{X}$ =2.83), relevance of ICTs to farming activities ($\bar{X}$ =2.74), and availability of ICTs ($\bar{X}$ =2.63). From the analysis, it was observed that male farmers have more factors that influenced their decision to adopt ICTs than the female farmers. For instance, the male farmers admitted that all the eleven items influenced their decision to adopt ICT facilities as against female farmers that were influence by eight items. This scenario probably may be attributed to the inability of women to have direct ownership of many ICT facilities as such they access it indirectly through their husbands.

CONCLUSION

The study observed that the most available, accessed and utilized ICTs in the study area are radio, mobile phones and television. However, the level of adoption of these facilities is generally low. Notwithstanding, the male farmers have higher extent of adoption than their female counterparts. Hence, the study concludes that there is significant difference between male and female farmers' extent of adoption of ICT facilities in the study area. It was also observed that a number of factors influenced the decision of male and female farmers to adopt ICT facilities at a disproportionate level in favour of the male farmers. Some of these factors include: educational attainment, income level, affordability of ICTs, farm size, availability of power supply, knowledge of ICTs, ease of use and relevance of ICTs to farming activities among others. Based on this, the study recommends provision of ICT support infrastructures at the rural area by the government, inclusion of gender mainstreaming ICTs programmes into extension service delivery to improve male and female farmers' knowledge and skills for effective adoption of ICTs especially in rural areas; and formation of cooperative societies to enable farmers pull their resources together to acquire modern ICTs in order to effectively harness the opportunities offered by ICT facilities in agricultural production.

Table 1: Percentage distribution of respondents based on awareness level of ICT facilities existing in the study area

ICT Facilities	Male		Female	
	Freq. (n=60)	%	Freq. (n=60)	%
Radio	42	70	32	53.3
Television set	36	60	25	41.7
Mobile phones	54	90	48	80.0
Internet connected computers	11	18.3	7	11.7
Newspapers	20	33.3	12	20.0
CDROM	8	13.3	3	5.0
Projector/power points	15	25.0	3	5.0
Mobile cinema	11	18.3	2	3.3
Media van	2	3.3	-	-
Geographical Information System (GIS)	4	6.7	1	1.7
Cassette recorder/player	22	36.7	4	6.7

Source**:** Field survey, 2016. *Multiple Responses Recorded.

Table 2: Mean scores distribution of respondents based on the extent of adoption of ICT facilities

ICT Facilities	Male (n=60)		Female (n=60)	
	$\overline{X}$	Decision	$\overline{X}$	Decision
Radio set	2.80	Accept	2.64	Accept
Television	2.77	Accept	2.54	Accept
Mobile phones	2.89	Accept	2.70	Accept
Internet connected computers	2.03	Reject	1.96	Reject
Newspapers	2.65	Accept	2.62	Accept
CDROM	2.02	Reject	2.01	Reject
Projector/power points	2.34	Reject	2.43	Reject
Mobile cinema	2.20	Reject	2.32	Reject
Media van	2.25	Reject	2.08	Reject
Geographical Information System (GIS)	2.38	Reject	2.02	Reject
Cassette recorder/player	2.70	Accept	2.58	Accept
Grand mean	2.45	Accept	2.35	Accept

Source: Field survey, 2016.

Table 3: Test of Difference between male and female farmers on the extent of ICTs adoption

Gender	N	Df	Mean ($\overline{X}$)	Std Dev	t-value	t-tab	Sig. level
Male	60	59	2.4573	0.31642	25.756	2.042	0.000
Female	60	59	2.3545	0.28724	27.187		

Source**:** Field survey, 2016.

Table 4: Distribution of respondents according to factors that influence adoption of ICTs in the study area

Factor	Male		Female	
	Mean score ($\bar{X}$)	Decision	Mean score ($\bar{X}$)	Decision
Educational attainment	2.70	Accepted	2.62	Accepted
Income level	3.50	Accepted	3.23	Accepted
Affordability of ICTs	3.32	Accepted	2.85	Accepted
Farm size	2.67	Accepted	2.32	Rejected
Availability of power supply	2.63	Accepted	2.56	Accepted
Knowledge of ICTs	2.95	Accepted	2.74	Accepted
Ease of use	2.56	Accepted	2.83	Accepted
Compatibility with previous experience	2.68	Accepted	2.37	Rejected
Relevance of ICTs to farming activities	2.85	Accepted	2.74	Accepted
Durability of facility	2.51	Accepted	2.48	Rejected
Availability of ICTs	2.74	Accepted	2.63	Accepted

Source: Field survey, 2016

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USE OF EFFECTIVE COMMUNICATION TECHNIQUES IN AGRICULTURAL EXTENSION TECHNOLOGY TRANSFER SYSTEM IN NIGERIA

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ABSTRACT
Agricultural extension technology transfer system largely depends on effective communication techniques with the aim of disseminating information and improved agricultural technologies to the people both in developed and undeveloped countries. Despite the existence of extension institution and technology transfer programmes in almost every developing country, coverage of farm families is still very limited. This is due to low quality of developing countries' extension programmes and ineffective communication techniques which consequently lead to the underutilization of improved agricultural technologies. It is against this background that this paper examines the use of effective communication techniques in disseminating agricultural extension messages to farmers. Based on the findings, it is concluded that timely and adequate dissemination of improved agricultural technologies requires effective and reliable communication techniques and recommended that the use of radio and cell phones contacts should be given more priority as well as organizing workshops or seminars to sensitize farmers in the use of communication techniques.
Keywords: **Effective communication techniques, agricultural extension, technology transfer, Nigeria.**

INTRODUCTION
It is recognized that emphasis on information and communication strategies can create a wide range of opportunities for participation of farmers' uptake of new farming technologies. This strategy provides basis for empowering the rural farming populace to understand and track new farming technologies for possible diffusion of research results and recommended practices which can lead to farmers' adoption for increased productivity. Upon this, Arokoyo (2005) defined agricultural extension as an advice and assistance given to the farmers and his families through educational procedures in order to improve their production efficiency, income, level of living and uplifting the education and social standard of the farmers. Incorporation of appropriate multi-channel communication strategies into extension programmes can improve this situation. Although, many information units already exist in developing countries' extension programmes, Olowokere (2006) posited that communication techniques are devices used in passing information from the teacher/trainer to the learners with the use of mass media, audio visual aids and printed materials. The skills of communication competence are essentially participatory. Participation has to do with the people's active involvement in every phase of development process. With their involvement, the people assume responsibilities for determining and shaping their own destinies. Thus, for development to be attained, nurtured and sustained, efforts must begin in collaboration with the beneficiaries. Participatory communication is the bidirectional sharing of ideas, information, knowledge and experiences among people. Therefore, in underlining the critical role of participation in both communication and development, Otitolaye (2006) reasoned that people-oriented development can only realize its full potentials if rural people are involved and motivated in information and knowledge sharing through mass media channels.

Use of effective communication techniques in disseminating agricultural extension messages to farmers
An important objective of agricultural extension and technology transfer system in Nigeria is to disseminate useful and practical information relating to agriculture, ensure practical application of such knowledge and mobilization of farmers' resources for the purpose of improving their welfare (Rogers, 1999 and Yekini, 2006). One of the strategies employed in achieving this, is through the use of effective communication channels among researchers, extension agents and farmers. Some of these strategies are radio, television, newspaper, Information and Communication Technologies (ICTs), internet connection and use of phones. The mainstream of agricultural extension service worldwide remains the development of the rural sector and improvement of the living conditions of farming household through increased farm production. It does this by providing the rural farmers with relevant and applicable research-based technologies. This is usually accompanied by technical information with which farmers are assisted to understand the potentials of the technologies and acquire the needed skills for their implementation, in order to successfully achieve this task.

Radio in rural development
Radio serves as an important medium in disseminating agricultural extension messages in both rural and urban centers. According to Olowokere (2006), an average rural or urban person listen to radio for more than three hours in a day. Also, many people spend more hours with the electronic media than they spend with other human beings in the community and carry out less reading and learning. Despite the importance of radio in community development, it has one major problem in its transient nature. For instance, it has a little reference value. Once a

programme is over, to recall the message of the radio may not be easy. Also, radio is like a one-way traffic by continuously talking without waiting to know whether anybody is listening or not and keeps talking even if nobody is within. This is why complex details in agriculture cannot be explain in radio programmes. However, radio is widely and cheaply used in agricultural technology and information dissemination to a large number of people scattered all over the country.

Radio is the most potent mass communication medium with its monumental success and potentials in educational projects in several developing countries of the world such as Mexico, Thailand, Philipines, Kenya, Gabon, Nigeria and other nations. In Nigeria for instance, over twenty radio stations have been added to the existing ones since the year 2000 when deregulation of the broadcast media was fully implemented (Omotayo, 2005). Access to radio is extensive compared to any other ICT with four (4) out of every ten (10) persons living in the rural areas (Oryokot, 2003). Radio transcends illiteracy barrier, geographical barriers, distances and time. Its broadcast can be picked instantly by the listener regardless of bad roads and barriers. It is because of the versatility of radio in communication to the grassroots level that made most governments of many developing countries to give radio the highest priority as an effective means of reaching the people even in the remote areas. Radio is used in public enlightenment programmes such as health, education, politics, agriculture, public awareness campaigns and other community development programmes. Some of the most successful public campaigns in Nigeria through the use of radio were: the change over from left hand drive to right hand drive, the change from British units of measurement to the metric system etc.

Radio in the dissemination of farm innovations

In agricultural extension work, radio is one of the most important and most effective sources of disseminating agricultural innovations in developing countries. In Nigeria, radio is next to extension agents in the transfer of agricultural technologies or research results to farmers. Some research evaluation studies determine the effectiveness of extension communication medium in disseminating information of improved farm practices to farmers in Nigeria showed that radio remains the major source of communication (NAERLS, 2010). Radio brings about widespread awareness and sustains the interest of the farmers. In Nigeria, radio programmes cover farming activities such as irrigation systems, production, processing and marketing of agricultural produce.

Television

Television, just like some other communication medium, passes both moral and immoral messages. The critical factor therefore, is how its potentials can be harnessed. Its unique characteristic of sight, sound, motion and consequent demonstrative power is a living testimony of its capacity to sensitize, convince and mobilize its audience socially, morally, psychologically, emotionally and otherwise. The attention given to television at every point of use can be understood in the direction of its attraction to all categories of audience and the reason for its abuse. Television has been regarded as a very important and powerful media for acquisition of knowledge in all spheres of life. Television has the power of sound and vision (audio visual) and these attributes make it useful in extension work, demonstrating technologies and video training (Omotayo, 2005). Documentaries on television are usually accompanied with pictures which are synchronized alongside with narration or explanation for the purpose of stimulating the audience's understanding of the message (Adebowale, 2009). Therefore, on this background, television can be relied upon as an effective communication channel through which agricultural technologies could be transferred to the farmers both at the rural and urban areas.

Newspapers

Although, most Nigeria's newspapers are biased in favour of the minority elites and literate people, this is because the language of the newspaper is of high standard and too advanced for easy comprehension of the rural farmers. But, if properly designed, formatted and packaged for rural developmental purposes, considering the educational level of the rural farmers, newspaper would be one of the most important medium to communicate improved agricultural technologies to farmers. This can be achieved by ensuring that all Nigeria's newspapers are translated into various local languages of the rural people for easy understanding. This can further be improved by specially packaging all agricultural related information into what can be called community newspaper. These community newspapers would be directed and master minded only in the rural areas and by the rural people. However, in whatever form it is made, newspaper can be used to perform advocacy role of sensitizing agricultural extension policy makers for development- friendly initiatives and decision making. Above all, it can be relied upon as an important medium of communicating agricultural ideas and improved farm practices to the rural farmers.

Information and Communication Technologies (ICTs)

There is a growing interest and excitement for the role and potential of ICTs in extension agents' development. ICTs can provide farmers' access to agricultural extension agents and agricultural information for best practices. Most ICTs in agricultural extension services are centered on mobile technologies, principally through subject matter specialists. The idea is that, because farmers will have control over the mobiles and how they choose to use ICT extension, they will be reaching out for the services they want through farmer-line. Therefore, for the achievement of any meaningful impact of agricultural development through ICT application, Michiels and Van

Crowther (2001) emphasized that appropriate application of ICT into farmers' learning programmes is imperative. They also included that the communication technologies should be channeled towards realizing their needs at hand. Where such is enhanced, the ICT would be said to contribute to reducing the digital division between rural and urban farmers at individual, group and community levels. Key improvements stem from information. Therefore, ICTs can be used for enhancing agricultural production at different value chain levels such as increase in efficiency, productivity and sustainability of small scale farms. Among others, communities and farmer organizations can be helped through the use of ICTs to strengthen their capacities and make them more responsible to their constituencies when negotiating for inputs, prices, land claims, rights and infrastructural projects. ICTs widen accessibility, in that; it enables the rural communities to interact with other stakeholders, thus reducing social isolation. Given the importance of ICT in facilitating effective and timely information delivery, it has witnessed wide application in nearly all human endeavours (Adebowale, 2009). However, in Nigeria, extension has not brought a clear picture of effective and timely information delivery services to rural farmers. If information is not timely or effectively disseminated, adoption of technology may be hampered. This may also retard farm outputs and worsen food insecurity.

Mobile Phone in Agriculture

Mobile phone plays a vital role through information supply and communication in agriculture especially in the area of marketing. The service of GSM has proven highly successful as it improves the relationship between farmers and the buyers of their produce (Arokoyo, 2005). In particular, it strengthens the farmers' role in the negotiation process, and the buyers' ability to spot the best available market opportunities. The mobile telephone has witness a meteoric rise in Africa over the past few years. It has shown the highest growth rates anywhere in the world (Farell, 2003). It is the latest development in the communication industry in which the global system of mobile telecommunication (GSM) has successfully replaced the table or desk phone especially in the third world countries. Today in Nigeria, most rural farm families and communities have access to GSM.

CONCLUSION AND RECOMMENDATIONS

It has become imperative for extension to exploit the opportunities offered by this digital age. For timely and adequate dissemination of improved agricultural technologies, effective and reliable communication techniques are required. For extension workers to however make effective use of any communication technique in extension message delivery, they certainly need to have not just a good understanding of the communication process, but also the operating procedures. It is also incumbent on them to know what role each can play in extension programmes in order to be effective and successful in extension message delivery. Hence, the following recommendations should be considered:

i. Based on the findings of the study, it is recommended that the use of radio and cell phones contacts should be given more priority since they are the most widely used by farmers.
ii. Extension agents should regularly organize workshops or seminars to sensitize farmers in the use of communication techniques.
iii. ICTs should be integrated into agricultural policies and supportive programmes
iv. Local language based-information should be mostly used while using any of the communication medium in disseminating agricultural technologies to rural farmers.
v. Adequate training and re-training of extension workers on information communication media should be accorded high priority.

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ASSESSMENT OF JOB SATISFACTION AMONG ACADEMIC STAFF OF AGRICULTURAL RESEARCH INSTITUTE IN NIGERIA: A CASE OF NATIONAL ROOT CROPS RESEARCH INSTITUTE UMUDIKE, NIGERIA

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ABSTRACT
This study was conducted to examine the effect of declining attention to research and development on employment decisions of the academic staff of National Root Crops Research Institute Umudike. This became necessary as a result of observed low morale of the research staff of the institute which has led to some of the scientist switching their service o the universities. Data used was generated from record of researchers who transferred their services to the universities. The study employed descriptive statistics to describe the data collected. The result shows that 12.8% of scientist who holds PhD has already transferred their services to universities. Most of the researchers (50%) are within the age range of 51-60yrs and the major attractions are enhanced salary packages and brighter prospects for career progression among others. Among the cause of this exodus is poor funding of research and a very narrow top in research career progression. It was therefore concluded that the exodus is most likely to continue giving the prevailing circumstance unless the government will quickly react to this by ensuring the new agricultural policy sufficiently recognize the research sector.
Keywords: Research, Scientists, Exodus, Universities, Institutes

INTRODUCTION
Job satisfaction is the level of the contentment a person feels regarding his or her job. This feeling is mainly based on an individual's perception of satisfaction. Job satisfaction can be influenced by a person's ability to complete required task; the level of communication in an origination, and the way management treats employees. Schermerhorn (1993) defines job satisfaction as an affective or emotional response towards variousaspects of an employee's work. The author emphasizes that likely causes of job satisfaction includeStatus, supervision, co-worker relationships, job content, remuneration and extrinsic rewards, promotionand physical conditions of the work environment, as well as organizational structure.Similarly, some reports have shown that job satisfaction refers to an individual's feeling or stateof mind giving heed to the nature of the individual's work. The author further explains that jobsatisfaction can be influenced by a diversity of job dimensions, inter alia, the quality of the employee'srelationship with their supervisor, the status of the physical environment in which the individual works, degree of fulfillment in work.
Some of the theories relating to job satisfaction may further illustrate the complexity of issue and help the understanding of how management may positively affect job performance through job satisfaction. Under this theory there are the big five personality attributes introduced by Goldberg (1990). These five traits include Extraversion, Neuroticism (or emotionality stability),agreeableness, conscientiousness and openness. Research has shown a strong correlation between these five factors and job satisfaction. For determining job satisfaction and job performance, Core self-evaluation theory has four facets included self esteem generalized self efficacy, locus of control and emotional stability (low neuroticism). This theory again links personality attributes and practices with motivation, job satisfaction and job performance. All three dispositional theories recognize the connection between job satisfaction, motivation and performance but focus on the attributes of the person entirely. Thus, the dispositional theory suggests that some people will be satisfied, motivated and high performing at work regardless of how poorly managed while other people will not be happy no matter how greatan organization. However, the data indicates that despite the correlation, personality can only explain less than half of the level of job satisfaction. This tells us that there are likely some elements within organizational control which can affect employee job satisfaction.
Another theory is the Hygiene Theory by Fredrick Hertzberg (1974) on job satisfaction and employee motivation which can tie the principles of the disposition theory together with the influence management has on job satisfaction, performance and motivation.) There are two factors relating to motivation in the workplace; satisfaction and Satisfiers relate to the content of the work such as "achievement, recognition for achievement, interesting work, increased work, advancement. Dissatisfiers are related to how employees are treated and include such items as "company policy and administration practices supervision,interpersonal relationships, working conditions, salary, status, and security Herzberg (1974).
If we combine this theory with the disposition theory we can more clearly see a model for job satisfaction in which some satisfaction or dissatisfaction is inherent in the nature of each individual worker, some satisfaction comes

from the content of the work and some dissatisfaction comes from the way they are treated. Managers have some influence on the level of satisfaction by fostering achievement, recognizing achievement, making the work interesting, giving employee's responsibility and providing for opportunities for growth and advancement. More importantly, managers concrete dissatisfaction with inequitable pay, poor organisational personal policies, working conditions or job security. The importance of each of these job dissatisfiers relates to the frequency it occurs and the intensity of the shortfall. In other words a policy that treats employees poorly every day is a bigger dissatisfier than a policy which treats them poorly only once per month. Moreover, the severity of the dissatisfier affects the importance of that dissatisfier. Therefore, if pay is at such a level that people cannot meet their basic needs, then pay would overshadow all other dissatisfiers and eclipse job satisfiers.

The most important demographic variable that receives huge attention in job satisfaction research is sex. A number of empirical studies on job satisfaction have suggested that female workers have lowerlevel of job satisfaction than their male counterparts because male officials dominate most of the publicorganizations.Another common demographic variable studied is educational level. Most of the researches on therelationship between education level and job satisfaction yield consistent findings. Especially Griffin,Dunbar & McGill (1978) found that workers with higher educational level would tend to be moresatisfied with their job than workers with lower educational level. The third commonly identifiedvariable in the research on demographic characteristics is age. Worker's age has been found to have a negative impact on worker's job satisfaction (Buzawa, 1984). This means that younger workers are more satisfied with their jobs than their senior counterparts.The fourth and final variable is the job assignment of a public official. Public officials have different interests, and these are sometimes satisfied on the job. However, the more public officials find that they can fulfill their interests while on the job, the more satisfied they will be with those jobs. For example, a recent study result showed that university graduates were more satisfied with their jobswhen these were consistent with their university majors than when these fell outside their fields of interest (Vandenberg & Lance, 1992).

Researchers and almost all the members of staff of the National Root Crops Research Institute had or enjoyed some level of job satisfaction. Research work were properly if not hundred percent funded. The Institute became a place where everyone wants to associate with. The environment was inviting and conducive for work. Staff welfare was adequately taken care of; Casual staff was not left out, some of the casual workers were converted to Permanent staff. Staff members in lower cadre encouraged to further their education. Promotion comes as at when due with the benefit accrued to it.

However, recent developments show that National Root Crops Research Institute Umudike became a pitiable Institute because both researchers and non-researchers started experiencing downward trends in welfare issues. The glory of the previous year's seemed to be departing. Staff salaries were slashed down, promotions comes as at when due but without benefits and no arrears in view, Causal worker were laid-off, the environment that used to be very neat has become a dumping ground. Poor funding of research work and necessary issues that enhances the growth of staff members became a common issue. This paper therefore examined the effect of declining attention to research and development on employment decisions of the academic staff of National Root Crops Research Institute Umudike.

METHODOLOGY

The study was carried out at National Root Crops Research Institute Umudike, using records of recent exodus of researchers to universities. The analysis was based on the socio economic characteristics of age, rank and remunerations of PhD holders that left the Research Institute for Universities. Data collected were analyzed with descriptive statistics.

RESULTS AND DISCUSSION

Influence of Exodus on numerical strength of PhD Holders

The result shows that 12.8% of the PhD holders in National Root Crops Research Institute left for the Universities. This is represented graphically in figure 1. This implies that these scientists were apparently no longer satisfied with the job they were doing in the institute. For these ones, switching to university is a greener pasture. This shows that one of the dissatisfiers described by Herzberg (1974) came into play. For this to happen, they must have seen either better conditions of service or brighter prospects in the universities. The implication of this is that of looming brain drain in research Institutes. Some of these scientists attribute this to the current poor remunerations and the inability to assess research funds.

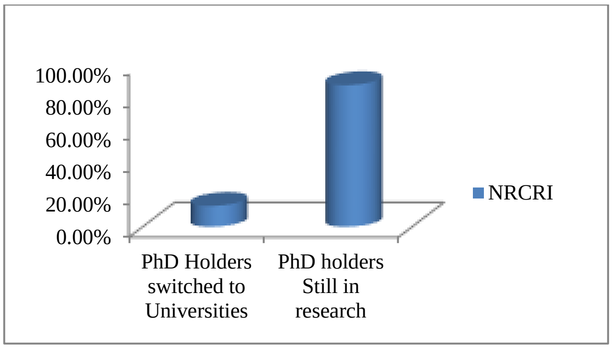

Figure 1: distribution of PhD holders switch to Universities

Exodus based on Age

The age distribution of the scientists that switched their services to universities is shown in figure 2. From the result, most of the scientists (50%) are within the age range of 51-60yrs. This means that the affected scientists are almost at the peak of their careers, which goes to suggest that they are experienced scientists. Altogether, over 80% of these scientists are above 40yrs. This means that the most active researchers are involved in this exodus, implying that the institute will require over 6yrs to replace them, and this will lead to heavy financial involvements in the midst of dwindling resources.

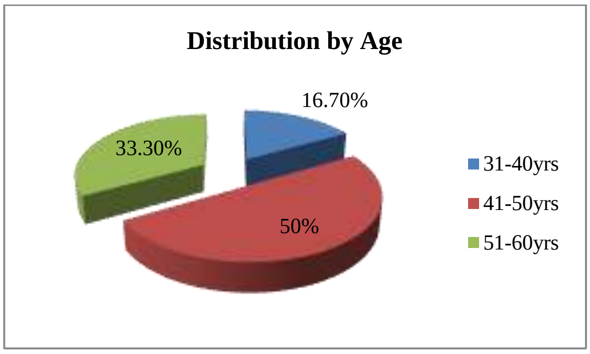

Figure 2: Distribution of scientists by Age

Exodus based on rank, position offered and remuneration

The entire affected scientists belong to the senior cadre. The result presented in table 1 shows that those involved were senior research officers, principal research officers and assistant directors. The table also shows the ranks offered to them in the university. It shows that they were offered enhanced positions with better salary packages. This could be the motivation for their decisions. Of course, labour is dynamic and skewed toward area of higher attraction in terms of remunerations.

Cause of exodus

Among the reasons for the exodus, enhanced salaries and better prospects for career progression appeared to be more prominent. This is shown in table 2. Also, 75% of the affected staff are of the opinion that the Research and development institutions in Nigeria are poorly managed.

CONCLUSION

Job satisfaction has been subject of great interest among behavioural scientists, Human research and management researchers over period of time. Number of organizational, individual, and psychological factors has been identified to enhance satisfaction level. However, these factors have been revisited time and again and job satisfaction determinants information is still inconclusive. This has led to develop a conceptual model and test it in developing country like Nigeria to assess the magnitude of different factors that might enhance job satisfaction of employee in Research Institute work setting. The current switch from research institutions to universities has serious developmental implications especially now that the Nigerian economy is begging for diversification. Technologies that will turn around the economy for good are developed in the research institutes. When researchers move to universities, their research activities and interest will also move from applied research to basic research.

Table 1: Distribution of scientists based on position offered and remunerations

Rank in NRCRI	Salary Ranges	Rank offered in University	Salary Ranges	Freq	%
Senior Research officers	₦1,460,163 - ₦2,120,427	Lecturer 1	₦1,649,508- ₦1,826,664	2	33.33
Principal Research officers	₦1,833,967 - ₦2,588,927	Senior Lecturer	₦3,091,500- ₦3,658,380	2	33.33
Assistant directors	₦3,363,134 - ₦4,452,271	Senior Lecturer /Associate Prof.	₦3,768,216- ₦4,417,068	2	33.33
Total				6	100

Table 2: Perceived causes of transfer of service to universities by researcher in NRCRI Umudike

Reason for transfer	Percentage
Better remunerations	100
Career progression/opportunities	100
Pride	10
Easy job performance	45
Poor management of R&D	75

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INFLUNENCE OF GENDER DIFFERENTIATED EDUCATION ON MANPOWER NEED FOR TEACHING VOCATIONAL AGRICULTURE IN SECONDARY SCHOOLS IN UMUAHIA NORTH LGA ABIA STATE

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ABSTRACT

The study was carried out in Umuahia North LGA of Abia State to examine the effect of gender differentiated education on the manpower need for the teaching of vocational education subjects. All the public (government owned secondary schools) in the study area were involved in the study. There were 17 public secondary schools in the LGA. Three vocational subjects, Agricultural Science, Fisheries and Animal Husbandry were studied in all the secondary schools in the LGA. There were a total of 517 teachers in the LGA of which 72 were vocational subject teachers. Secondary data was used to obtain the information needed for the study. The data was subjected to descriptive statistical analysis and chi-square. Result of the study showed that most of the vocational Agricultural teachers were females. Also males and females were not equally distributed in the different vocational subjects. As more males (54.05 per cent) were involved in the teaching of agricultural science, there were more females (90.48 percent and 64.29 per cent) in Fisheries and Animal Husbandry respectively. Chi-square analysis was used to determine the level of difference in male and female participation in the teaching of vocational subjects showed that there was no significant difference between the number of male and female vocational subject teachers as the table X^2 (7.82) was more than the calculated X^2 (4.5) at 0.05% confidence level and 3 degree of freedom.

Keywords: Manpower, Education, Gender, Vocational, Teaching

INTRODUTION

Formal education which takes place within the enclosure of a school started in Nigeria during the colonial period especially through the missionaries. The major aim of education as purveyed by the colonial administrators and missionaries was to produce teachers for the missions as well as low level manpower especially interpreters for the administrators. To this end the 3 'R' subjects (reading, arithmetic and writing) occupied major parts of the school syllabus. Schools commonly known as the grammar schools were established to prepare students for the General Certificate of Education at the ordinary level. The grammar schools were fashioned in such a way that they did not accommodate subjects that will expose the learners to technical skills. Most of the youths who passed through the secondary grammar schools were grossly deficient. The educational dispensation which the colonial masters set up was criticized on several grounds. The neglect of vocational education in that system was a major criticism. At the political independence of Nigeria, there was a realization that the type of education inherited from our colonial masters needed a critical re-examination of the worth: of content, objectives, relevance, methods, administration, evaluation, and so forth. This according to Ezeobata (2007) brought a national aspiration that gave birth to a new educational system of education commonly referred to as the '6-3-3-4' system of education. Among other innovations, the system provided for pre-vocational and vocational curricular offerings at the junior and senior secondary schools respectively. For the first time in the history of education in Nigeria, vocational and technical education subjects were, as a matter of national policy, to be offered side-by-side, and hopefully, enjoy parity in esteem with the more academic courses hitherto run by the secondary grammar schools under the old colonial-based system of education (Elebe, 2011). The vocational education curriculum was aimed at helping the secondary school leavers to imbibe technical skills that would prepare them for non academic and civil work after school.

Vocational education is that aspect of education that gives its recipients an opportunity to acquire practical skills as well as some basic scientific knowledge. Oni (2007) defined vocational education as that type of education, which fits the individual for gainful employment in recognized occupation as semi-skilled workers or technicians or sub-professionals. Vocational education could be regarded as that aspect of education, which provides the recipients with the basic knowledge and practical skills needed for entry into the world of work as employees or as self-employed (Oni 2007). Vocational education therefore nurtures skills that are necessary for agricultural, industrial, commercial and economic development and thus builds a self-reliant nation. According to her two of the aims of vocational education as stated in the Nigerian National Policy on Education (1981) are to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant; and to enable Nigerian young men and women to have an intelligent understanding of the increasing complexity of technology.

The importance of teachers in the achievement of the objectives of vocational education in Nigeria cannot be over stressed. This is because teachers interpret the curriculum content and transfer the needed technical knowledge and skill to the students. Specifically, teachers have been referred to by Oyedeji (1998) as an agent of innovation. The development of the teacher as a necessary manpower for the development of vocational education is very vital. Laboratories, equipment, instructional materials, infrastructural facilities, studio and even the workshop may be available in abundance but without the trained manpower that will man these facilities, learning cannot take place. According to the National Policy on Education (FRN, 2004), no education system may rise above the quality of its teachers. Therefore, manpower development in science education is paramount to sustainable development. Manpower development according to Ogbaunya and Usoro (2009) is a process of improvement that embraces all those activities that are geared towards the growth and improvement of skills, knowledge and attitude of personnel. A teacher who is not currently in tune with modern trend is a danger to the system. Staff development in terms of continuing education appears rather very poor, haphazard, politicized and lack continuity. Dryaklor (1994) asserted that teachers need to be retrained two to six times in lifetime to keep abreast with changes in his profession. The initial attempt by the Federal Government of Nigeria to retrain teachers for the implementation of the vocational education curriculum was a failure because such teachers were swallowed by the brain drain syndrome as they never came back and even those that came back settled on for other jobs that are taught to be greener pastures rather than the teaching profession.

Aside the problem of shortage of teachers for the teaching of vocational education subjects, there also seem to be a level of gender stereotype in the choice of specific vocational subjects. Despite the uncountable contributions of vocational education to national development, social malaise of gender dichotomy is most often discovered in the participation of people in the teaching and learning of the vocational subjects. This has tremendous effects on the quality and quantity of teachers teaching the vocational science subjects in Nigerian Secondary Schools.

In developing countries of Africa, most crucial to any education that involves manual labour is a favourable attitude. Factors such as cultural tradition, early childhood socialization, parental expectations, the actual handwork involved in manual labour, the reward that go with it, the behaviour and attitude of teachers, and as well influence the attitude the children towards acquiring the vocational subjects. This paper analysed the influence of gender differentiated education on the choice of any vocational education subjects as a teaching subject.

METHOOLOGY

The study was carried out in Umuahia North Local Government Area of Abia State. Survey design was used for the study. Abia State is in the South East geopolitical zone of Nigeria. All the public secondary schools in the Local Government Area were involved in the study. There were seventeen (17) of such public secondary schools in the study area. Three vocational subjects that were commonly studied in all the schools in the LGA were Agricultural Science, fishery and animal husbandry. There were five hundred and seventeen (517) teachers in the public secondary schools in LGA of which seventy two (72) of them were vocational subject teachers. Secondary data was used for the study. The secondary data which included annual returns from schools, school nominal rolls and other books were collected from the statistical unit of the Abia State Secondary Education Management Board (SEMB). Data collected from the study was analysed using simple descriptive statistical tools and the chi-square.

RESULTS AND DISCUSSION

Table 1 shows the distribution of the vocational education teachers in Umuahia North LGA according to their gender. According to the table, 62.50 percent of the teachers of vocational education in the study area were females while 37.50 percent were males. This gives a ratio of approximately two female teachers to one male teacher (2:1). Analyses of the gender of vocational education teachers in Umuahia North LGA show that there were more female teachers teaching vocational education than male teachers in the Local Government Area. The result is indication that both gender (males and females) are involved in the teaching of the vocational subjects. The more number of females than males participating in the teaching of vocational subjects is a proof that there is a twist of events from the hitherto held assumptions that the males are more involved in the vocational and technical education subjects than the females (Jones and Dindia, 2004). The more number of female teachers that are involved in the teaching of the vocational subjects however may be an indication that even in subject areas as important as the vocational sciences the endemic problem of male exodus from the teaching profession still persist (Adeyemo, 2010).

Table 2 is a distribution of the teachers according to their gender and area of specialisation. The table shows that 51.39 percent of the teachers of vocational subjects in the study area were in Agricultural Science. However 54.05 percent of them were males while 45.95 percent were females. Those that had Fisheries as their area of specialisation and teaching subject accounted for 29.17 percent of the population of which majority (90.88

percent) were females thus male teachers in the subject area accounted for only 9.52 per cent. Also the table shows that of all the teachers of vocational education, 19.44 percent of them were teaching Animal Husbandry of which 64.29 per cent of them were females while 35.71 per cent were males. The result showed a level skewed distribution of the manpower for the teaching of the vocational, as more of the men opt for and teach agricultural science which is often taught to be more tedious, laborious and tasking .

That more men than women opting for agricultural science as a teaching subject is suggestive that the bias and phobia which women have against the study of agriculture and the practical work associated with it still lasts. The result further agrees with the assertion that ordinarily female students tend to have preference for the Art subjects and such vocational areas as Home Economics while the males are found in the Sciences and the Science related subjects such as Agricultural science, Biology, Chemistry, Physics, Mathematics and the Engineering courses while the females are found in the Languages, Humanities and the Arts (Ikeoji, Agwubike and Disi, 2007).

Table 3 is a Chi-square analysis to determine if there is a statistical difference in the number of male and female teachers of vocational education subjects in the study area. The result shows that at 5 percent confidence level and degree of freedom 0.05, the calculated Chi- Square (4.5) is less than the table Chi- Square (7.82). The null hypothesis that there is no significant difference in the number of male and female teachers of vocational education is accepted while the alternative hypothesis is rejected.

Although numerically there were more female teachers than male teachers of vocational education subjects in the secondary schools in Umuahia North LGA of Abia State, but the differences in the number was not significant as to have undue impact on teaching and learning of the vocational subjects in the study area. The result however shows a shift from the status quo where there was the dominance of males over females in the field of science and vocational technical subjects (Hays and Farhar 2002). The result perhaps is an indication that the gender gap that exist between the males and females in the study of vocational technical subjects is being closed to the extent that at least more women than men are getting involved in the teaching of the vocational sciences.

CONCLUSION

The role of vocational education in the entrepreneurial, social and overall economic development as well technological advancement of Nigerian and other developing countries of Africa cannot be over emphasized. Thus vocational technical education should to a great extent be regarded as the hob of technological and industrial development of any nation. No matter the state of the art equipment imported for the teaching of the vocational education subjects, without well grounded teachers, the expected result will not be feasible. In Nigeria nay Africa however the choice of specific vocational subjects as teaching subjects of specialisation is stereotyped along gender lines. This ultimately will affect the quality of output of schools that offer the vocational courses as subjects of study in the secondary schools. Concerted efforts should be made to address the skewed participation of males and females in the teaching of these important subjects as indirectly some vocational areas have been labelled as women's area while others should be left for the men. To heave this burden the government and other bodies involved in the education of the child should articulate and implement programmes that will disabused people's mind of the age long assumption that certain academic responsibilities are for a certain gender while others should be left for the other.

Table 1: Distribution of Vocational Education Teachers in Umuahia North LGA According to Gender

Gender	Frequency	Percentage
Male	27	37.50
Female	45	62.50
Total	**72**	**100.00**

Source: SEMB 2013

Table 2: Distribution of the Vocational Education Teachers According to their Gender and Subject Specialization

S/No	Subject	Males		Females		Ratio	Total	
		Frequency	%stage	Frequency	%stage		Freq.	%stage
1	Agricultural Science	20	54.05	17	45.95	**1:1**	**37**	**51.39**
2	Fisheries	2	9.52	19	90.48	**0:21**	**21**	**29.17**
3	Animal Husbandry	5	35.71	9	64.29	**1:6**	**14**	**19.44**

Source: SEMB 2015

Table 3: Chi-Square Analysis of the Differences in the Number of Male and Female Teachers of Vocational Subjects in Umuahia North LGA

Variables	O	E	E-O	$\frac{(E-O)^2}{E}$
Male	27	36	-9	2.25
Female	45	36	9	2.25
Total	**72**	**72**		**4.5**

Source: SEMB 2013
Calculated Chi Square— 4.5
Table Chi-Square--- 7.82
Degree Freedom 3
Confidence Level 0.05

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ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME VII:

ICT, AGRICULTURAL DEVELOPMENT PROCESS & CONSULTANCY

ASSESSMENT OF INFORMATION SERVICES IN ADDRESSING CHALLENGES FACING POOR RESOURCE FARMERS IN THE NORTHERN GUINEA SAVANNA OF NIGERIA

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ABSTRACT
The assessment of information services in addressing challenges facing poor resource farmer in the Northern Guinea Savanna of Nigeria was conducted in the adopted villages of NAERLS, Ahmadu Bellow University, Zaria. Survey method was adopted for the study using stratified random sampling technique for selecting the respondents. Structure questionnaire was used in collecting data which was administered to small holder farmers in the Sakadadi (150 respondents) and Tudun-Iya (150 respondents) of NAERLS adopted villages respectively. Data collected were analyzed using descriptive statistical tool. Findings reveal that the extension services provided had enhanced welfare (30.0 %) and economic growth (25.5 %) of the small holder farmers compared to their welfare before the villages were adopted by NAERLS. Therefore, the study recommended the employment of profession to assist extension agents in information delivery and use of modern information machineries to enhance access to information in the study area.
Keywords: Information service, poor resource farmers, challenges, welfare, economic growth,

INTRODUCTION
Information service is an important and powerful commodity in any human community especially farming community. Information services are the key ingredient to accomplish the potentials of people at the grassroots, re-align their thought processes and mobilize them for their welfare and economic growth, environmental activities, which will in turn increase the standard of small holder farmers. According to Opara (2014), certain characteristics of information services make it a critical development resource. These are its ability to act as a dynamic force that drives the recipients to action; extend the knowledge base of its recipient; increase and broaden the perceptions of its users or recipients; enhance their competencies through the knowledge and skills they gain; improve their self-esteem; and also its ability to be regenerative and versatile. Evidence has shown that small holder farmers need unhindered access to information services to make informed decision-making especially agricultural production (Issa and Salman, 2012).
In addition to information services on agricultural production, small holder farmers require accurate and reliable information services on health, economic and social issues. Unfortunately, rural people who are in majority lacks access to information services necessary for their improved welfare and increased productivity. According to Egbe (2014) the main features of small holder farmers are depression, degradation and deprivation due to low and unreliable information exchange which hinders their agricultural productivity. As a result, any rural villages are immersed in poverty and food insecurity. Therefore, information service is necessary to lift them out of poverty and improve agricultural production. This implies that small holder farmers' welfare and economic growth is dependent on the availability and access to information for effective decision making. This study sought to assess whether information services have improve small holder farmers welfare and economic growth through agricultural production in NAERLS adopted villages.

MATERIALS AND METHODS
The study was conducted at two Adopted villages (Sakadadi and TudunIya) of the National Agricultural Extension and Research Liaison Services (NAERLS), Zaria, Nigeria. The sites were located at Sakadadi in Sabon Gari Local Government Area of Kaduna State and TudunIya in Futua Local Government Areas of Katsina State. They were located within longitudes (11º 23' N) and latitudes (7º 22' E) for TudunIya adopted village and longitudes (11º 11' N) and latitudes (7º 43' E) for Sakadadi adopted village. The study areas have a mean temperature of 21.05ºC (minimum), 33.47ºC (maximum), and relative humidity of 55.23 %. The annual rainfall was 1100 mm which distributed between May to October and a mono-modal rainfall pattern. The main soil sub-group is TypicHaplustalf which was derived from Pre-Cambrian Crystalline basement complex rocks with some quanternary aeolian deposits (Malgwi *et al*., 2009). The soils of the study areas were generally slightly or mildly acidic, less leached soils and low to medium in fertility (Odunze, 2006). The vegetation in the study areas is dominated by few of fire-tended and fire-tolerant trees with an understory of shrubs and more of grasses. Farming constitutes the major socioeconomic activity of the study locations.

This work employed the use survey method. In order to achieve the objectives of this study, three hundred and twenty research questions were formulated. Out of the three hundred and twenty research questions formulated; one hundred and sixty each were administered to the two communities. The instrument used for collecting data was questionnaire which was administered to three hundred respondents that were purposively selected for this study because of scatter nature of the small holder farmers' settlement and difference in occupation. The data collected was analyzed based on four (4) point rating scale using frequency and percentage. The options were; Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD)

RESULTS AND DISCUSSION

Percentage of information services available

The result on information services available to the NAERLS adopted villages dwellers is presented in Table 1. The result shows that orientation/instruction services is the major information available to small-holder farmers (41% Sakadadi and 44 % Tudun-Iya). Others are current awareness service (33 % for both adopted villages) while referral services is the least service. This result implies that orientation/instruction services and film show enhance the welfare economic growth of the rural dwellers in both adopted villages than other information services because they are presented in the format that farmers appreciates. This also suggested that the main purpose of information services in any rural settlement is to provide relevant and pertinent information desired to improve rural welfare and economic growth. This result is in line with the view of Igwe and Onah (2013), who opined that dissemination of useful agricultural information to farmers in developing countries has not been effective due in part to weak information services and presentation in a way that farmers will understand them.

Use of Information Services for Poor Resource farmer

Result of Table 2 shows that majority of the respondents (34% and 36%) makes effective use of information service (orientation/instruction services) for providing basic techniques to farmers on how to improve in their farming system, also enhance their knowledge in agronomic practices for arable crops production and welfare in both locations. Whereas, film show and referral services as a means of providing information services to the farmers least contributes to the welfare and economic growth of the rural dwellers especially Tudun-Iya adopted village. By implication, this shows that the films show and referral service were not satisfactory due to inadequate facilitates and service provision. Harande (2009) observes that "the rural populace suffers from acute low productivity, social and economic retrogression due mainly to ignorance which is also a direct consequence of either inadequate or total lack of information provision to them". Information services that will greatly enhance their productivity, transform their community into a lively and enlightened one, and empower their economic base, may not effective and relevant, if the information services are not fashioned towards their set objectives.

Challenges in Information Services Delivery for poor resource farmers

Table 3 shows the challenges in information service delivery for improving rural welfare and economic growth of the adopted villages. The results indicated that majority of the respondents agreed that there is no information center and inadequate facilities for information services delivery in both villages. Whereas, the data also shows that 30 % of the respondents disagreed that the information provider find it difficult in reaching out to the farmers because of poor road but from the rating it shows a kind of laxity on the part of information provider. Similar, observation was found in both locations in terms of difficulty in gathering the rural dwellers in a place for information services delivering. The result revealed that the majority of the respondents agreed that the challenges militate against information services delivery due to illiteracy and inadequate facilities. Nchuchucwe and Adejuwon, (2012) reported that the condition of rural dwellers in Nigeria and indeed in the developing countries is pathetic; traces of abject poverty and discomfort can be seen conspicuously. These are evidence of poor information service delivery due to some challenges like acute shortage or absence of social amenities and essential commodities that will make the life of rural dwellers bearable. This could explain why rural dwellers adopt "rural-urban drift" as an alternative and solution to this terrible condition.

CONCLUSION

Effective information service delivery and coordination as well as adequate infrastructures are the essential ingredient for improving the agricultural production of the poor resource farmers. Information service in Nigeria's rural communities must be recognized and empowered. The paper concludes that information service enhanced the welfare and economic growth of the poor resource farmers in the NAERLS adopted villages. On the strength of the findings, the study recommended that information professional should be employ to assist the extension workers in information delivery in the rural areas because they are capable of identifying the types of information that would be good to rural dwellers. In addition, there should be consistent training using modern information technology and effective implementation of information service policy.

Table 1: Percentage of information services available

S/N	Information services	SA	A	D	SD
			Sakadadi adopted village		
1	Current Awareness Services	27(18%)	50(33%)	40(27%)	33(22%)
2.	Exhibition Services	38(25%)	42(28%)	38(25%)	32(21%)
3.	Film show	36(24%)	40(27%)	36(24%)	37(25%)
4.	Orientation/Instruction Services	42(30%)	62(41%)	20(13%)	26(17 %)
5	Referral services	22(15%)	34(23%)	51(34%)	43(29 %)
			Tudun-Iya adopted village		
1.	Current Awareness Services	30(20%)	49(33%)	38(25%)	33(22%)
2.	Exhibition Services	30(20.7%)	40(27%)	42(28%)	38(25%)
3.	Film show	42(28%)	44(29%)	35(23%)	30(20%)
4.	Orientation/Instruction Services	43(29%)	66(44 %)	25(17%)	16(11%)
5	Referral services	22(15%)	38(25 %)	50(33 %)	40(27 %)

Source: Field survey, 2015

Table 2: Use of Information Services for Poor Resource farmer in NAERLS Adopted Villages

S/N	Use of Information Services	SA (%)	A (%)	D (%)	SD (%)
				Sakadadi adopted village	
1.	Current awareness services enhance farmers knowledge on new technology like seed production and agronomic practices	45(30)	40(27)	35(23)	30(20)
2.	Exhibition service showcase facilities for farming and improve practices	29(19)	41(27)	60(40)	20(13)
3.	Film show services demonstrate new technology and welfare	30(20)	47(31)	37(25)	36(24)
4.	Orientation/Instruction Services provides bases for farming, processing, utilization, marketing and welfare services	51(34)	43(29)	36(24)	20(13)
5.	Referral services link rural dwellers financial institution, agro dealers and welfare services	39(26)	41(27)	48(32)	22(15)
			Tudun-Iya adopted village		
1.	C Current awareness services enhance farmers knowledge on new technology like seed production and agronomic practices	46(31)	43(29)	31(21)	20(13)
2.	Exhibition service showcase facilities for farming and improve practices	40(27)	44(29)	53(35)	13(9)
3.	Film show services demonstrate new technology and welfare	22(15)	34(23)	48(32)	46(31)
4.	Orientation/Instruction Services provides bases for farming, processing, utilization, marketing and welfare services	54(36)	46(32)	36(24)	14(9)
5.	Referral services link rural dwellers financial institution, agro dealers and welfare services	37(25)	45(30)	44(29)	24(16)

Source: Field survey, 2015

Table 3: Challenges in Information Services Delivery for poor resource farmers in NAERLS Adopted Villages.

S/N	Challenges in Information Services Delivery	SA (%)	A (%)	D (%)	SD (%)
			Sakadadi adopted village		
1.	Most of the rural dwellers are slow in adopting to changes	38(25)	48(32)	39(19)	25(17
2.	The information provider find it difficult to get to the farmers because of poor road	36(24)	38(25)	45(30)	31(21)
3.	There is no information center in the villages which will enable information provider to provide information	55(37)	62(41)	23(15)	10(7)
4.	Inadequate facilities for information services delivery	46(31)	51(30.3)	30(34)	23(13)
5.	It is difficult to get the rural dwellers together in a place for information services	20(13)	26(17)	56(37)	48(32)
			Tudun-Iya adopted village		
1.	Most of the rural dwellers are illiterate and hardly care for information provided	36(24)	52(31)	36(24)	26(17)
2.	The information provider find it difficult to get to the farmers because of poor road	25(17)	28(19)	57(38)	60(40)
3.	There is no information center in the villages which will enable information provider to provide information	50(33)	62(41)	18(12)	20(13)
4.	Inadequate facilities for information services delivery	44(29)	51(34)	29(19)	26(17)
5.	It is difficult to get the rural dwellers together in a place for information services	39(19)	45(30)	38(25)	28(19)

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DETERMINANTS OF USE OF INFORMATION COMMUNICATION TECHNOLOGIES IN FAMILY FARMING IN SOUTH EAST AGRICULTURAL ZONE, NIGERIA

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ABSTRACT
The study investigated determinants of Information Communication Technologies (ICTs) among rural farm families in south east agro ecological zone, Nigeria. It examined the socio economic characteristics of the respondents, analyzed their access to ICTs use and its determinants. Multi stage sampling technique was used in selecting a total of 240 respondents. Data were collected through interview schedule and analyzed with inferential statistics. Results indicated that the ICTs accessible in the study area were GSM phones (M=2.81) and Radio (M=2.64). in addition, result further revealed that the gender, age, education, income, extension contact, affordability farming experience and household size were the major determinants of the use of ICTs among respondents in the study area. Therefore, the study recommends that ICTs should be made accessible to them to source agricultural information easily. When this is done, it will enhance their productivity and arrest food insecurity in the society.
Keywords: Rural households, ICTs and farming families.

INTRODUCTION
Agricultural growth is essential for fostering economic development and feeding growing populations in less developed countries like Nigeria. The increasing prospect of agriculture in the face of increasing population and economic situation have continue to encourage interest in family farming as a livelihood option among many Nigerians. FAO (2014) defined family farming as a means of organizing, agricultural forestry, fisheries, pastoral, aquaculture production which is managed and operated by family and relied on family labour including men's and women's. Unfortunately, most family farming does not maximize the benefit of their investment due to lack of or poor access to information on the farming methods, quantity and quality of produce traded, commodity and input prices and credit sources which results in opportunistic behaviour by traders, input dealers etc. In the absence of infrastructure, family farming face problem of adverse selection that limit the performance of agricultural commodity and input markets.

In south east agricultural zone, family farming constitutes of the majority of farming community. Most of them produces small marketable surplus and are geographically dispersed. Market access is one of the most important factors influencing family farming in Nigeria. Access to new and better paying markets for agricultural products is vital in enhancing and diversifying the livelihood of subsistence farmers. In the absence of information, small holder producers face adverse selection that limit performance of agricultural commodity and input markets and in turn the participation of subsistence farmers in these market. Information and Communication Technology offer the ability to increase the amount of information provided to all participants in the agricultural sector and decrease the cost of disseminating the information (Kurtenbach and Thompson 2000). ICT in the agricultural sector facilitates knowledge sharing within and among a variety of agricultural networks including researchers, exporters, extension services, traders and farmers. The use of ICT can progressively reduce the costs of managing information, enabling individuals and organizations to undertake information related tasks much more efficiently and to introduce innovations in products, process and organizational structure in agricultural sector in Nigeria. However, it reveals a certain number of disparities among subsistence farmers according to their socio economic situations, gender and other factors associated with ICT use in agriculture will enable the development of strategies to promote ICT use and increase the effectiveness and efficiency of information use in agricultural sector (Yekinni and Olaniyi 2007). This justified the objectives of this paper which consists of investigating the determinants of ICT use by subsistence farmers in south east agricultural zone, Nigeria.

METHODOLOGY
The study area was south east agro ecological zone of Nigeria. The south east zone is located within the longitude $5^{0}25^{E}$ and $8^{0}51^{E}$ and latitude $4^{0}20^{1}$N and $7^{0}25^{1}$N. It is bounded in the west by the river Niger, in the south by Atlantic Ocean and in the north by Kogi and Benue states. The zone occupies a lead area of about 109.524sqKm representing 11.86% of the total land of Nigeria (Ekong 2008). The region supports a wide variety of agricultural production such as crops, agroforestry and livestock.

Multi stage sampling procedure was used in selecting 2 states from the zone (Enugu and Ebonyi states). Ebonyi state is made up of three agricultural zones namely Ebonyi north, Ebonyi central and Ebonyi south while Enugu state is made up of Enugu, Agwu and Nsukka zone respectively. From each zone, 1 local government area was randomly selected, followed by a selection of 1 block and 2 cells from each LGAs and a random selection of 20 farm families from each cell in each state, thereby bringing the total number to 240 respondents. Data were collected with the use of interview schedule and later analyzed with descriptive and inferential statistics like multiple regression.

The explicit form is expressed below

$Y=f(X_1, X_2, X3, X4, X_5, X_6, X_7, X_8+e)$
Where
Y= dependent variable (use of ICT among farm families
And $X_1 - X_7$ (Independent variables)
X_1= Gender (male 1, female 0)
X_2= Age (measured in years as supplied by the respondents)
X_3= Income (measured in naira for major occupational respondents)
X_4= Educational level (number of years of formal education of respondents)
X_6= Extension contact (number of times visited by extension agent in a year)
X_7= Farming experience (measured in years)
X_8= Household size (number of people living with the respondents)
e= error term

RESULTS AND DISCUSSION

Table 1 shows that the coefficient of gender $(0.0018)^{xx}$ had a postive and significant relationship with ICT use at 5% level. This implies that gender has direct influence on the use of ICTs in family farming. The coefficient of age $(0.003)^{xxx}$ was positive and significantly related to use of ICTs at 1% level of probability. This implies that as farmers age increases the use of ICTs in farming increases. This result is not in consonance with the findings of (Ahmad, 2010; Adeniyi, 2007) who reported that younger age adopts innovations more rapidly than older ones. Coefficient of income $(0.000)^{xxx}$ was postive and significantly related to ICT use in family farming. This is in line with findings of Obey (1995) who reported that gross income the amount of influenced adoption ability of farmers to adopt new farm practices depends on their financial position. The implication is that the higher the income, the more likely the respondents may seek more information on better practices to improve their farming activities. The result also revealed that educational level has a positive coefficient of $(0.000)^{xxx}$ at 1% level of probability. This implies that farm families with well educated members are more likely to use ICTs in accessing agricultural information than those who are not. This finding is in line with (Akuchugu *et al* 2012) who found out that in Ghana the maximum level of education within the farm household was found to have positive relationship with the probability of adoption and significant at 1%. In contrast, Auta *et al* (1992) found out that there was no significant difference between literate and non-literate farmers in their adoption behaviour. Also extension contact $(0.000)^{xxx}$ was positive and significantly related to ICT use. This implies that the higher the number of extension contact to the farmers the higher the level of use of recommended practices. But if the extension contact is low, the use of ICT become necessary. Affordability of ICT $(0.000)^{xxx}$ was positive and significantly related to ICT use at 1% level of probability. This revealed that the lower the cost of ICT to farm families the higher the use in sourcing agricultural information. This research finding is in line with Ojo (2009) who found that a positive contribution of technology affordability to adoption of recommended cassava production practices. Farming experience $(0.002)^{xx}$ has a positive and significant relationship with ICT use in sourcing agricultural messages. Farm families with high farming experience adopt recommended practices more than the inexperience farmers do.

The coefficient of multiple determination, F-value shows proportion of the variation explained by the model which gave a value of 0.0885 as per the R-square adjusted value. This implies that there is an existing relationship between Y variable and other X variables, where 85 % of the variables observed was explained by the model, while the remaining 15 % was accounted by the error term. Therefore, the model is fit for study.

CONCLUSION

From the findings ICTs present farm families with opportunity to reach a wider audience therefore ICT intervention such as provision of an accessible rural pay phone can play a significant role in enhancing the ability of poor rural farm families to contribute to national agricultural production and post-harvest activities.

Hence, it is recommended that there should be more effort in order to bring ICT nearer to farm families, and also facilities to ease of use of ICT device and facilities.

Table 1: Determinants of the use of ICTs in family farming

Variables	Linear	Exponential	Semi Log	Double Log
(Constant)	.543 (0.594)	-1.178 (0.254)	3.943 (0.001)	3.745 ($0.001)^{xxx}$
Gender	2.603 $(0.018)^{xx}$	2.603 $(0.018)^{xx}$	1.956 (0.066)	1.956 (0.066)
Age	-1.555 ($0.003)^{xxx}$	-1.555 $(0.003)^{xxx}$	-3.232 ($0.005)^{xxx}$	-3.232 ($0.005)^{xxx}$
Income	6.386 ($0.000)^{xxx}$	6.386 $(0.000)^{xxx}$	5.145 ($0.000)^{xxx}$	5.145 ($0.000)^{xxx}$
Educational level	-6.639 ($0.000)^{xxx}$	-6.639 $(0.000)^{xxx}$	-4.608 ($0.000)^{xxx}$	-4.608 ($0.000)^{xxx}$
Extension contact	2.328 $(0.032)^{xx}$	2.328 $(0.032)^{xx}$	2.589 $(0.019)^{xx}$	2.589 $(0.019)^{xx}$
Affordability	10.030 ($0.000)^{xxx}$	10.030 $(0.000)^{xxx}$	5.939 ($0.000)^{xxx}$	5.939 ($0.000)^{xxx}$
Farming experience	3.689 ($0.002)^{xxx}$	3.689 $(0.002)^{xxx}$	4.331 ($0.000)^{xxx}$	4.331 ($0.000)^{xxx}$
Household size	7.389 ($0.000)^{xxx}$	7.389 $(0.000)^{xxx}$	4.189 ($0.001)^{xxx}$	4.189 ($0.001)^{xxx}$
Extension visit	3.813 ($0.001)^{xxx}$	3.813 $(0.001)^{xxx}$	4.899 ($0.000)^{xxx}$	4.899 ($0.000)^{xxx}$
R^2	0.885	0.885	0.756	0.756
R^{-2}	0.827	0.827	0.635	0.635
F ratio	15.387 (0.000)	15.387 (0.000)	6.213 ($0.000)^{xxx}$	6.213 ($0.000)^{xxx}$

Source: Field survey 2015

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DETERMINANTS OF FERTILIZER USE INTENSITY AMONG SELECTED ARABLE CROP FARMERS IN IKWUANO LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

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ABSTRACT

The study analyzed determinants of fertilizer use intensity among arable crop farmers in Ikwuano Local Government Area of Abia State, Nigeria. Primary data were obtained from 80 arable crop farmers randomly sampled from 8 villages in the study area. Descriptive statistics and multivariate linear regression analysis were used to analyze data collected. The result showed that the fertilizer use in the study area was moderately high due to enormous demand on the limited land in the study area. Age, gender, educational level, household size and price of fertilizer were the significant factors that influenced fertilizer use intensity among the arable crop farmers. The study recommends that government and policy makers should invest on increased knowledge and skill of farmers through avenues such as field days, extension agents contact with farmers or any other capacity building mechanism. Rural credit should be emphasized in order to mobilize savings and maximize the availability of credit to the farmer and to facilitate the distribution and uses of fertilizers, the agro-services centers should be opened in the rural areas. In addition, mechanism should be put in place to ensure that the subsidized fertilizer reaches the right target at the subsidized price. Fertilizer records at state and local government level over the years could be scrutinized to ensure and instill a sense of accountability and determine the true fertilizer situation at the levels.

Keywords: ***socioeconomic, fertilizer, use intensity, arable crop farmers***

INTRODUCTION

Soil, which is the top most part of the earth, is an essential resource for mankind particularly agricultural, whose activities are carried out intensively on soil. The level of crop yield depends largely on the fertility of a given soil. According to Oguwole *et al.*, (2002), the inability to incorporate soil improvement technique into farming practices degrade the soil. It does not only frustrate efforts at achieving higher productivity but also undermine the carrying capacity of the environment to sustain the welfare of humans. It is obvious that environmental sustainability and sustainable agriculture brings about wellbeing of the people, particularly the rural dwellers whose basic survival are hinged upon by environmental dynamics. The environment in its various conceptualization includes the social, physical, economic, political and policy environment (Adebayor, 2006). As a matter of fact, this environmental component has impact on the welfare of resource-poor rural farmers, consistent depletion of soil nutrients in several rural farming communities has prompted the unavoidable reliance on chemical fertilizers in order to sustain crop production. The use of chemical fertilizers have made significant contribution to increase production largely. Akpoko, (2004) noted that traditional bush fallow system as well as inaccessibility to other soil improvement techniques like organic manure, mulching, zero tillage, minimum tillage have been sustainable hence make the use of organic fertilizer popular. Although organic fertilizer has impacted greatly on crop yield and enjoys wide spread among farmers, inorganic fertilizer has become a major source of soil nutrient improvement for many farmers, but its high cost made it inaccessible to arable crop farmers. These has resulted to low level of production among framers. Halley (1992) had noted that many Nigerian soils have no sufficient qualities of nutrient necessary for high yield in crops. Therefore, fertilizers are the key to rapid improvement in agricultural production and productivity (Husain, 1987).

In recent times, there is an increased awareness of the use of chemical fertilizers in order to augment for the depleted soil nutrients and sustain soil fertility for crop yield. This has led government to increase budgetary commitment to fertilizer procurement. However, procurement of chemical (organic fertilizer) by government is just a subset of the fertilizer-rural farmer-livelihood matrix. Accessibility of rural farmers to the procured fertilizer is the most important issue. Okoji and Ayichi, (2000) opined that the major bottlenecks to fertilizer accessibility are inadequate physical infrastructure, absence of well-organized rural institutions to handle input-distribution, political interference, fraudulent practices by staff of ministry and local government directly involved in fertilizer distribution and delay in procurement due to cumbersome procedure and bureaucratic process in decision making. These have affected the availability and usage of chemical fertilizers. Hence the main objective of the study was to examine fertilizer use intensity among arable crop farmers in Ikwuano Local Government Area of Abia state, Nigeria, using the fertilizer use intensity (FUI) adopted from Maingwa *et al*. (2007) and Olayide *et al*. (2009), estimate the determinants of fertilizer use intensity.

METHODOLOGY

The study was conducted in Ikwuano LGA of Abia State, Nigeria. The main occupation of the people is farming. The major crops cultivated are cassava, melon, yam, maize, rice vegetables and cocoa which is an important cash crop. A simple random sampling technique was used to select 8 communities from the LGA. Thereafter 10 respondents each were selected randomly from the 8 communities to give a total of 80 arable crop farmers for the study. The arable crop farmers in the study area cultivate the following crops either solely or mixed cropping; cassava, maize, fluted pumpkin, okra, pepper, green, water leaf and yam. In specific terms, three objectives were realized. Objective 1 on the socio-economics was realized using percentages and tables. Objective 2 on the fertilizer use intensity was achieved using the fertilizer use intensity (FUI) adopted from Maiangwa (2007) and Olayide (2009) stated thus

$$FUI = \frac{\text{Quantity of fertility used by the farmer measured in Kg}}{\text{Area of land cultivated by the farmer measured in hectare}}$$

Objective 3 on the determinants of fertilizer used intensity was realized using multivariate linear regression analysis. The model is stated thus

$$FUI = B_1Age + B_2GEN + B_3EDU + B_4HHS + B_5LANS + B_6PRD + B_7OUT + B_8PANI + U_i$$

Where FUI = Fertilizer use intensity, X_iAGE = Age of farmers (in years), X_2GEN = Gender of a farmer (1 = male, 0= female), X_3EDU = level of education (years), X_4HHS = Household size of farmers, X_5LAN = Land size cultivated by farmers (in hectares), X_6PRD = Perceived price of fertilizer by farmers (1 = high price, 0 = low price), X_7OUT = Output of fertilizer (in Naira (₦)), X_8PANI = Poultry owner (1 = owned poultry enterprise, 0 = otherwise) and U = error term

RESULTS AND DISCUSSION

Socioeconomics characteristics of the fertilizer users in the study area

Table 1 shows that the average farmer in the study area had a mean age of 43years. This implies that they are of active age, which could be positively related to farming and the adoption of new technologies like fertilizer usage. This is in line with the study of Nwaiwu *et al.* (2004) whose work on problems and prospects of large scale plantain banana marketers production in Abia State shows that the farmers were at their middle age of 46 years. Male dominated their female counterparts in the use of fertilizer with a percentage of 80 to 20 respectively. This is expected because the farm lands are usually owned by the men. The farmers in the study area were literate with a mean value of 11.8year. This implies that most of the farmers spend about 12years acquiring formal education. The level of education will reflect their technology adoption level positively. The arable crop farmers in the study area had a mean value of 0.43hectare of land. This implies that, they are smallholder farmers. The result is similar to the findings of Nwaiwu *et al* (2004), who observed that plantain/banana farmers in Abia State are smallholder with a mean value of 1.4hectares and therefore they are limited in capital, scope of operations and production. The arable crop farmers in the study area had a mean income of N76,487 per annum. This implies low income level of the farmers. This could be the reason why they could not have savings that could be reinvested into their farm business, hence appear to operate in a somewhat vicious cycle of poverty. The findings showed that 85% of the farmers use fertilizers representing more than half of the sampled farmers and this implies that the farmers adopted the use of fertilizers in the study area. Only about 50% of the sampled farmers do not use fertilizers.

Level of Fertilizer Use by Sampled Farmers

Table 2 showed that 52.6% of the arable crop farmers use a minimum of 50kg fertilizer. The mean value obtained was 88.9kg. This implies that the level of fertilizer usage in the study area was moderately high indicating high demand for fertilizer because fertilizer is one the important technologies used in increasing food production (Obiesesan *et al.*, 2013).

Determinants of Fertilizer Use Intensity among Arable Crop Farmers

From Table 3, age of the arable crop farmers was significant at 1% level and had a positive relationship with fertilizer use intensity (FUI). This implies that a unit increase in the age of the farmers increases the fertilizer use intensity by 0.4867. It also means that older farmers use more fertilizer than younger farmers. This is in line with the findings of Ugwuja *et al.*, (2011). Also, gender was significant at 1% level but inversely related to fertilizer use intensity. This indicated that a unit change in the gender of the farmers will change the fertilizer use intensity by 137. This showed that majority of the farmers were female, as females tend to be involved in cultural practices during farming. Education level was significant at 1% level and was positively related to FUI, indicating that higher educational level influenced higher fertilizer use. This is in agreement with (Njoku, 2005) who reported that education correlates positively with adoption of improved practices. This is expected since most of the farmers in the study were educated The coefficient of household size was significant at 10% level and had positive relationship with FUI. This implies that, the higher the number of the household size of the family, the higher the use of fertilizer by the family. This conformed to *a priori* expectation because higher household members would require more food and this would mean more fertilizer use to grow more crops. Price of fertilizer was significant at 10% level and was positively related to FUI. This implies that a unit increase in price of fertilizer would increase the use of fertilizer by 0.077. This is contrary to *a priori* expectation. It is plausible however because fertilizer is an essential commodity to these farmers and as demand for fertilizer increases, its prices also increases but would not stop farmers from using them. This is contrary to the work done by Obisesan (2013) who reported that farmers use more fertilizer when the price of fertilizer is low than when the price is high. The R^2 value was 0.906 indicating that about 90.6% of total variation in the dependent variable was explained by the exogenous variables in the model. The F-ratio was also significant at 1% level. This indicated the goodness of fit of the model.

CONCLUSION

It is concluded that arable crop farmers in the study area were at their active age, literate, had mean income of about N76,487 and showed high use of fertilizer despite its high cost. Age, education and household size were significant factors that had positive relationship with fertilizer use intensity while high cost of fertilizer, limited access to credit and inadequate supply of fertilizer were the constraints to fertilizer use by farmers. Therefore, it is recommended that government and other policy makers should initiate capacity building programme to increase knowledge and skill of farmers through avenues such as field days, extension agents contact with farmers; emphasize rural credit mobilization to boost farmers savings and maximize the availability of credit to farmers; establish functional agro-services centers near to rural areas as sources of fertilizer supply to farmers, by this government can monitor the distribution and uses of fertilizer and ensure that subsidized fertilizer reach the farmers that need them at subsidized price. Fertilizer record at state and local government level over the years should be scrutinized to ensure and instill a sense of accountability and determine the true fertilizer situation at these levels.

Table 1 Socio-economic characteristics of fertilizer users in Ikwuano local Government Area

Variables	Frequency	Percentage	Mean
Age			
20-29	15	18.7	
30-39	12	15.0	
40-49	27	33.8	
50-59	26	32.5	
Total	80	100	43
Gender			
Male	64	80	
Female	16	20	
Total	80	100	
Educational level			
Primary	18	22.5	
Secondary	38	47.5	
Tertiary	24	30.0	
Total	80	100	11.8
Farming experience			
0-9	27	33.8	
10-19	34	42.5	
20-29	13	16.2	
30-39	06	7.5	
Total	80	100	14.3years
Farm size			
0.1-0.2	3	3.8	
0.3-0.4	27	33.8	
0.5-0.6	32	40.0	
0.7-0.8	18	25.4	0.43ha
Income level of respondents			
10,000-49,999	12	15.0	
50,000-89,999	43	53.8	
90,000-129,999	25	31.2	
Total	80	100.00	76,487
Fertilizer use			
Fertilizer users	68	85.0	
Non-fertilizer users	12	15.0	
Total	80	100	

Source: Field survey, 2014

Table 2. Level of fertilizer used by farmers

Quantity of fertilizer	Frequency	Percentage
40-49	3	3.8
50-55	16	20.0
60-69	8	10
70-79	3	3.8
80-89	15	18.8
90-99	2	2.5
100-109	3	3.8
110-119	19	23.8
120-129	5	6.2
130-139	6	7.3
Total	80	100 88.9kg

Source: Field survey, 2014

Table 3: Determinants of fertilizer use intensity among arable crop farmers.

Variables	Coefficient	T-value
Constant		-1.734
X_1 (AGE)	0.487	8.123***
X_2 (GEN)	-0.137	-3.111***
X_3 (EDU)	0.551	8.826***
X_4 (HHS)	0.068	1.772*
X_5 (LANS)	0.010	-0.243*
X_6 (PRI)	0.030	2.103
X_7 (OUT)	-0.016	-0.711
X_8 (PANI)		-0.447
f-ratio		96.055***
R – value		0.915
R^2		0.906

Source: Field survey, 2004

Note;***,**,* are significant level at 1%,5%,and 10% respectively.

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MAXIMIZING THE POTENTIALS OF THE SOCIAL MEDIA TECHNOLOGY IN AGRICULTURAL EXTENSION SERVICES DELIVERY IN NIGERIA

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ABSTRACT
With the collapse of prices of crude oil, many investors in Nigeria are repositioning their investments into the non-oil sectors of the economy. Agriculture remains the solution to resuscitate and revamp the Nigerian economy. In order to achieve these, all efforts need to be put in place to ensure that agricultural global best practices and technologies are transferred to the farmers easily, promptly, effectively and efficiently using social media since it has taken over the way we communicate in our world today. The survey showed that there are potentials to be enjoyed if social media is used in agricultural extension services delivery in Nigeria. The research also identified challenges that might hinder harnessing these potentials in agricultural extension delivery in Nigeria. The study further highlights strategies to be adopted in order to overcome the challenges and better maximize the potentials of use of social media in agricultural extension services delivery.
Keywords: Social Media, Potentials, Agricultural, Extension, Services, Delivery, Strategies, Challenges, Maximize, Technology, ICTs.

INTRODUCTION
According to Iannacone (2001), social media is a set of technology platforms that have the ability for people to communicate more easily, sharing ideas, videos and other materials which might be from elsewhere or their own user generated content. Ahlgvist et al (2008) as cited by Suchiradipta and Saravanan (2016), focuses the definition of social media on three basic components which are content, communities and web operationalise social media as the interaction of people and also creating, exchanging and commenting on contents in virtual communities and networks. Social media is seen as a collection of online communication channels dedicated to community based input interaction, content-sharing and collaboration. Information and communication technologies have long been used in agricultural extension delivery for facilitating communication, and innovation brokering between farmers and extension workers, and of its numerous applications. Social media is the most recent addition; Social media has already impacted the wind of global development, making people more informed and aware. Introduction of social media to agricultural extension services delivery is still very recent but the promises is showing are huge.

This paper aims at identifying the potentials of social media and how best these potentials could be maximized for agricultural extension in Nigeria. This specific objectives of the paper are to: identify the potentials of social media in agricultural extension services delivery in Nigeria; ascertain the challenges facing effective use of social media in extension services delivery in Nigeria; highlight the strategies that would be adopted in order to maximize the potentials of the use of social media in extension service delivery in Nigeria.

MATERIALS AND METHODS
The research is a survey type. The population of the survey comprised of agricultural extension officers in Abia state of Nigeria. 120 Agricultural extension officers were purposively sampled, 40 from each of the three agricultural zones in Abia State. Although 120 questionnaires were distributed but the study used only 100 questionnaires, which were properly filled out and returned bringing the sample size to 100.

Data collected were analyzed using frequency distribution tables and percentages.

RESULTS AND DISCUSSION
Table 1 shows that respondents identified several potentials agricultural extension services delivery will enjoy when they incorporate social media usage in their operations. These potentials as elucidated included: Efficient and prompt feedback (98%), Easy and quick communication (95%), Encourages collaboration irrespective of geographical location (90%), Reaching out to global audience (85%), Creation of discussion groups and virtual communities among global and local colleagues (78%), Creation of knowledge pool in real time (60%), and finally Provides interactive and multimedia content support (56%).

Responses as shown in Table 2 identified several challenges facing effective utilization of social media in agricultural extension. These challenges included: poor support infrastructure (95%), these support infrastructures include but not limited to power supply which is very epileptic in Nigeria today and is the backbone powering both devices and installations that ensure that the internet is up and running to enable social media function. Majority of farmers who are majorly domiciled in the rural areas are illiterate (90%), hence lack technical know-how on the use of these technologies. Mobile data and internet service access charges are still very expensive (90%), making it difficult for the few who are able to use these technologies to stay online always and benefit from its potentials. Many a times those who have the knowledge and are able to purchase the devices and internet access are faced with very poor signals and service by internet service providers (80%), the signals are poor, slow or totally unavailable most of the time. Another challenge identified is unwillingness of both extension officers and farmers to adopt change in technology (75%), as they seem to be very comfortable with traditional methods they are used to. The effect of this is that they will not benefit from the amazing potentials these technologies have to offer, as those who change with changing times tend to key in first to the numerous benefits these new technologies present.

Results from Table 3 identified strategies that could be adopted in order to maximize the potentials of social media to agricultural extension service delivery. Top of these strategies to combat the challenges identified in table 2 above. Included: subsidizing enabling devices so that both farmers and extension officers can afford them (100%), the cheaper these services are made, the more people key into using them and better results are achieved. Intensive farmer education (97%), and Capacity building of agricultural extension officers (95%), as this will enable both farmers and extension officers acquire the technical know-how to be able to use these social media technologies better. Rapid awareness campaign on benefits and uses of social media in agricultural extension services delivery (82%), is also a key strategy that will help spread the word on the potentials and benefits accruing from use of social media technology in agricultural extension services delivery. Improvement of government policies to improve internet service delivery (77%), is another key strategy, as the government need to ensure that service providers render services worth subscribers' money paid, by putting in place policies to checkmate their excesses.

CONCLUSION

The role of agricultural extension services delivery to the farmers is such that it serves as a link between developers of the technologies and the farmers as well as input sources and market forces as agricultural extension service delivery connects farmers to the technical know-how needed to achieve maximum production. In developed countries, agriculture is highly commercialized and ICTs including the use of social media are used to ensure quick and timely information dissemination and feedback. However, in Africa and specifically Nigeria, the reverse is the case. The results of this survey has highlighted several potentials that could aid extension service to the use of social media in agricultural extension service delivery, top of which is that social media ensures for easy and quick communication between farmers and extension services workers. Some challenges facing use of social media in agricultural extension services delivery were elucidated and they include but not limited to poor support infrastructure and illiteracy. Finally, the research highlighted some strategies to be adopted in ensuring full maximization of the potentials of use of social media in agricultural extension service delivery and top on the list of these strategies is subsidizing, enabling devices so that both farmers and extension officers can afford them.

Table 1: potentials of social media to agricultural extension delivery

Potentials	Frequency	Percentage (%)
Reaching out to Global Audience	85	85
Creation of knowledge pool in real time	60	60
Creation of discussion groups and virtual communities among global and local colleagues	78	78
Provides interactive and multimedia content support	56	56
Ensures efficient and prompt feedback	98	98
Ensures easy and quick communication	95	95
Encourages collaboration irrespective of geographical location	90	90

Source: Field data, 2016

Table 2: challenges facing effective utilization of social media in agricultural extension

Challenges	Frequency	Percentage (%)
Faulty and unstable internet connection	80	80
Expensive internet access costs	90	90
Lack of expertise in use of social media	85	85
Unwillingness to adopt new technologies	75	75
Poor support infrastructure	95	95
Illiteracy on the part of majority of rural farmers in Nigeria	90	90

Source: field data, 2016.

TABLE 3: Strategies to adopt to maximize the potentials of social media for agricultural extension services delivery.

Strategies	Frequency	Percentage(%)
Rapid awareness campaign on benefits and uses of social media in agricultural extension services delivery	82	82
Improvement of government policies to improve internet service delivery	77	77
Intensive farmer education	97	97
Capacity building of agricultural extension officers	95	95
Subsidizing enabling devices so that both farmers and extension officers can afford them	100	100

Source: field data, 2016.

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ASSESSMENT OF GROWTH ENHANCEMENT SUPPORT SCHEME AMONG CASSAVA FARMERS IN BENUE STATE, NIGERIA

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ABSTRACT

The study assessed growth enhancement support (GES) scheme in Benue State, Nigeria. The population of the study included all cassava farmers that participated in the scheme in Benue State. Multistage sampling was used, and a combination of purposive and simple random sampling techniques was used in selecting a total sample size of 180 participants. Primary data collected were through the use of questionnaires. Percentage and mean were used to analyze data. The result of the findings showed that the majority (70.6%) were male and married (90.6%). The farmers mean age was 54 years and were literate (75.5%). The mean farming household size was 8 persons and had farm size of 3.4 ha. The scheme made great changes in food productivity (M=2.81), farmers' access to farm inputs (M=2.62). Farmers had high level of satisfaction on the scheme's participation processes on GES scheme awareness (M=2.74), registration process (M2.18) and quantity of cassava stems (M=2.02). Major challenges identified were poor awareness (M=2.72), mixed up of names of registered farmers (M=2.99) and poor mobile phone possession and usage (M=2.53). It was recommended that more awareness and adequate training be given to farmers for them to participate actively for other farmers to join in the scheme.

Keywords: assessment of GES scheme, participation, cassava, Benue State.

INTRODUCTION

Agriculture has been the mainstay of Nigerian economy for several years and is still contributing significantly to the Gross Domestic Product (GDP) of the country (Patachu, 2012). Subsistence level lifestyle in rural areas is a daily concern for many people. A way out of this is to boost agricultural production through developing and empowering people to design and manage their own developmental activities. Growth enhancement support (GES) scheme was initiated by the Federal and State Government under the Agricultural Transformation Agenda (ATA) for the provision of subsidized inputs to farmers in Nigeria (FRN, 2013) to help farmers in their developmental activities.

GES, a special agricultural scheme of the Federal and State Governments, is aimed at delivering subsidized farm inputs to farmers and facilitating a shift from subsistence to commercial farming. It was designed as a component of the ATA of the Federal Government in 2012. The ATA is the government policy measure to realizing food security and increasing household income for farmers at the micro level. With GES, the government seeks to withdraw from direct fertilizer purchase and distribution, and introduce an alternative system of distribution built on the voucher system. Under the scheme, registered farmers receive e-wallet vouchers with which they can redeem fertilizer and seeds from agro-input dealers (Fertilizer Suppliers Association of Nigeria (FESPAN), 2012).

Adesina (2012) noted that GES is a strategy by the Federal and State Government under the ATA to provide subsidized inputs to farmers and ensure that the financial burden is shared between government and farmers. The scheme is also aimed end the unwholesome activities of middle men who, over the years, had been diverting the products to other countries thereby denying farmers the benefits of increasing their productivity over the years. In addition, the GES scheme represents a policy and pragmatic shift within the existing Fertilizer Market Stabilization Programme and it puts the resource constrained farmer at its centre through the provision of series of incentives to encourage the critical actors in the fertilizer value chain to work together to improve productivity, household food security and income of the farmers (Federal ministry of agriculture and rural development (FMARD), 2013).

Benue State, Nigeria started participating in the scheme in 2012 in which both maize and cassava farmers benefited in the scheme. The questions are: to what extent had the scheme achieved its laudable objective in the provision of farm such as fertilizers and improved seeds at subsidized rate especially to farmers in Benue State, Nigeria? What are the farmers' perceptions of changes brought about by the scheme on food production as well as access to farm inputs? What are the farmers' level of satisfaction and participation in the scheme? What are the challenges to effective participation of the scheme? This study seeks to provide answers to these questions as a means of validating or otherwise of the policy.

METHODOLOGY

The study was carried out in Benue state, Nigeria. Benue is made up of 23 local government areas (LGAs). The population of the study includes all cassava farmers that participated in the scheme in Benue state, Nigeria. Multi-stage, purposive and simple random sampling techniques were used in selecting a total sample size of 180 respondents.

The first stage involved the purposive selection of three LGAs (Makurdi, Otukpo and Katsina-Ala) that are notable for cassava production activities in the state. In the second stage, three communities were purposively selected from each of the three local government areas due to their high cassava production activities. They include Agan, Gaadi and Adeke for Makurdi LGA, Allan-akpa, Ugboju-ehaje and Okete for Otukpo LGA and Mbacher, Michihe and Katsina-ala in Katsina-ala LGA. This gave a total of nine communities.

The third stage involved the selection of twenty GES Scheme beneficiaries using simple random sampling from each of the selected communities. This gave a total of 180 farmers that serve as sample size for the study. Primary data were obtained through the use of questionnaire administered to farmers.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the respondents

Result in Table 1 shows that the beneficiaries in the study area were largely male (70.6%). This implies that more male farmers participated in and benefited from the GES. This is because women are restricted to domestic activities such as processing of agricultural produce and childbearing and upbringing. It was also found that about 30% of the respondents fall within the age bracket of 51-60 years. According to FAOSTAT (2006) people between 15-64 of years are considered as economic productive or active age. Majority of the respondents were married (90.6%). The predominance of married individuals agrees with a study by Uddin (2014) which revealed that 85.8% of Edo farmers were married. This implies that they are ready to improve livelihood and that of their families, since marriage is associated with occupational stability and more responsibility. In terms of educational qualification, 24.4% had no formal education, 29.4% had primary education, 23.3% has secondary education and 22.8% has tertiary education. Level of educational attainment can increase the ability of the farmer to access and interpret relevant information about agricultural innovations, which lead to efficient use of agricultural to enhance productivity. Oluwatayo (2009) found out that education has significant relationship with farmers' level of awareness to innovation, diffusion and adoption of innovation. The area was characterized relatively by large household size (42.8%) with more than 8 family members. This result is line with Amaza (2000) who found that household members supply labour bulk of the farming and other operations. Members of the household play a key role in dissemination of information as most of the GES farmers go to know about the scheme through members of the household. The study also found that majority of the respondents (55.6%) cultivate on small land areas of 3-4 hectares. Furthermore, 35.5% cultivate on plots of less than 1-2 ha in size.

Cassava farmers' perception of changes brought about by the scheme

Table 2 shows that the respondents agreed that the scheme brought great changes in the following activities: increase in yield (M=2.81), access to fertilizers at subsidized rate (M=2.62), and access to improved seeds (M=2.64), better quality of fertilizer (M=2.44) and the use of e-wallet in input redemption (M=2.53). This implies that the scheme made great changes in food productivity and farmer's access to farm inputs such as fertilizer and improved seeds.

Farmers' level of satisfaction on the scheme's participation processes

Table 3 shows that the cassava farmers had high level of satisfaction on the scheme's participatory processes/activities in the areas of GES scheme awareness (M=2.74), registration process (M= 2.18), and quantity of improved cassava stems redeemed (M=2.02). However, the farmers had unsatisfactory participatory process/activities in the areas of timely access to information on the scheme (M=1.93), redemption process (M=1.53). This implies that farmers are not satisfied with some of the scheme's participation. This is an indication, for instance that farmers were given adequate awareness for massive participation in the scheme; and there was untimely access to information on the scheme in many cases. The redemption process was rigorous and disappointing in many cases and in different locations. Quantity of fertilizer (2 bags of 50kg- 1NPK & Urea) allocated/redeemed was not enough for the majority of farmers that cultivate 1hectrare of land and above.

Major challenges in participation of the scheme

Table 4 shows the mean distribution of identified challenges to effective participation of the scheme in the study area. The result revealed that mixed up of names of registered farmers (M=2.99); poor awareness (M=2.72) poor mobile phone possession and usage (M=2.53); lack of registration forms for all practicing farmers (M=2.71) poor network (M=2.73); lack of logistics to get farmers in rural areas registered (M=2.70);

transportation (M=2.76), difficulty in redeeming input (M=2.75); late supply of agro-input (M=2.56) and inadequate number of fertilizers supplied at redemption centers (M=2.62) were the major challenges. This implies that despite some success stories of the scheme, it still faces some serious challenges which should be taken into considerations for it to stand a test of time.

CONCLUSION

The result of the findings showed that the majority (70.6%) were male and married (90.6%). The farmers mean age was 54 years and were literate (75.5%). The mean farming household size was 8 persons and had farm size of 3.4 ha. This scheme brought great changes in increase in yield, access to fertilizers at subsidized rate and access to improve seeds. Farmers had high level of satisfaction on the scheme's participatory processes and activities in the following GES scheme awareness, registration process and quantity of improved cassava cuttings. The identified major challenges to effective participation on the scheme includes poor awareness, poor mobile phone possession and usage, poor network, difficulty in redeeming input, late supply of agro input and inadequate number of fertilizer supply at redemption center. Based on these findings, the following recommendations were made: more awareness and adequate training be given to farmers by the extension arm of the scheme for them to participate actively and for other farmers to join in the scheme; managers of the scheme should ensure early provision or supply of fertilizers and improve seeds to farmers for optimal utilization and finally, since network possesses great challenges, the authority should use alternative means such as voucher cards to ensure that farmers get their messages and packages.

Table 1: Socio-economic characteristics of farmers

Variables	Percentage
Sex:	
Male	70.6
Female	29.4
Age:	
21-30	6.1
31-40	18.3
41-50	25.6
51-60	30
61-70	15.6
71-80	40.5
Marital status:	
Single	9.4
Married	90.6
Widowed	-
Educational qualification	
No formal education	24.4
Primary education	29.4
Secondary education	23.3
Tertiary education	22.8
Household size:	
1-5	7.8
6-10	42.8
11-15	28.6
16-20	10.1
21-25	4.2
26-30	3.2
31-35	1.1
Farm size:	
1-2	35.5
3-4	55.6
5-6	7.8
7-8	1.1
9-10	0

Source: Field survey, 2016

Table 2: Mean distributions of respondents according to their perception of changes brought about by the scheme on food production as well as access to farm inputs.

Activities	Mean (M)	SD
Increase in yield	2.81	0.493
Access to fertilizer at subsidized rate	2.62	0.703
Access to improved seeds	2.64	0.658
Ability to own a phone	2.70	0.548
Better quality fertilizer	2.44	0.644
Use of e-wallet in input redemption	2.53	0.628

Source: field survey, 2016; = M≥2.00 = great change; SD = standard deviation

Table 3: Mean distribution of respondent according to their level of satisfaction on the scheme's participation processes

Activities	Level of satisfaction	
	Mean	SD
GESS scheme awareness	2.74	0.566
Registration process	2.18	0.534
Timely access to information on the scheme	1.93	0.576
Redemption process	1.53	0.607
Quantity of fertilizer allocated/redeemed	2.64	0.638
Quantity of allocated/redeemed cassava stems	2.02	0.547

M≥2.00 = satisfactory participation process. Source: filed survey, 2016.

Table 4: Mean distribution of respondents according to their major challenges in participating in the scheme

Challenge	Mean (M)	SD
Mixed up of names of registered farmers	2.99	0.149
Poor awareness	2.72	0.569
Poor mobile phone possession and usage	2.53	0.720
Lack of registration forms for all practicing farmers	2.71	0.541
Poor network	2.73	0.488
Lack of logistics to get farmers in rural areas registered	2.70	0.503
Transportation	2.76	0.521
Difficulty in redeeming input	2.75	0.547
Late supply of agro input	2.56	0.661
Inadequate number of fertilizer supply at redemption centre	2.62	0.669

Source: Field survey, 2016 *= major challenge (M≥2.00)

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THE APPLICATION OF PRINCIPAL COMPONENT ANALYSIS IN PERCEIVED USEFULNESS OF SHORT MESSAGE SERVICE AMONG ARTISANAL FISHERS IN COASTAL SOUTH-WEST, NIGERIA

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ABSTRACT
This study determined the major components of Artisanal fishers' Perceived Usefulness (PU) of Short Message Services (SMS) in coastal South-West, Nigeria. Principal Component Analysis (PCA) was used to determine the key determinants of PU in the study area. A multistage sampling procedure was used to select 77 artisanal fishers for the study. Primary data were obtained with interview guide. Results showed that the mean age of the respondents was 38.61 years and majority (87.0%) had primary education. The mostly used mobile phones were Visafone (93.5%) and Techno (77.5%). The main respondents PU were that SMS-FI would suite and address their location based information needs ($\bar{x}$ = 5.36) and SMS-FI would address their fishery related needs ($\bar{x}$ = 4.29). PCA revealed that PUI (0.706), PU11 (0.767), PU13 (0.813) and PU15 (0.738) were highly correlated and were major determinants of artisanal PU of SMS. It was recommended that SMS is accessible, timely and should be based on the need of the fishers.

Keywords: Principal Component Analysis, Short Message Service, Artisanal Fishers

INTRODUCTION
The advent of modern Information and Communication Technology (ICTs) has undoubted revolutionilised information flow globally and this had made information available and accessible by the users (Banmeke and Oose, 2012). It is believed that ICTs holds the solution to the challenges of globalization in whatever form they are manifested. According to Technical Centre for Agricultural and Rural Cooperation (CTA) (2000), efficient information dissemination remains the key to bridge the gap between the developed and underdeveloped countries.

In recent years, there has been a rapid growth of mobile phone network in developing countries. Currently, mobile telephony is the predominant mode of communication in developed world (Fasina and Alfred, 2013). The global mobile penetration rate was estimated at about 76 per 100 inhabitants in 2010 International Telecommunication Union (ITU, 2011). Poor developing countries are increasing part of this spread. Importantly, use of mobile phone is making quick inroads in rural areas where most the people lives. Short Message Service (SMS), an aspect of mobile telephone service is a very important communication tool that can be used to serve several purposes. It is understood as text based read on small mobile phone screen, typically capable of presenting 15 to 20 characters per line. The messages are written with numeric keypad on the phone with message restricted to 160 characters in length. Short Message Service –Fisheries Information (SMS-FI) are set of messages developed based on the identified information needs of artisanal fishers and these messages are disseminated to the fishers in their local languages.

SMS-FI comes in recognition of the important contributions of fish to the food security of about 200 million Africans (World Fish Centre, 2005). Artisanal fishing accounted for more than 80%, aquaculture has less than 8% while industrial fluctuate around 13.9 to 5.0% (Federal Department of Fisheries, FDF, 2011). However, before the advent of mobile phone and SMS, artisanal fishers had extremely small possibility to communicate with others while in the sea. They are usually cut off from all activities and ties from families. The need for a channel through which they can communicate amongst them become very vital. It is therefore imperative to understudy the importance of SMS and its usefulness in information dissemination among the fishers. Perceived Usefulness (PU) of artisanal fishers is the degree to which to which they believe they using a particularly system will enhance their performance. PU has been used extremely in information research and has strong empirical support as an important predictor of technology adoption. (Mathieson, 1991). The specific objectives were to identify the types of mobile phone used, determine the respondents' perceived usefulness of SMS-FI and to determine the major components of artisanal fishers' PU in the study area.

METHODOLOGY
The study was conducted in coastal southwest, Nigeria. The 3 states are Lagos, Ogun and Ondo states. The states have a combine coastline of approximately 853km facing the Atlantics Ocean. Multi-stage sampling technique was used to select respondents for this study. Three (3) Local Government Areas (LGAs) namely

Ibeju-Lekki, Ogun waterside and Ilaje were selected purposively from Lagos, Ogun and Ondo respectively. This is based on the fact that these LGAs were along the same coastline. Two fishing communities namely; Akodo and Orimedu were selected from Ibeju-Lekki, Okun Ileti and Igbeki were selected from Ogun Waterside while *Enu Amo* and Holy centre were selected from Ilaje LGA. Watson, (2001) sampling technique at confidential level of 95% with an estimated 50% variance was used to select 77 artisanal fishers for this study. Primary data were collected with the aid of interview guide and data were subjected to descriptive and inferential statistical analysis.

RESULTS AND DISCUSSION

Production characteristics of Respondents

Results in Table 1 showed the production characteristics of the respondents. The mean age of the respondents was 38.61 years. This is explicable because the study has to do with coastal fishing and mature male are able to withstand the stress of fishing on the sea. This is in consonance with Udoh and Nyienakuna (2008) who posited that coastal fishing is dominated by matured male. The table further showed that 87.0% of the respondents had primary education, this indicates that primary education is the basic educational status of the respondents. The mean years of experience of artisanal fishers in coastal fishing were 17.84 years. From this finding, it implies that there were respondents with substantial fishing experience that have better approaches in carrying out their fishing activities. As regard artisanal fishers income made per trip, their mean income was ₦ 53.077 per trip. It was observed that about 2 to 3 fishers operate a single Outboard Engine and the money is shared accordingly. From this result, it is pertinent that fishers made more income but the cost of fueling the engine and repairs was very high. Majority (92.9%) indicated that they use encircling gill net which the size determines the types of fish catch.

Types of Mobile Phone Used by Artisanal Fishers

The type of mobile phone used by artisanal fishers is presented in Table 2. Artisanal fishers indicated they mostly used mobile phone as follows Visafone (93.5%), 77.9% used Techno phone, 54.5% used Nokia phone. This observation implies that most of the artisanal fishers across the coastal communities in the study area prefer Visafone mobile phone. It was found that Visafone mobile network service is very active within coastal communities. Some of the artisanal fishers explained that the nature of their job is very hard and Visafone mobile phone had helped them with the problem of fluctuating network services. Muhr and Nordstrom (2007) corroborate this finding that improved access and ownership of mobile phone improved artisanal fisher livelihoods

Perceived Usefulness (PU) of SMS-Fishery Information

The perceived usefulness of SMS- Fishery Information by respondents indicates that the respondents were of the view that SMS-FI suite and address their location based information needs ($\bar{x}$ = 5.36), SMS-FI would address their fishery related needs ($\bar{x}$ = 4.29), using SMS-FI would improved their fishing performance ($\bar{x}$= 4.66), also others indicated that if they are sent SMS-FI it would be accessible ($\bar{x}$ = 4.64), SMS-FI would be advantageous ($\bar{x}$ = 4.56) while others accounted that SMS-FI would support critical aspect of their fishing work ($\bar{x}$ = 4.52). These findings concur with the position of Guriting and Ndubisi (2006), that PU refers to individuals' perception that using a new technology well enhances or improve his/her performance. The implication of these findings to agricultural communication is that the PU of artisanal fishes is an important predictor of whether or not they will accept SMS-FI in their fishing activities.

Principal Component Analysis for Perceived Usefulness of SMS-FI

The Principal Component Analysis (PCA) of artisanal fishers' Perceived Usefulness (PU) of SMS-FI presented in Table 3. The major aim of PCA is to reduce information idleness and reduction of the dimensionality. Eigenvalues greater than one was considered. Five (5) variables are retained in the analysis and it accounted for 81.32% of the variability. The PCA model of analysis allows us to transform the 15-dimensional space into 5-dimensional space losing about 18.68% of the information in the original variables. As shown in Table 4, the factor loading using the rotated factor matrix. The first PC (factor 1) is highly correlated with 4 of the original variable that is, PU1 (0.706), PU11 (0.767), PU13 (0.813) and PU15 (0.738). These 4 items represent the weighted average of the efficiency of information seeking. Also, the fisher educational status would enhance their use of SMS-FI in their fishing activities. This is in agreement with Oose *et a*l., (2015) that artisanal fishers within coastal south, Nigeria were literate.

CONCLUSION

Based on the outcome of the analyzed results, it was concluded that SMS is accessible, timely, and advantageous to the need of the fishers. Also, the PU of artisanal fishers of SMS influences their adoption. It is therefore recommended that extension agents and relevant stakeholders should disseminate information to farmers via SMS.

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Table 1: Production characteristics of the respondents (n=77)

Variables	**Definition**	**Distribution**
Age	Actual age of respondents	Average age = 38.61 years
Educational Level	Educational as No formal, Primary, Secondary and Tertiary	Mode is Primary education (87.0%)
Fishing Experience	Number of years spent in artisanal fishing	Average = 17.84 years
Income/Trip	Actual income/trip	Average = ₦ 53.077
Gear Used	Gear used as gills or encircling	Mode is encircling gear (92.2%)

Source: Field survey 2016

Table 2: Types of mobile phone used by the respondents (n=77)

Variables	**Frequency**	**Percentage**	**Ranking**
Visafone	72	93.5*	1st
Techno	60	77.9	2nd
Nokia	42	54.5	3rd
Samsung	6	7.6	4th
Blackberry	4	5.3	5th

Source: Field survey 2016 *Multiple responses applicable

Table 3: Result of rotated factor matrix for Perceived Usefulness of SMS-FI

Variables	Eigen Values	% of Variance	Cumulative %	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
PU1	6.026	40.17	40.17	**0.706**	-0.293	0.128	-0.009	-0.270
PU2	2.256	15.04	55.21	0.394	0.248	**0.738**	0.259	-0.096
PU3	1.706	11.37	66.58	0.611	-0.405	0.015	0.095	0.340
PU4	1.209	8.057	24.64	0.213	0.006	0.695	0.547	0.094
PU5	1.002	6.681	81.32	0.609	-0.471	-0.029	0.054	0.085
PU6	0.709	4.728	86.05	0.545	0.521	0.164	-0.131	0.376
PU7	0.640	4.268	90.31	0.657	0.052	-0.475	0.454	0.099
PU8	0.439	2.928	93.24	0.494	**0.706**	-0.264	0.160	0.241
PU9	0.278	1.852	95.09	0.665	-0.710	-0.076	-0.077	0.362
PU10	0.228	1.519	96.61	0.352	0.679	-0.400	0.192	-0.288
PU11	0.185	1.235	97.85	**0.767**	-0.429	-0.137	-0.224	0.093
PU12	0.133	0.886	98.73	0.672	0.544	0.212	-0.344	-0.250
PU13	0.198	0.656	99.39	**0.813**	-0.170	-0.187	0.105	-0.306
PU14	0.050	0.330	99.72	0.599	-0.202	0.262	0.594	0.026
PU15	0.641	0.276	100.0	**0.738**	-0.157	0.002	0.078	-0.447

Source; Computed form data, 2016

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ACCESSIBILTY AND RELEVANCE OF INFORMATION COMMUNICATION TECHNOLOGY IN EXTENSION DELIVERY TO RURAL FARMING HOUSEHOLDS IN KATSINA STATE, NIGERIA

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ABSTRACT
The agricultural sector in Nigeria is bedeviled by dearth of information. This is evident in poor perfomance and slow pace of technology transfer by the extension agents to the end users of technology. This study examined the relevance of information technology in extension service delivery in katsina state, Nigeria. Primary data was used to elicite information using pretested and structured questionaires from 128 respondents selected through multi-stage sampling. Descriptive statistics and likert scale were analytical tools used. The result shows that extension workers are male dominated in the study area, highly educated and experienced. The result from the likert scale indicate that their mean scores were below the decision point x=2.0.This implies that the use of internet as an ICT tool is poor in the study area.The study concludes that information communication technology is relevant to extension delivery in the study area. The study recommends that government should formulate policy that will create an enabling working environment for capacity building among extension agents and greater access to internet facility at the grass root level. Workshops, conferences and seminars should be organized to train extension agents in the use of internet technology which will improve efficiency in their work.

Keywords: Accessibilty,Information Communication Technology, Extension Delivery, Katsina State, Nigeria.

INTRODUCTION

The agricultural sector has been recognized as the major driver of economic growth and development. Nigeria's government over the decades has neglected agriculture, hence no plausible effort had been made to make the sector great. Rather still, there had been diversified interest, and this has made her economy to be oil dependent. However the recent crashed in the prices of oil in international market has awaken interest towards agriculture as a means of diversifying the economy. Over 75% of agricultural production is produced by the rural farming households whose means of livelihood depends only on cultivation of crops and livestock production. Agricultural extension deliverables remain the only way through which these rural farmers will be informed of latest agricultural ideas. Knowledge of innovation can make them improve in agricultural production and competitive; in addition to subdue the challenges impose by technological advancement. It has been observed that there is gross inadequate extension personnel that will serve the poor farmers and update their knowledge in Nigeria. This is evidence in poor performance and often resulted in upsurge of poverty and under performance of agriculture sub-sector of the economy (Adetunji, 2013). Local production of agricultural produce is therefore possible if the necessary stakeholders for agricultural production are provided with information and knowledge that will help to create a network that encourages information and knowledge sharing.

Despite the increase in information occasioned by information communication technology, agricultural sector is still bedeviled by dearth of information. This is evident in slow pace of technology transfer by the extension agents to the rural farmers who are the end users of technology. Rural farmers especially at the grassroots still record poor harvest and low quality of farm produce. Some of the major problems encountered by farmers are occasioned by insufficient information by the appropriate agency, poor awareness of available information, or inability of most farmers to effectively utilize and apply the information to boost their farming operations. The resultant effect of these problems are low agricultural productivity, poor marketing and pricing of agricultural products. These aggravate poverty and hunger among rural farming households' food shortage.

This study therefore intends to assess the extension delivery to rural farming households in katsina state, Nigeria. The objectives are to: describe the socio-economic characteristics of agricultural extension agents; ascertain the accessibility of internet services by the extension agents and the level of application of the Internet by the agricultural extension agents.

METHODOLOGY

This study was conducted in Katsina State. Katsina state is located in the North West Geo-Political Zone of Nigeria. It has a population of 7,452,629.

A two-stage sampling technique was used to select the respondents for this study. The list of all the extension workers in the state was obtained from Katsina State Agricultural and Rural Development Authority (KTARDA). In the first stage, a purposive sampling method was used to select Agricultural extension workers from the three Zones of Katsina State Agricultural and Rural Development Authority (KTARDA). The second stage involved a random sampling of thirty-six (36) respondents from zones I (Ajiwa), thirty-six (36) respondents from zones II (Funtua) and thirty-six (36) respondents from zones III (Dutsin-Ma) of KTARDA making a total of one hundred and eight (108) respondents for the study.

Analytically, descriptive statistics such as mean, media, mode and percentage, and likert Scale was used to analysed the data.

RESULTS AND DISCUSSION

The result in Table 1 revealed that the respondents have the mean age of 44years. This indicates that extension worker in the study area were predominantly young people who are active. This finding is similar to that of Alocha, *et. al* (2013) who reported that extension agent from this age were in their active years and still have more productive years to put into the extension work. The results showed that all the respondents were literate. Majority of them 32.4% and 25.0% had center certificate and OND/NCE certificate respectively.This finding is in corroboration with Yakubu, *et. al* (2013), who reported that extension agents in Kano State were literate and could utilize ICTs to improve their work as change agents.

The extension agent were male dominated, 90.7% are male while 9.3% are female. This reveals the low involvement of women in extension service delivery. The years of experience also shows that 52.8% of the extension agents had been in the job for 21years and above. The mean working experience of the extension agents was 18 years implying that almost all the extension workers in the State had longer years of working experience and this gave them advantage of appreciating the role of internet technology in extension work. This finding agrees with that of Salau and Saingbe (2008) who reported that extension workers in Nasarawa State had longer working experience. This also implies that the extension agents had knowledge to analyze between how it was without internet and what the present scenario is with the use of internet

Frequency of Internet Usage by the Respondents

Results in Table 2 show the distribution of the extension agents on the frequency of internet usage. From the table, the extension workers that used Social network for knowledge update and to sought information were in the majority with a mean score of 1.68. This was followed by the use of Search engines with a mean score of 1.55. Getting information from recreational center from friends and through interaction was popular in the study area. The table shows that extension workers with a mean score of 1.33 used the internet as recreational to obtained information and news that will be helpful to them. Those that used Websites ranks fourth with a mean score of 1.55. Online chatting gained prominent among the extension workers as a good number of them with mean score of 1.20 engaged in chatting using social media such as facebook, whatsapp, and twitter among others. The use of the E-mail was also popular among the respondents. The table shows that extension agents with a mean score (1.00) was versatile in the use of electronic mail as means of communication. The respondents were found to be those that frequently asked questions. Those who were found in this category were with the mean score of 0.78. Extension agents in the study area were also found to be using Internet Telephony. Those who were found in this category were found to have a mean score of 0.56. Furthermore, Professional Blog is rarely used as a means of information dissemination in the study area. The mean score of those who were using Professional Blog is 0.53. Lastly, online public access catalogue was the least used internet facilities in the study area. The mean score of extension agents using public access catalogue is 0.48. Comparing their individual means to grand mean (1.04), it shows that the frequency of internet usage among the extension workers in the study area is low because it is only in social network, search engines, recreational, websites and online chatting that internet usage was high in the discharge of their duties. Their internet usage was very low in other internet facilities. This could be attributed to low internet accessibility in the rural areas. This finding is similar to that of Chukwunonso, *et. al* (2012) who reported that lack of Internet access in most of the rural areas in Adamawa State.

CONCLUSION

It can be concluded from the study that extension agents in the study area utilized internet services to a very low level in their extensions service delivery, since their mean scores were below the decision point x=2.0. It is also established that the extension agents in the study area are not aware of the fact that internet technology can be used to accomplish many functions in extension service delivery. In the light of the finding, the study makes the following recommendation: government should formulate policies that will stimulate Nigeria working environment and enhance the capacity of extension agents and enable them to access internet facility at the grass root level. This will go a long way to improve the extension delivery system. Workshops, conferences and seminars should be organized to train the extension agents in the use of internet technology which will improve efficiency in their work.

Table 1: Distribution of Respondents according to Socio-economic characteristics (n=108)

Characteristics	Frequency	Percentage (%)	Mean
Age (years)			
20-29	4	3.7	
30-39	28	25.9	44.07
40-49	42	38.9	
50-59	34	31.5	
Gender			
Male	98	90.7	
Female	10	9.3	
Educational Level			
Secondary School	15	13.9	
Farm Center Certificate	35	32.4	
OND/NCE	27	25.0	
HND	17	15.7	
B.Sc./ B. Agric.	12	11.1	
M. Sc.	2	1.9	
Working experience (years)			
1-5	21	19.4	
6-10	12	11.1	18.36
11-15	6	5.6	
16-20	12	11.1	
21 and above	57	52.8	

Feild survey 2015.

Table 6: Distribution of the Respondents based on their Frequency of Internet Usage

Internet Services	Daily	Twice/ Week	Weekly	Monthly	Never	Mean score	Ranking
E-mail	15(13.9)	7(6.5)	9(8.3)	9(8.3)	68(63.0)	1.00	6th
Search engines	27(25.0)	13(12.0)	5(4.3)	10(9.3)	53(49.1)	1.55	2nd
Websites	24(22.2)	8(7.4)	7(6.5)	4(3.7)	65(60.2)	1.28	4th
Chatting on the net	28(25.9)	2(1.9)	3(2.8)	6(5.6)	69(63.9)	1.20	5th
Internet Telephony (Skype)	9(8.3)	3(2.8)	4(3.7)	8(7.4)	84(77.8)	0.56	8th
Social network site	40(37.0)	3(2.8)	2(1.9)	8(7.4)	55(50.9)	1.68	1st
Frequently Asked Questions (FAQs)	4(3.7)	8(7.4)	17(15.4)	10(9.3)	69(63.9)	0.78	7th
Online Public Access Catalogue (OPAC)	4(3.7)	4(3.7)	9(8.3)	6(5.6)	85(78.7)	0.48	10th
Professional Blog	5(4.6)	5(4.6)	7(6.5)	8(7.4)	83(76.9)	0.53	9th
Recreational	25(23.1)	10(9.3)	2(1.9)	10(9.3)	61(56.5)	1.33	3rd

Source: Field Survey, 2016 Figures in Parentheses are in Percentages

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THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN THE EMPOWERMENT OF THE NIGERIAN WOMEN IN AGRICULTURE

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ABSTRACT

The study was a survey type of research. Structured questionnaires were distributed to women farmers within the 3 agricultural zones in Abia State (Aba, Umuahia, and Ohafia). The responses from the questionnaires were analyzed using descriptive statistics. The result of the survey showed that Information and communication technologies (ICTs) were beneficial to the women farmers. Top on the list of benefits was that ICTs brings education to rural areas where majority of Nigerian women farmers reside and also ensures speedy delivery of local and globally available information. The sampled women made recommendations on ways to improve delivery of ICTs to Nigerian women farmers. These recommendations included encouraging the government to subsidize ICTs tools to make them affordable for the women to purchase and use. The respondents also advocated sensitization of women on benefits and empowerment roles of ICTs especially rurally located women. The study also highlighted the several empowerment roles played by ICTs on women; top of which included knowledge empowerment, information base, wealth creation and economic empowerment.

Keywords: women, agriculture, empowerment, ICTs, benefits, roles, recommendations.

INTRODUCTION

Women make essential contributions to the agricultural and rural economies in all developing countries (FAO, 2011). These roles played by women in agriculture vary considerably between and within regions and are changing rapidly in many parts of the world; where economic and social forces are transforming the agricultural sector. In Nigeria, the involvement of women in agriculture has attracted greater attention in recent years. Hence the need to develop a suitable extension service delivery system that is gender specific and tailored to women farmers cannot be over emphasized.

Information and communication technology(ICT) is the term that describes communication devices such radios, cellular phones, computers, satellite systems, et cetera, as well as the services and applications associated with them (Ezike and Chigozie-Okwum, 2014). Akinpelu (2008), stated that information and communication technology has been promoted as an important tool in ensuring that marginalized groups, particularly women are included in the development of global information society. Because of its unique benefits, ICT have been recognized as a tool for empowering women. However women still have challenges using ICT. While some believe it is a male affair, others cannot comprehend the seemingly complexity of the technology. The results of the survey aim at showcasing the several roles ICT play in empowering the Nigerian women in agriculture.

MATERIALS AND METHODS

The research is a survey type. The broad aim of the survey was to identify the roles of information and communication technologies in the empowerment of the Nigerian women in agriculture. However, the specific objectives included to determine the benefits of information and communication technologies to the Nigerian women in agriculture; to identify ways of improving the delivery of information and communication technologies to the Nigerian women in agriculture and evaluate the roles of Information and communication technologies in the empowerment of Nigerian women in agriculture.

The population used for the survey comprised of women in agriculture in Abia state of Nigeria. 120 women were randomly sampled, 40 from each of the three agricultural zones in Abia State. Hence 120 questionnaires were distributed to the sampled population. However, 100 questionnaires were properly filled out and returned bringing the sample size to 100.

Where-; n = 100.

Primary data was collected using structured questionnaires. Secondary data was sourced from review of related literature. Data collected were analyzed using histogram, frequency distribution tables and percentages.

RESULTS AND DISCUSSION

The results of the survey are presented and discussed below:

The results as shown in Table 1 show that information and communication technologies are very beneficial to the Nigerian women in agriculture. These benefits as deduced from the research results included bringing education to rural areas, where majority of women in agriculture reside (98%), ensuring speedy delivery of local and globally available information (95%), allowing large number of women in agriculture to communicate directly, cheaply and speedily (92%), reduction of cost and time spent on information dissemination (90%), and increasing access to global best practices (85%). Other benefits as identified from the research results as presented in table 1 are, round the clock access to funds as made possible by e-banking (75%), promotion of networking and collaboration among women irrespective of their location (72%), and ease in modern research methods of data collection, analysis, and reporting (65%).

Results from Table 2 above highlights some recommendations made by the sampled women on ways to improve ICTs delivery to the Nigerian women in agriculture so that they can benefit from the use of these ICTs tools and subsequently be empowered by them. The results show that 100% of the respondents agreed that ICTs services delivery will be improved if Government should subsidize ICTs tools so that it can be more affordable for Women in Agriculture. Some other recommendations made included; sensitization of women in agriculture especially the majority stationed in the rural areas on benefits of ICTs tools (98%), Increasing the availability of ICTs especially to rural areas so that rural women in agriculture can benefit (95%), funding women groups in agriculture to enable them acquire and benefit from ICTs (92%), driving more awareness campaigns on empowerment roles of ICTs to be carried out nationwide especially in rural areas (88%), and finally capacity building on the part of the women in agriculture (70%).

The survey identified the roles played by ICTs in the empowerment of the Nigerian women in agriculture. The sampled population all agreed that information and communication technology play vital roles in empowering women in agriculture especially in ensuring that knowledge base is constantly updated (85%), the women also identified that ICTs empowers them by widening their information base and source (70%). Other empowerment roles played by ICTs as identified by the respondents include wealth creation (35%), economic empowerment (35%), and promoting them by paving a way for online business (30%). 25% of the respondents stated that women could engage in e-learning which will advance their skills and empower them educationally. Other empowerment roles as seen from the result in figure 1 above are e- commerce (15%), where they respondents identified that women could get more financial empowerment and independence if they engaged in buying and selling over the internet. 10% of the respondents said women in agriculture could advertise their goods and services hence reaching a wider audience through the use of ICTs like radios, televisions, telephone calls, text messages, instant messages and through the vast array of services provided by the internet.

CONCLUSION

Women play a vital role in agriculture and agricultural development in Nigeria. The women in agriculture program seeks to improve agricultural extension services for women, and ensure that extension services have female extension workers at every level operation. These women in Agriculture need all the empowerment and support they need and can get, in other to perform their duties diligently as this will lead to greater production and in ensuring food security in Nigeria.

The survey identified that ICTs, is beneficial to the Nigerian women in agriculture and hence the respondents made recommendations on how best to improve and ensure better delivery of ICTs to women in agriculture in Nigeria. The research enumerated several empowerment roles played by ICTs to the Nigerian women in agriculture which included but not limited to; knowledge empowerment, wealth creation, increased information base, e- learning and fostering online business.

Table 1: Benefits of ICTs to women in agriculture

Benefits of ICTs to women in agriculture	Frequency	Percentage (%)
Ensures speedy delivery of local and globally available information.	95	95
Reduces cost and time spent on information dissemination.	90	90
Makes for easy data collection, analysis, and reporting of research	65	65
Access to global best practices in farming, storage, processing and marketing of agro- produce.	85	85
E- Banking enables access to funds round the clock.	75	75
Brings education to rural women, where majority of women in agriculture reside	98	98
Allows large number of people to communicate directly, cheaply and speedily	92	92
Promotes networking and collaboration among women in agriculture irrespective of geographical location	72	72

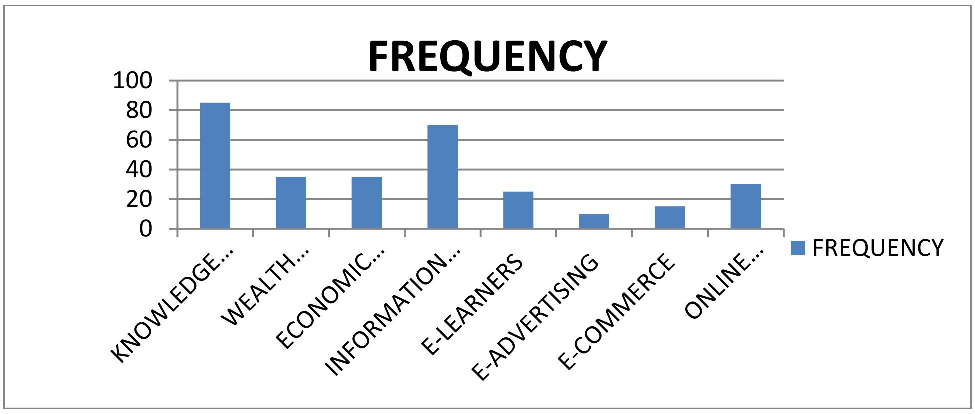
Source: field data 2016

Table 2: Recommendations on how to improve ICTs delivery to Nigerian women in agriculture

Recommendations	Frequency	Percentage(%)
Government should subsidize ICTs tools so that it can be more affordable for Women in Agriculture.	100	100
Sensitization of women in agriculture especially the majority stationed in the rural areas on benefits of ICTs tools	98	98
Increased availability of ICTs especially to rural areas so that rural women in agriculture can benefit	95	95
Capacity building on the part of the women in agriculture	70	70
Government to fund women in agriculture groups to enable them acquire and benefit from ICTs	92	92
Awareness campaign on empowerment roles of ICTs to be carried out nationwide especially in rural areas	88	88

Source: Field data, 2016

Figure 1: Roles of ICTs in the empowerment of Nigerian women in agriculture



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ADMINISTRATION OF INTELLECTUAL PROPERTY IN NATIONAL AGRICULTURAL RESEARCH INSTITUTIONS OF NIGERIA

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ABSTRACT
Agriculture which is the Science, Art or Practice of cultivating the soil, producing crops and raising livestock and in varying degrees the preparation and marketing of the resulting products is of great importance to the society, particularly to Nigeria which has a teaming population. Because of the importance of agriculture to society and the economy of Nigeria as a whole, it is desirable that continuous research be carried out in order to improve on the variety of agricultural produce so as to make available high yielding and resistance free varieties desirable for the expanding and dynamic society of Nigeria for enhance income, poverty reduction, export and good living. One of the missions of public research institutes is to generate knowledge technologies and products that promote the public good. Traditionally this has been achieved by practicing the "Open Science Policy" which means that scientists at public research institutes completely disclose all their research discoveries and innovations to the scientific community and made it available for commercialization at no cost (that is zero technology fee or licensing fee) through Extension Agents. However, in some instance there is need for Intellectual Protection (IP) even for the public research. One of the Instances where protection makes economic and social sense is when the protection of IP helps in promoting public – private cooperative relationship and speeds up the development of new products and services. If for instance, a public research institute generates a technology or product with great potential social benefits but requires huge financial resources or business structure to further develop and market this major scientific breakthrough, then the public's interests are best served by protecting and restricting its use. This is necessary to give protection to the private sector which will be the vehicle through which the technology or product may be made available for public consumption. It is not gain saying that there can be no talking about economic diversification without talking of partnering with the private sector for mass production of improved varieties for consumption as well as export. There is no doubt that we are in a globalised world that is intensely knowledge driven in which Nigeria as a developing country can favorably compete given an appropriate and well informed and reformed IP Law and Policy that would advance human and economic development. Your IP which is the creation of your minds is a tangible asset that can be used to generate income for your parastatals and of course attract loyalties even for yourselves. This could reduce total dependence on government for research funds as well as enhanced multiplication of improved varieties for enhanced commercialization.
Keywords: Intellectual property, national, research institutes

INTRODUCTION
In its bid to position, coordinate and facilitate the development and application of IPRs policies and practices in National Agricultural Research Institutions, the Agricultural Research Council of Nigeria (ARCN) outlined the following comprehensive draft IP Rights Policy Guidelines on IP issues in relation to Plant Variety Protection, Technology Transfer, Commercialization of IP or Technologies, Human Resource Development, Incentives and Benefit Sharing (ARCN 2009).

Plant Variety Protection
The IP Protection of plant varieties of ARCN, including the extant varieties, will be secured under the relevant Act. It is noteworthy here that the draft law does not specify which Act is relevant. It is my opinion that the Act meant here should be the enabling Act on IP in Nigeria, There is also no legislation on plant variety protection in Nigeria for now. This in turn will enable a more rapid and effective transfer of plant varieties to the end users. However, a decision can be taken by the ARCN even after the plant variety protection (PVP) certificate has been obtained as to whether a particular variety will be transferred for commercial use through exclusive or non-exclusive licences or it will be placed solely in public domain to meet some specific national need or situation. Where it is considered necessary in public interest to specifically promote some ARCN verities for food and nutritional security or for diversifying agriculture, special steps will be taken as may be deemed fit by the competent authority. This should *advert* the fear of granting IPR on plant variety as farmer's right will also be adequately protected.

Registration and protection of plant varieties of filed, horticultural and agro forestry crops, developed by ARCN institutions, which meet the essential criteria for their protection, will be obtained by the institutions in the name of ARCN, under the law. The period for which the PVP title of the protected varieties will be maintained will depend on the actual performance or adoption of the variety. This will be periodically reviewed by the concerned Institutes Technology Management Centre's (ITMCs) or Zonal Technology Management Centre's (ZTMCs). and decided by the respective ITMUs or ZTMGs ARCN will maintain the IPR portfolio of its varieties, hybrids or transgenic in a transparent manner. ARCN may file PVP applications for sole ownership over its plant varieties for firstly, the varieties developed in ARCN institutions(s), the hybrids developed in ARCN where the parents of hybrid belong solely to ARCN, and the transgenic where the transgenic events are carried out in ARCN institution(s) and the initial variety and gene sequence(s) or events belong solely to ARCN. ARCN may file joint application with others, such as, NARIs or FCAs or other concerned organizations/institutions/research establishments in the public or private sector for varieties which have been developed through collaborative efforts. Where it has been decided to file joint applications, the same will be taken up on mutually agreed terms between ARCN and the other collaborators or research partners. Where the collaborator(s) or research partner(s) assign a jointly developed plant variety to ARCN for protection and further management, ARCN will file PVP application as sole applicant. However, it shall include the names of the research partners as the breeders of the candidate variety in the PVP application. In other cases, ARCN as well as the other collaborator jointly responsible for developing a plant variety will be the co-applicants. ARCN will share benefit accrued from commercialization of that variety with the collaborator(s) research partner(s) on mutually agreed terms. Where the collaborator or research partner is an international agency or a foreign client, and the variety hybrid or transgenic is developed in ARCN, the ownership and the licensing rights will be determined on mutually agreed terms. The Memorandum of Understanding (MOU) with the collaborator or partners will be executed by ATMC at the ARCN headquarters. Other terms and conditions, and limitations of the MOU will be entered as per the mutual agreement. As ARCN will be the institutional breeder and the applicant in the PVP application for each of the plant varieties developed in its set up, it will also discharge any liability in respect of benefit sharing as may be determined by the PVP Authority; compensation for under performance, if any and any other liability that may be fixed by the PVP Appellate Tribunal, or any court of law.

Registration and Protection of Extent Varieties

An extant variety is the variety available in Nigeria which is either (i) notified under the relevant law, or (ii) a farmers' variety, or (iii) a variety about which there is common knowledge, or (iv) of any other variety which is in public domain. The following procedure may be followed for registration and protection of extant varieties of ARCN in relevant cases. ARCN institutions shall provide all the necessary information required under the law/rules for registration of extant varieties developed by them to ARCN. This will include the particulars required for the National Registrar of Plant Varieties, such as the denomination of the variety, names of breeders involved in its development, pedigree details salient features of identity vis-à-vis most similar varieties, zone(s) of adaptation, performance limits under specified situations particularly for Distinctiveness, Uniformity and Stability (DUS) traits, along with a referral seed sample. ARCN will further verify the database of extant varieties developed and maintained at the Bureau with the information received from different institutions and supplement the information with the molecular profile of the variety if available. Authenticated seed samples of the variety will also be developed in the active and base collections at the national gene bank at ARCN on immediate basis. Availability of adequate quantity of nucleus/breeder seed will be simultaneously ensured. ARCN will also ensure that the seed samples of all extant varieties are available for registration as well as conservation purposes. At the earliest, ARCN will take action so that proposal(s) for registration of all extant varieties of ARCN which have not completed 15 years from the date of their notification under the law are kept ready in all respects. Application(s) for registration and protection of these extant verities shall be made as soon as possible. In a specific case where there is common knowledge about a variety developed by ARCN which is not notified under the law, or it is already in public domain, such matters will be brought before the competent authority at the ARCN headquarters for decision. But for the extant varieties other than those described above for example farmers; varieties or some varieties of common knowledge no direct role of ARCN is stipulated.

Registration and Protection of New Varieties, Hybrids or Essentially Derived Varieties

The Principal Investigator (PI) plant breeder will inform the respective ITMU or ZTMC at the institution early about the availability of any prospective material developed by him or her which can qualify for a new distinctive, uniform and stable crop variety. The following are to be provided by the PI or Breeder.

1. The salient particulars of the prospective varietal material along with name(s) of most similar varieties will be provided by the PI or Breeder.
2. In case of a hybrid or appropriate information on parental line, this shall also be provided by the PI or Breeder.
3. In case of transgenic variety, information will be provided with respect to the initial variety and its parents, the gene sequence including the promoters and their source, and the transgenic events.

4. In case of seed propagated crops, the above early information will be given at least for months prior to the next crop season alter duly completing the harvest, seed processing and storage, appropriate statistic analysis and interpretation of result of the previous crop storage, appropriate statistical analysis and interpretation of results of the previous crop season. In case of vegetative propagated crops like sugarcane such information will be given while the crop is still standing.

The Institutions by way of follow up action will through the ITMUs or ZTMCs prepare the lists of prospective varieties of their respective institutions proposed by Plant Breeders, and prepare schedule of assessment of these material in the next crop season involving ITMU or ZTMC and other co-opted crop specialists from within or outside the institution. The ITMC or ZTMC will make necessary recommendations for follow up by the concerned scientists or institution on the basis of assessment of the potential varietal materials in the experimental plots as per given schedule, consideration of the performance data in station and cooperative trials in the previous years. DUS parameters vis-à-vis the most similar varieties and some extraordinary or exceptional merit seen in the varietal material, if any, based on which it can be taken up for filling PVP application at an early date. ITMC or ZTMC will also advise on the finalization of a suitable denomination for the deemed variety, which should be unambiguous and in conformity with the requirements of PVP Law. Decision to file PVP Application: Normally, the process of filling application for registration and protection of varietal materials recommended by the ITMC will be taken up by the concerned institution as soon as the variety has been identified in the ARCN workshop. Therefore, the basic information required for filling the PVP application should be kept ready by the respective ITMUs in consultation with the concerned Pant Breeders. ARCN will thus normally prefer filling its applications for variety protection only when there is satisfaction with respect to the outcome of Value for Cultivation and Use (VCU) of identified varieties. In exceptional cases, on a case-specific merit basis, early application can be filled by ARCN institutions for registration and protection of prospective varietal materials.

In case of new varieties and hybrids, PVP application will be filed differently from and that for the essentially derived varieties under the relevant provisions of the law. Nucleus and Breeder Seed: The PI or Breeder will accord priority to the production and maintenance of nucleus seed of the prospective varietal material(s) reported to the ITMU or ZTMC as candidate varieties for PVP. The concerned institutions shall take up production of breeder seed of prospective varieties (most promising varieties in advance varietal trials), one year prior to filing the application for their registration. Performance Limits. All concerned Breeders or Scientists shall specifically provide the performance limits under each of the different environments/situations that are considered suitable for cultivation of the variety proposed for registration and protection under the law. This would be necessary to avoid any uncalled for litigations and compensation for under performance.

Maintenance of Seed or Propagation of Protected Plant Varieties

Concerned institutions or breeders will be responsible for the maintenance of varietal purity, and will ensure the availability of breeder seed for public supply or commercial use, as applicable. On Variety Registration and Protection, Concerned ITMUs or ZTMCs will undertake and pursue the needed steps under the law required for seeking registration and protection of plant varieties.

Maintenance of the Protection

The ITMUs or ZTMCs will maintain the PVP titles secured by them by payment of requisite recurrent fees to the registrar. The ITMUs will undertake periodical reviews and decide on further maintenance of titles by payment of requisite fee based on actual performance of variety, further licensing potential of the variety in Nigeria or abroad, potential use of the variety for further variety development programme, or any other specific or relevant criteria considered appropriate for the purpose.

Farmer's Rights

All matter related to farmers' rights arising in the protection of plant varieties by ARCN will be taken up or resolved as per the provisions of the law. A Mechanism of IP monitoring and watch will be developed. The ATMC may assist the ITMUs or ZTMCs and wholly or partially outsource the task of IP watch. In the event of suspected infringement of protected ARCN variety, the concerned institution(s) will take initial action at their own, or in consultation with the ZTMCs or ATMCs. All cases of litigations where ARCN is made a defendant will be taken up by the concerned institutions that have protected/maintained the IP under the disputed case. Institutions will, if required, seek assistance of ARCN legal adviser or other legal experts. In all cases the institutions will notify and keep the ARCN headquarters informed of any such dispute. In all cases of litigation where major stakes of ARCN are involved, ATMC will take up the matter with the assistance of empanelled experts or other competent experts on need basis.

Technology Transfer and Commercialization of Plant Varieties

On the procedure for improving access to plant varieties by end users based on national priorities and issues of food and nutritional security, ARCN may decide to place a plant variety solely in the public domain or else it may be licensed for commercial use on exclusive or non-exclusive basis. However, registration and protection of all protectable varieties will be ensured under the Plant Variety Protection (PVP) and Farmers' Right (FR) Act before placing them in public or commercial domain. For commercialization of plant varieties broadly the general guidelines for technology transfer or commercialization of IP enabled ARCN technologies will be followed. ARCN will make the specific considerations in the commercialization of its plant varieties as they can have direct impact on issues of food and nutritional security and farm income**s.** For other consideration**,** all the registered varieties will be transferred for cultivation and use through open access or commercialization. No plant variety will be transferred or commercialized before its registration and protection under the PVP and FR Act.

ARCN may consider any appropriate proposal for the grant of exclusive Licence to a private seed company or public seed agency for commercialization of its protected plant variety abroad. All such varieties of ARCN institutions which have commercialization potential abroad shall be assigned to ATMC and licensed under suitable arrangements or agreement keeping in view the interest of Nigerian farmers and national priorities.

1. Advance breeding material or parental lines shall not be transferred or licensed on exclusive basis. These will first be registered with the National Centre for Plant Genetic Research (NCPGR) before any material transfer or licensing will be done.
2. Normally, commercialization of an ARCN variety will be done by same institution or zonal institute that has secured the PVP title. However, where more than one ARCN institutions are involved or interested in the commercialization of the same variety, or where they are given this specific responsibility in public interest by the ARCN, these institutions will mutually settle the sharing arrangements.
3. ARCN institutions will obtain assistance or advice of ATMC or ZTMC, if needed, particularly for any legal opinion or market information.
4. The parametric values of all successful licenses will be recorded in the institutional/zonal central database.
5. ATMC will evolve suitable mechanisms for quick disposal of plant variety licensing cases at different levels in ARCN.

Other Related Matters

Standard records of generic stocks at the research institutes or colleges along with confidential records (codes) where applicable shall be maintained in signed and countersigned notebooks or registers. Suitable data sets will also be documented in the institutional, zonal or central database. All confidential information, such as codes, etc. will be kept safely and would not be revealed by individuals or institutions except through confidentially agreements which will expressly mention the purpose for sharing such information and other terms and conditions.

Concerned breeder or other ARCN scientist will report all matters of infringement or suspected infringement of plant variety rights in their knowledge to the respective ITMUs, ZTMCs or ATMC as appropriate. Concerned ITMUs or ZTMCs will handle the cases reported to them or other apprehended cases either on their own or with the assistance of ATMC. Further legal action, if required will be taken with the approval of competent authority.

The commercialization of plant variety portfolio will be monitored by ITMUs or ZTMCs or ATMC. The relevant developments or matters of concern, etc. will be critically observed and addressed. ATMC or ZTMCs will develop a mechanism of market watch. ATMC will plan, organize or assign suitable impact assessment studies on socio-economic impact of the commercialized plant varieties or hybrids of ARCN in different crops and regions of the country.

Technology Transfer/Commercialization of IP Technologies

Procedures for Technology Transfer or Commercialization

A central database of the IPR enabled technologies will be at the ATMC. The concerned institutions or zonal institutes will make entries of all new cases in their respective datasets as soon as the process for their IPR protection is started. They shall also update the status of IPR protection maintenance in the data set from time to time. The entire ARCN IP database will be suitably inter-linked to the NARIs and Federal Colleges of Agriculture (FCA) through intranet, at the earliest opportunity. Notwithstanding the fact that only a small proportion of protected IP generally meets with commercial success world-wide, the ATMC and ZTMCs or ITMUs will make efforts for technology commercialization with the primary objective of technology transfer to end-users. Depending upon factors such as technology etc. a decision will be taken by the competent authority whether the technology will be placed in the public domain through open access, or it will be transferred to end-users through commercialization. The ITMUs or ZTMCs or ATMC shall develop a system of registering industry, enterprises or cooperatives for technology transfer or commercialization of ARCN Technologies. Registration of area, discipline or zone-wise potential licensees from industry, enterprises or cooperatives will be undertaken by inviting applications through advertisement. The registered entities will be informed of the IPR enabled technologies available from time to time for transfer through commercialization. A nominal registration fee will be charged and the registration renewed annually. Concerned ITMUs will disclose the salient features of technology ready for commercialization. The technology disclosure for commercialization will be made in a confidential agreement. The ITMUs, ZTMCs or ATMC will also advertise the IP enabled ARCN technologies available for commercialization by suitable means. The IPR enabled ARCN technologies ready for transfer or commercialization will be given publicity through web portals of federation or Chambers of Commerce, and other organizations for wide reach to interested clients. The IPR enable technologies will be transferred for commercial purposes with suitable understanding or agreement or contracts with the concerned parties. Specific terms of licensing can be negotiated. Commercialization will be undertaken either by ITMUs of the concerned institutions that have the requisite expertise and experience or the concerned ZTMCs or ATMC. Commercialization in foreign countries shall be undertaken by the ATMC.

CONCLUSION

The administration and practice of Intellectual Property and Intellectual Property Rights in National Agricultural Research Systems is a very veritable tool for effective and proper utilization of research results and innovations through public - private partnership relationship which should make mass production and commercialization possible for the benefit of the masses, the scientists and even for exports which should increase the Gross Domestic Product of Nigeria. We are in a globalised world and the earlier the National Agricultural Research Systems in Nigeria cue's in the global positive issues relating to agriculture, the better for the system. However, it is my view that the use of Technology Transfer Offices in the various National Agricultural Research Institutes headed by intellectual property professionals and intellectual property lawyers to enhance proper coordination and collection of new research results and innovations for patenting will be more effective than the use of Institute Technology Management Committees (ITMC), Institute Technology Management Units (ITMU), Central Technology Management Committee (CTMC), Zonal Technology Management Committee (ZTMC), Zonal Technology Management Unit (ZTMU),

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USE OF MOBILE PHONES IN AGRICULTURAL INFORMATION TRANSFER BY EXTENSION AGENTS IN OYO STATE, NIGERIA

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ABSTRACT
The study determined the use of mobile phones to disseminate agricultural information between extension agents and farmers in Oyo State, Nigeria. Structured questionnaire and interview sessions were used to obtain data from 120 extension agents. Descriptive statistics was used to analyze the result obtained. Male and female extension agents in the state comprised 85% and 15% respectively. The highest age range was between 31 – 40 years with 46.7%. Majority of the respondents (98.3%) had tertiary education and 74.2% had put in less than 10 years of service with the ADP. Almost, all the respondents (98.3%) owned personal mobile phones. Those who owned ordinary phones were 67.5 while 32. 5% had phones with multi-media effects. Those who used their phones for agricultural messages were 92.5% and information sent in order of importance are notice of meetings (96.7%), feedback to famers' questions (93.3%), offer of solution to farmers problems (91.7%) and prices and cost of products (90%), notification of disease and pest outbreak (82.5%) and introduction of new technologies (81.7%). Voice calls (59.5%) and short messages systems (40%) are the mobile phone technologies used mainly by respondents. The average time spent in calling a farmer by all respondents is less than 2 minutes. The weekly amount spent on the recharge cards are below N1, 000 (60.8%). Only 4.2% received official allowance for recharge cards. All the respondents agree that mobile phones enhance general access to information, and 83.3% believed that it reduces the number of group meetings. The use of mobile phone enhances information and technology transfer and should be encouraged by all stakeholders in agriculture.
Keywords: Mobile phones, Agricultural messages, Dissemination, Technology

INTRODUCTION

Information and communication technology (ICT) play a major role in bringing agricultural information to rural communities, especially in the delivery of information and technical advice to farmers through extension services. There are many technologies with potentials to improve the economy of the rural farmers, in research institutes that are kept in their files and shelf. Interactive forum for research, extension agents, and farmers is either inadequate or not efficiently done due to inadequate funding. Agricultural extension is an important means of enabling farmers to benefit from agricultural research and development by taking the interventions and innovations to them. Survey has revealed that only 5.7% of farmers have access to information from the extension workers, and this clearly shows that the current number of extension workers is inadequate to meet the needs of farmers. Also, it has been discovered that the use of mobile phones play a very useful role in fulfilling the information needs of farmers, most especially among marginal and small ones (Lawal, 2008) Extension workers to farmers have the ratio of 1:3000 farm families, and inadequate mobility are another constraints to dissemination of research proven, findings and relevant agricultural technologies that aim at providing solutions to poverty, hunger, and malnutrition in Nigeria (Bolarinwa and Oyeyinka, 2011). The use of mobile phones can help facilitate the link between research and extension (Chauhan,2006). Based on the foregoing, the study attempted to determine the use of mobile phones in the transfer of agricultural information by the extension agent in Oyo state of Nigeria. It examined the information types delivered by agricultural extension to farmers, its effects and constraints in its usage.

METHODOLOGY

The study was carried in Oyo state, in Nigeria. The population of the study consisted all extension agents (155) in Oyo state Agricultural Development Programme (ADP). The list of all extension officers in the 4 administrative zones in the state ADP which are Oyo, Ogbomoso, Saki and Ibadan/Ibarapa were obtained to be 34, 29, 36 and 56 respectively. giving a total of 155. All of them were purposively selected for the study. However, only 120 questionnaires were recovered. The primary data was collected through the use of questionnaires and in-depth interview with key informants. The data collected was analyzed using simple descriptive analysis such as frequencies and percentages.

RESULTS AND DISCUSSION

Table 1 below indicates that 15% of the extension agents were of the female gender, while 85% were males. Their highest age range was between 31-50 years with 72.5% while, 9.2% were above 50 years. Almost all the respondents (96.3%) had tertiary education. The result also revealed that 74.2% of the respondents had worked as extension agents for less than 10 years, while 25.8% had worked for above 10 years. The involvement of extension workers in the study area seems to be tailored along gender lines as more male extension officers than females were employed. Having very few women extension workers could affect agricultural educative outreach program that are female specific.

Table 2 shows that 99.2% of the respondents personally owned their mobile phones while 0.8% did not. While 67.5% used ordinary (low technology phones) 32.5% used high technology multimedia phones which enables them to send picture messages and carry other more high profile activities. Majority of them (92.5%) used their mobile phones to contact the farmers and disseminate agricultural information to them. This shows that usage of phones for extension work is a veritable tool for agricultural development and information transfer and it supports the statement by Chauhan (2006) that use of mobile phones can help facilitate the link between research and extension.

According to the result in Table 3 extension agent made use of their phones for the following types of information: notification to farmers about meeting (96.7%), updating farmers about the cost of produce (90.0%), notification of pest and disease outbreaks (82.5%), providing information on new technological approaches to farming operations (81.7%), response to the questions of the farmers on an issue bothering them (91.7%), and obtaining feedback from farmers to ascertain the level of effectiveness of the information's and solution given to them (93.3%). This result depicts that the use of mobile phone is a very useful and effective tool in the extension service delivery of agents in the study area. According to Alonge *et al* (2012) after an initial personal contact with a famer by an agent further discussions can be by phones a follow up to the personal meeting.

Table 4 showed the most used mobile application to be voice calls by 59.2% and 40% used Short Message Service (SMS) to disseminate information. About 42% of the respondents spend $\leq$ 2 minutes in calling the farmers respectively, while 50% spent more than 2 minutes. Extension agents (60.8%) spent less than N1000 every week, and 33.3% spent between N1000 and N2000 for information dissemination. The 4.2% who reported funding of their expenses for recharge card from the office are likely to be top management staff who are entitled to such allowances. Extension agents' assessment of the effectiveness of the use of mobile phones using a lickert-type scale showed high and positive rating in terms of speed (95.8%) to access information and reduction in the number of meetings (74.2%) per agent. According to Alonge *et al* (2012) mobile phones are used for follow ups thereby reducing the number of visits by extension agents.

CONCLUSION

The use of mobile phones in agricultural information and technology transfer between extension personnel and farmers is very effective. The most effective mobile phone applications used are short message service and voice calls. The use of mobile phones enhances quick access to information and reduces the number of visits to farmers without reducing the quality of service delivered. For effective utilization of mobile phones by extension workers special customized phones meant for farmers/ extension activities should be introduced and allowance for air time subscription paid by the ADP.

Table 1: Extension Agents Personal Characteristics in the Study Area

Item	Frequency	Percentage
Sex:		
Male	102	85%
Female	18	15%
Total	**120**	**100%**
Age:		
≤ 30	22	18.3%
31-40	56	46.7%
41-50	31	25.8%
Above 50	11	9.2%
	120	**100%**
Educational Qualification		
O'Level/SSCE	2	1.7%
NCE/ND	8	6.7%
HND	38	31.7%
BSc/BA/B.Engr/B.Tech	55	45.8%
Post graduate	17	14.2%
Total	**120**	**100%**
Years of Experience		
≤ 10	89	74.2%
11-20	22	18.3%
21-30	8	6.7%
> 30	1	0.8%
Total	**120**	**100%**

Source: Field survey 2015

Table 2: Ownership and Use of Mobile Phones by Extension Agents

Item	Frequency	Percentage
Ownership of Mobile Phone		
Yes	119	99.2%
No	1	0.8%
Total	**120**	**100%**
Type of Mobile Phone		
Ordinary	81	67.5%
Multimedia	39	32.5%
Total	**120**	**100%**
Use of mobile phone for work Activities		
Yes	111	92.5%
No	9	7.5%
Total	**120**	**100%**
Years of using mobile Phone		
< 5	17	14.2%
5-10	27	22.5%
> 10	76	65.8%

Source: Field Survey, 2015

Table 3: Type of information sent out through the use of mobile phone (n=120)

Types of Information	Frequency	Percentage
Notice of meeting	116	96.7%*
Cost of procedure	108	90%
Notification of disease/Pest outbreak	99	82.5%
Introduction of new technologies	98	81.7%
Solution to farmers problems	110	91.7%
Feedback to farmers questions	112	93.3%

Sources: Field Survey, 2015 * Multiple Responses

Table 4 Mobile Phone Applications and Cost of Usage

Items	Frequency	percentage
Mobile phone Applications		
SMS	48	40%
Voice Call	71	59.2%
Pictures	1	0.8%
Average Time per Call in minutes		
≤ 2	50	41.7%
2-3	48	40%
4-5	12	10%
Above 5	10	8.3%
Total	**120**	**100%**
Cost of recharging per week in ₦		
Below 1000	73	60.8%
1000-2000	40	33.3%
Above 2000	7	5.8%
Total	**120**	**100%**
Recharge card allowance		
Yes	5	4.2%
No	115	95.8%
Total	**120**	**100%**

Source: Field Survey, 2015

Table 5: Evaluation of the effectiveness of the use of mobile phone

S/n variables	S A	A	U	D	S.D
1.Quick access to information	115(95.8%)	5(4.2%)	-	-	-
2.Better access to information	26 (21.7%)	44(36.7%)	20(16.7%)	30 (25%)	-
3.Easy passage of information	56 (46.7%)	38(31.7%)	20 (16.7%)	6 (5%)	-
4.Reduction in number of meetings	89 (74.2%)	10 (8.3%)	16 (13.3%)	5(4.2%)	-

Source: Field Survey, 2015

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ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

SUB-THEME VIII:

LIVESTOCK AND POULTRY PRODUCTION, IMPROVEMENT, HEALTH AND WELFARE

PERFORMANCE AND ECONOMIC EVALUATION OF BROILER CHICKENS FED GRADED LEVELS OF ROASTED BAOBAB (*ADASONIA DIGITATA*) SEED MEAL

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ABSTRACT
A 55 day feeding trial involving one hundred and eighty one day old Oba Mashall was conducted to determine the performance and economic effectiveness of broiler chicks fed dietary levels of roasted baobab seed meal (RBSM). The birds were randomly allocated to four dietary treatment groups (A, B,C and D) at the levels of 0, 4.12, 8.24 and 12.36 % respectively. The parameters considered were initial weight, final weight, body weight gain, feed intake, feed to gain ratio, feed cost per kg, feed cost per kg body weight, income above feed expenses (IAFE) and mortality rate. The result from this study revealed that all the birds on RBSM dietary treatment performed better than those on control diet. The performance improved with increased dietary levels of RBSM. The cost analysis indicated that the control diet had higher feed cost/kg, and feed cost/kg body weight gain than those on the RBSM diets. The control diet had lower IAFE than those on treatments. The lower feed cost/kg, feed cost/body weight gain and higher IAFE observed in birds fed diets containing RBSM in this study is due to low cost price of baobab seed. In conclusion, dietary inclusion of RBSM at 12.36 % both reduced cost of production and did not impair the performance of birds.
Keywords: Performance, Evaluation, Broiler, Meal, Roasted

INTRODUCTION
There has been an unprecedented demand for meat and other animal products in recent times. According to FAO (2004), the increase in demand for animal products will likely be at the rate of 3.3% per year. In animal production, poultry production has the highest turnover rate and quickest returns to investment outlay (Ogundipe and Sanni, 2002), which had led to the rapid growth in poultry enterprise in Nigeria. However, the sudden decline noticed in the industry is attributed to lack of feed. Esonu *et al.* (2001) reported that about 50% of Nigeria poultry farms have been closed down and another 30% will likely reduce their production capacity due to lack of feed. While poultry producers want to maximize profit, consumers on the other hand desire quality products. The cost of producing poultry products using conventional feedstuffs that are in high competition with human is on the increase Therefore, to bridge the gap between poultry products prices and consumer purchasing power, the nutritionists and researchers have resorted to alternative feedstuffs with little or no competition between man and livestock industry (Adeosun *et al*., 2004; Adeosun *et al*., 2013; Sola-Ojo *et al*., 2013), and yet without compromising quality for low cost. Onimisi *et al.* (2009) working on quality protein maize (QPM) opined that the rapid demand in feed stuff for livestock could only be met by cereals which have potential for increasing productivity and improve nutritional value through better feed efficiency. However, these cereals are equally in demand for human consumption. As researchers therefore explore new and non-conventional crops, it is important to sort out free crops grown in such region where poultry production is situated. Baobab is a well adapted deciduous tree crops found in most part of Africa FAO (1980). These plants are indigenous in Katsina state and are in abundant supply.
The seed being rich in protein and fats will play a dual role in meeting both energy and protein requirements of broiler birds. Saka *et al.* (1994) reported that baobab seed contains 29.6% fat, 28.7 crude proteins and 7.3% crude fibre. Saulawa *et al.* (2014) worked on different methods of processing baobab seed, and reported ranges of proximate composition, as 18.68 to 28.85% CP, 2.19 to 4.41 ether extract and 8.29 to 10.78% CF. The aim of this study therefore, was to evaluate the growth performance and cost implication of feeding roasted baobab seed meal to broiler chickens.

MATERIALS AND METHODS

The experiment was carried out at Federal University Dutsinma Katsina's Livestock Research and Teaching farm. A total of one hundred and eighty one day old Oba Marshall purchased from commercial supplier was used in this study. The birds were weighed with similar average weight and allocated to four dietary treatment groups which were further divided into 3 replicates with 15 birds per replicate. The baobab seed purchased in Dutsin-Ma Local Government area of Katsina State were washed, sun-dried, roasted to golden colour and ground to a meal and then used to formulate the diets for starter and finishers phases (Table 1 and 2). The roasted baobab seed meal (RBSM) was included to four dietary treatments, A, B,C & D at levels of 0 (Control), 4.12, 8.24 and 12.36% respectively. This was done in accordance with NRC (1994) requirements. The experiment ran continuously for a period of 8 week. All necessary routine management with vaccination schedule was followed.

The parameters measured were initial weight, final weight, body weight gain, feed intake, feed to gain ratio, feed cost/kg, feed cost/kg weight gain and mortality rate. Income above feed expenses was also considered. All data collected were summarized and analysed statistically according to Steel and Torrie (1980) and significant means separated using Duncan Multiple range test (Duncan, 1955).

RESULTS AND DLSCUSSION

Table 3 shows the performance of broiler chickens fed dietary levels of RBSM. No significant ($p>0.05$) difference was observed among treatment means in final weight, body weight gain, feed intake and feed conversion ratio. Sola-Ojo *et al. (2013*) reported better performance in birds fed decorticated undefatted baobab seed meal (DUBSM) at 7.55% inclusion level. However, Ezeagu (2005) reported lowered weight gain in rats fed heat treated baobab seeds, while Hayward *et al.* (1936) reported that heat treatment enhances nutritive value of proteins by making sulfur containing amino acid readily available. It was also noticed from this study that feed cost/kg decreased as the inclusion levels of RBSM increased in the diets. The lowered feed cost/kg might be attributed to low price of baobab seeds which eventually resulted in low feed cost/kg weight gain. It is therefore concluded that inclusion of RBSM up to 12.36% in broilers diets was beneficial to growth performance of birds and also resulted in better economy of production.

CONCLUSION

In conclusion therefore, the inclusion of RBSM in the diets of broiler chickens resulted in low feed cost/kg, feed cost/kg weight gain and higher income above feed expenses; it is therefore less expensive to include RBSM in broiler diets compared with soybean meal.

Table 1: **Composition of Experimental Diets for Starter Broiler Chickens containing graded levels of Roasted Baobab Seed Meal (23% CP) Roasted Baobab Seed Meal (23% CP)**

Ingredient	**T_1**	**T_2**	**T_3**	**T_4**
Maize	54.31	53.40	52.47	51.55
Groundnut cake	26.31	23.51	20.73	17.91
Soyabean cake	10.00	10.00	10.00	10.00
Fish meal	3.50	3.50	3.50	3.50
Limestone	0.05	0.05	0.05	0.05
Salt	0.35	0.35	0.35	0.35
Bone meal	3.60	3.60	3.60	3.60
Vit. Premix	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.18	0.18	0.18	0.18
Oil	1.20	0.79	0.38	0.00
RBSM	0.00	4.12	8.24	12.36
Total	**100.00**	**100.00**	**100.00**	**100.00**

Table 2: Composition of Experimental Diets for finisher Broiler Chickens containing graded levels of Roasted Baobab Seed Meal (21 % CP)

Ingredient	T_1	T_2	T_3	T_4
Maize	59.92.	58.96	57.96	56.94
Groundnut cake	21.30	18.50	15.71	12.95
Soyabean cake	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00
Limestone	0.05	0.05	0.05	0.05
Salt	3.50	3.50	3.50	3.50
Bone meal	0.25	0.25	0.25	0.25
Vit. Premix	0.25	0.25	0.25	0.25
Lysine	0.18	0.18	0.18	0.18
Methionine	0.35	0.35	0.35	0.35
Oil	1.20	0.84	0.51	0.17
RBSM	0.00	4.12	8.24	12.36
Total	**100.00**	**100.00**	**100.00**	**100.00**

Table 3: Performance and Economic Evaluation of Broiler Chicken fed graded levels of roasted baobab seed meal (0-8 weeks) treatments

Parameters	A	B	C	D	SEM
Initial weight g(bird)	46.67	46.67	46.67	46.67	0.010
Final weight (g/bird)	2008.16	2168.19	2388.32	2666.46	18.31
Weight gain (g/bird)	1961.49	2121,52	2341.65	2619.79	8.11
Feed intake (g/bird)	4284.78	4382.18	4419.24	4475.59	32.14
Feed conversion ratio	2.19	2.07	1.79	1.71	0.02
Feed cost/kg	101.64	98.46	96.78	91.98	41.51
Feed cost/bird	435.65^{b}	431.47^{ab}	427.69ab	411.66^{a}	4.31
Feed cost/kg gain	229.24^{d}	204.15^{c}	182.59^{b}	162.80^{a}	0.75
IAFE (₦)	470.75	496.51	517.41	537.20	0.15
Mortality (%)	24.00^{b}	13.33^{a}	11.11^{a}	11.11^{a}	1.53

^{a,b,c,d} Mean with different superscript in the same row are significantly ($p < 0.05$) different

SEM: Standard Error of Mean

IAFE: income above feed expenses at N700.00 per kg

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HAEMATOLOGICAL INDICES OF WEST AFRICAN DWARF GOATS FED YELLOW ROOT CASSAVA PEEL-CENTROSEMA LEAF MEAL BASED DIETS

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ABSTRACT
A 74-day feeding trial was conducted to study the effect of yellow root cassava peel-centrosema leaf meal based diets on haematology of 36 West African Dwarf (WAD) goats. Four diets were formulated such that diets A, B, C and D contained 0%, 10%, 20% and 30% centrosema leaf meal. The diets were offered to the growing goats, which were randomly divided into 4 groups of 9 goats each, with three goats constituting a replicate in a completely randomized design. Each animal received the designated diet on 3.5% body weight basis in addition to wilted Panicum maximum. Result showed on the proximate analysis revealed that the diets were within the nutritional requirements of goats. Results showed that packed cell volume (PCV), haemoglobin (Hb), mean cell haemoglobin concentration (MCHC), mean cell volume (MCV) and white blood cell (WBC) differed (P<0.05) significantly, while red blood cell and mean cell haemoglobin were similar (P>0.05) among the groups. PCV, Hb, MCHC, MCV were improved (P<0.05) by the test diets. White blood cell (WBC) count of goats in treatment groups were significantly (p<0.05) higher and better than the control. All the haematological indices studied fell within the normal reference range reported for clinically healthy goats; an indication that of the diets had no detrimental effect on blood formation and health status of the animals.
Keywords: β-Carotene Cassava peel, centrosema Leaf meal, WAD goats, unconventional feedstuffs, blood

INTRODUCTION

Cassava is an adaptable crop that grows on marginal soils and is able to withstand disease and drought. As one of the major sources of staple food in Africa and Latin America, the need for genetic improvement became very necessary. The provitamin A (yellow root) cassava have been developed either through traditional plant-breeding or bioengineering (Sayre *et al*., 2011). Cassava with higher levels of provitamin A can help reduce vitamin A deficiency among undernourished communities that rely upon cassava for sustenance. The new yellow root cassava varieties have potential of providing up to 25% of daily Vitamin A requirements of children and women (Aniedu and Omodamiro, 2012). Yellow root cassava is very high in carotenoids. More recently, protective effects of carotenoids against serious disorders such as cancer (Donaldson, 2004), heart disease (Sesso, 2003) and degenerative eye disease (Mozaffarieh, 2003) have been recognized, and have stimulated intensive research into the role of carotenoids as antioxidants and as regulators of the immune response system. These numerous advantages has led to high demand for yellow root cassava for different human or industrial uses thereby enhancing the availability of the peels which are grossly underutilized and were hitherto discarded as waste. The yellow root cassava peels are made up of mainly polysaccharides and carotenoids; hence holds inestimable potentials as energy and vitamin A sources for goats. However, due to its crude protein deficiency, the need to supplement with readily available non competitive unconventional protein source like *Centrosema pubescens* leaf meal becomes imperative. Nworgu and Egbunike (2013) reported 23.24% CP in *Centrosema pubescens* leaf meal; hence being a potential protein source in a goat production.

Evaluation of the blood profile of animals may give some insight as to the potentials of a dietary treatment to meet the metabolic needs of the animal hence Church *et al*. (1984) noted that dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inference on the nutritive value of feeds offered to the animals. Haematology is a good indicator of the physiological status of an animal. The assertion of Ikhimoya and Imasuen (2007) that most of the available information on haematological parameters of goats in the humid tropics is based on disease prognosis from the region. Thus, data on haematological profile of West African dwarf (WAD) goat offered agricultural by product and leaf meal from non-conventional sources are scanty.

However, the sourcing for readily and locally available feed ingredients to enhance food production stimulated this research which aimed at evaluating the efficacy of yellow root cassava peel – centrosema leaf meal based diets on the haematological parameters of West African dwarf goats.

MATERIALS AND METHODS

The experiment was carried out at the sheep and goat unit, Federal College of Agriculture, Ishiagu, Ivo L.G.A., Ebonyi state, Nigeria.

Fresh yellow root cassava peels varieties (TMS011368, TMS011412 and TMS1371) were obtained from National Root Crops Research Institute, Umudike, Abia State, Nigeria. The peels were subsequently dried to about 10% moisture content before milling and used in the formulation of yellow root cassava peel-centrosema leaf meal based diets. Fresh green *Centrosema pubescens* leaves were harvested within the College environment. The *Centrosema pubescens* were shade-dried in batches, milled and also used at different levels in the formulation of yellow root cassava peel - centrosema leaf meal based diets.

Thirty six (36) WAD goats of about 8 – 10 months of age were selected from the College herd for this experiment. The goats were randomly divided into four (4) groups of nine (9) animals each with 3 goats constituting a replicate. The groups were randomly assigned the 4 experimental diets (A, B, C and D) in a completely randomized design (CRD). The animals were housed individually in well ventilated cement floored pens equipped with feeders and drinkers. Each animal received a designated treatment diet in the morning for 74 days. Feed offered was based on 3.5% body weight per day; the animals in addition were fed 2kg wilted *Panicum maximum* later in the day. Regular access to fresh drinking water was made available.

Experimental diets designated as A, B, C and D were formulated from yellow root cassava peel, brewers dried grain, palm kernel meal, wheat offal, *Centrosema pubescens* leaf meal, bone meal, molasses and salt. Diet A served as a positive control and contained 0% of yellow root cassava peel - centrosema leaf meal based diets. Diets B, C and D contained 10%, 20% and 30% inclusion levels of centrosema leaf meal based diets respectively as illustrated in Table 1.

All feeds and test ingredients were analyzed for proximate compositions using the method of AOAC (2000) as presented in Table 2.

Blood samples (4ml) were drawn from the animals on the last day of the study. The goats were bled through the jugular vein and used for haematological studies. Mean cells haemoglobin (MCH), MCV and mean cell haemoglobin concentrations (MCHC) were calculated.

The results were analyzed using the Special Package for Social Sciences Window 17.0. One -way analysis of variance (ANOVA) was employed to determine the means and standard error. Treatment means were compared using Duncan's new multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical compositions of the experimental diets, yellow root cassava peel meal (YRPM) and *centrosema pubescens* leaf meal (CLM) used in this study is presented in Table 2. The proximate values for the yellow root cassava peel meal showed a higher crude protein (CP), ash and ether extract (EE) and lower crude fibre (CF) values compared to the reports of Ahamefule *et al*. (2005) for cassava peel meal. The differences could be attributed to the improvements that have been carried on the yellow root cassava. The proximate compositions of the *centrosema pubescens* leaf meal in this study are comparable with the findings of Nworgu and Egbunike (2013) for the same leaf meal. The dry matter levels of the test diets (B, C and D) compared favourably well with the control diet (A). The CP, ash and ether extract of the test diets were higher than the control diet and tended to increase with the increasing levels of CLM in the diets. The fibre content on the other hand is higher in the control diet and tended to decrease with increasing levels of CLM. The nitrogen free extract and gross energy did not show any specific trend among the diets.

The haematology of West African dwarf (WAD) goat fed yellow root cassava peel-centrosema leaf meal based diets is presented in Table 3. The study of the haematological parameters is in agreement with the view of WHO (1963) that blood examination is a reliable way of assessing the health status of animals as it plays a vital role in the physiological, nutritional and pathological status of animals. The packed cell volume (PCV) values (%) for the treatment groups fell within the normal range for WAD goats (21-35%), as reported by Daramola *et al*. (2005) and differed significantly ($P<0.05$) among the treatment groups. PCV is generally used as an index of toxicity and its value is influenced by breeds, age and sex. The significant increase in the concentration of PCV in the blood usually would suggest the absence of a toxic factor like haemagglutinin which had adverse effect on blood formation (Jiwuba *et al*., 2016). *Centrosema pubescens* had been reported to contain 20.01mg/kgDM iron (Nworgu and Egbunike, 2013) and yellow root cassava implicated to contain high level of vitamin A; a fat-soluble vitamin, involved in a number of physiological processes like hematopoiesis (Guimarães *et al*., 2014). It is possible that traces of iron and the vitamin A still abiding in the treatment diets may perhaps have been responsible for the improved values.

The haemoglobin (Hb) value of the treatment groups differed ($P<0.05$) significantly with diet A animals having the lowest (10.77g/dl) and diet D animals the highest value of 13.23g/dl. The Hb concentration compared

favourably with the normal range of 7-15g/dl reported by Daramola *et al*. (2005) for WAD goats. The high level of Hb of animals on diet D relative to other treatment groups may imply that the dietary protein was of higher quality, probably due to 30% fortification of the diets with *Centrosema pubescens* leaf meal. This agrees with the observation of Esonu *et al*. (2003) that one of the possible sources of cheap protein in the diets is the leaf meal of some tropical legumes. Diets containing poor quality protein would usually influence poor transportation of oxygen from the respiratory organs to the peripheral tissues (Robert *et al*., 2000).
Mean cell haemoglobin concentration (MCHC) and mean corpuscular volume (MCV) of the WAD goats fed yellow root cassava peel-centrosema leaf meal based diets differed significantly (P<0.05) while mean cell haemoglobin (MCH) values were similar (P>0.05) among the treatment groups. All the values however fell within the reference range for goats as reported by Fraser and Mays (1986). The normal range of MCV, MCHC and MCH recorded in this study for the WAD goats gave a clear indication of the absence of anaemia among the experimental groups. In humans, a close relationship between vitamin A deficiency and anemia has been long recognized (Semba and Bloem, 2002).
White blood cells differed significantly (P<0.05) among treatment groups. The values obtained in this study (8.82-11.69 ×109/l)) were within normal range of 6.8-20.1 x10/ul for WAD goats and 4–13×109/l as reported by Daramola *et al*. (2005) and Fraser and Mays (1986) respectively. WBC of the goats showed an increasing value in relation to an improvement of the immunological system. Vitamin A is has been extensively studied for its influence on immunity due to its requirement for normal functioning of the immune system. Vitamin A deficient people are more prone to more severe infections and have a higher mortality than vitamin sufficient people (Beaton et al., 1992).

CONCLUSION

In conclusion**,** yellow root cassava peel-centrosema leaf meal based diets could stimulate erythropoiesis and influence immunity of goats. It is therefore recommended to boost the blood indices of goats, since all the parameters studied were within the normal reference range for goats. The inclusion of yellow cassava peel-centrosema leaf meal at 30% produced the best performance and therefore encouraged as animal feed supplement to enhance goat production.

Table 1: Percentage Composition of the yellow root cassava peel-centrosema leaf meal based diets

	Dietary levels (%)			
Ingredients (%)	**A**	**B**	**C**	**D**
Yellow root Cassava peel	40.00	40.00	40.00	40.00
Centrosema pubescens leaf meal	0.00	10.00	20.00	30.00
Brewers dried grain	38.00	28.00	18.00	8.00
Palm kernel cake	18.00	18.00	18.00	18.00
Bone meal	2.00	2.00	2.00	2.00
Molasses	1.50	1.50	1.50	1.50
Common salt	0.50	0.50	0.50	0.50
Total	100	100	100	100

Table 2: The chemical compositions of yellow root cassava peel, Centrosema leaf meal and yellow root cassava peel-centrosema leaf meal based diets

	Dietary levels (%)					
Parameters	**A**	**B**	**C**	**D**	**YRPM**	**CLM**
Dry matter (%)	91.32	91.54	91.37	91.74	90.28	86.03
Crude protein (%)	12.11	12.78	13.41	14.32	9.23	20.44
Crude fibre (%)	14.36	14.65	13.13	13.07	12.93	10.32
Ether extract (%)	4.83	5.11	5.97	5.99	3.41	2.09
Ash (%)	9.01	9.63	10.17	10.19	9.74	6.95
Nitrogen free extract (%)	51.01	49.37	48.69	48.17	55.67	44.22
Gross energy	3.90	3.92	3.91	3.95	3.71	3.64

YRPM = yellow root cassava peel meal; CLM = centrosema leaf meal

Table 3: haematology of West African dwarf (WAD) goat fed yellow root cassava peel-centrosema leaf meal based diets

	Dietary levels				
Parameters	**A**	**B**	**C**	**D**	**SEM**
Packed Cell Volume (%)	28.87^{c}	30.35^{b}	30.53^{b}	32.91^{a}	0.49
Red Blood Cell $x10^{6}$/ul	10.94	10.71	10.97	11.01	0.11
Haemoglobin g/dl	10.77^{d}	11.63^{c}	12.40^{b}	13.23^{a}	0.18
Mean Cell Haemoglobin conc. (%)	32.05^{b}	33.68^{a}	33.79^{a}	34.25^{a}	0.52
Mean cell Haemoglobin (pg)	6.13	6.27	6.29	6.34	0.09
Mean cell volume (fl)	17.04^{b}	17.11^{b}	18.37^{a}	19.04^{a}	0.17
White Blood Cell (×109/l)	8.82^{d}	9.38^{c}	10.50^{b}	11.69^{a}	0.10

$^{a, b, c, d}$ means in the row with different superscripts are significantly different (P<0.05)

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GROWTH PERFORMANCE AND ORGAN CHARACTERISTICS OF RABBITS FED DIETARY LEVELS OF *MORINGA OLEIFERA* LEAF MEAL

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ABSTRACT
A feeding trial was conducted to determine the growth and organ characteristics of growing rabbits fed dietary levels of Moringa oleifera leaf meal (MOLM). A total of forty eight growing rabbits with an average initial weight of 588.05g were randomly divided into four experimental groups of twelve animals each, with four rabbits constituting a replicate. Four diets were formulated such that diets T1, T2, T3 and T4 contain MOLM at 0%, 10%, 20% and 30%, respectively and fed to the animals for 41 days. Results on average daily feed intake differed significantly (P<0.05) with rabbits on T4 diet having the highest intake of 89.84 g/day. However, average daily weight gain was different (p<0.05) across the treatments but was highest for T3 and T4 animals which were statistically (P>0.05) similar. Feed conversion ratio differed significantly (P<0.05) and was also best for T3 and T4 rabbits. Liver and kidney showed significant (P<0.05) decrease on organ weight with increasing levels of Moringa oleifera leaf meal in the diets of grower rabbits. Diets T3 and T4 promoted the best performance among the treatment diets and are therefore recommended for rabbit production.
Keywords: rabbits, ***Moringa oleifera*, performance, organ, alternative, protein resource.**

INTRODUCTION
Rabbits are highly prolific animals capable of increasing the animal protein intake among the increasing population in the developing countries like Nigeria. They are sources of cheap animal protein and mostly used in experimental research and to a lesser extent, pets and fur production in Nigeria and most other West African countries. Rabbit meat is highly nutritious, easily digestible, tender and extremely low in cholesterol and sodium hence, suitable for those with various health conditions.

Inadequate nutrition opposes rabbits in expressing their full potential. This may be due to the high cost of conventional feedstuffs and little knowledge about the efficient utilization of unconventional crude protein sources. Intensive approach to rabbit production would however entail the use of alternative nutritionally viable sources other than the conventional ones to enhance the production of meat at affordable price; hence the need for multipurpose tree species (MPTS) such as *Moringa oleifera* to improve animal performance (Jiwuba *et al*., 2016). *Moringa oleifera* is known with diverse names; miracle tree in English language and Okochi egbu in Igbo language. *Moringa oleifera* is one of the most widely cultivated species of the genius *Moringa* and serves as a nutritious vegetable tree with a variety of potential uses (Ramanchandran *et al*., 1980). Its leaves are used as vegetables by humans with good medicinal values and are rich in carotene and ascorbic acid with a good profile of amino acids, vitamins A, B and C, Ca, Fe, P (Makkar and Becker, 1996). Therefore this study was designed to determine the effects of dietary levels of *Moringa oleifera* leaf meal on growth and organ characteristics of growing rabbits.

MATERIALS AND METHODS
The research was carried out at the Rabbit Unit, Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria.

Fresh leaves of *Moringa oleifera* were harvested within the College environment and air dried for some days to a moisture content of about 10%. The dried leaves were processed and milled.

Four diets, T1, T2, T3 and T4 were formulated from maize, wheat offal, soybean, fish meal, palm kernel cake, *Moringa oleifera* leaf meal, bone meal, limestone, vitamin premix, methionine, lysine and common salt. Treatment one (T1) did not contain the test ingredients, thereby serving as the positive control. The experimental diets were formulated such that *Moringa oleifera* leaf meal was included at the levels of 0%, 10%, 20% and 30% for T1, T2, T3 and T4 respectively as presented in Table 1.

Forty eight growing rabbits were randomly divided into four (4) experimental groups of twelve (12) animals each, with four (4) rabbits constituting a replicate. The four treatment groups were assigned the four experimental diets in a Completely Randomized Design. Each rabbit received an assigned diet for forty one (41) days. Regular access to fresh drinking water was made available. Feed offered and refusal was recorded on a daily basis. Initial weights of the animals were taken at the beginning of the trial and weekly subsequently. Average feed daily intake, average daily weight gain and feed conversion ratio were calculated accordingly.

At the end of the feeding trial, two rabbits per replicate were randomly selected, starved of feed for twenty four hours, weighed, stunned and bled through the jugular vein. The dressed carcass was weighed expressed as percentage of carcass weight. The organ weights were determined and expressed as the percentage of dressed weight.

All feeds and experimental materials were analyzed for proximate compositions using the standard method of (AOAC, 2000) as presented in Table 2. Metabolizable energy calculated using the formula; ME = (3.5 X Crude protein) + (8.5 x crude fat) + (3.5 x Nitrogen Free Extract) x 10.

The results were analyzed using the Special Package for Social Sciences Window 17.0. One -way analysis of variance (ANOVA) was employed to determine the means and standard error. Treatment means were compared using Duncan's new multiple range test.

RESULTS AND DISCUSSION

The proximate compositions of *Moringa oleifera* leaf meal and experimental diets are presented in Table 2. Proximate analysis of *Moringa oleifera* leaf meal and experimental diets revealed the presence of dry matter, crude protein, crude fibre, ether extract, ash, nitrogen free extract and metabolizable energy. The dry matter values of the test diets (T2, T3 and T4) compared favourably with the control diet, but however did not show a specific trend. The crude protein of the experimental diets ranged between 18.03 - 19.92% and tended to decrease with increasing levels of the test diets. The crude protein, crude fibre and energy values met the requirements for rabbits

The growth performance of grower rabbits fed diets containing *Moringa oleifera* leaf meal is presented in Table 3. The average daily weight gain differed significant ($P<0.05$) with T2, T3 and T4 having higher values than T1. The result of the present study on average daily weight gain (16.71 - 21.90g) comparable to the range of values (15.68 – 25.36g) for rabbits fed sorghum offal-based diets as reported Ogunsipe *et al*. (2014) respectively. The result of the present study on weight gain is in agreement with the results of Nuhu (2010) for weaner rabbits fed *Moringa* leaf meal diets showing significant ($P<0.05$) increase in daily weight gain over the control diet. The increase in body weights of the rabbits on test diets may be attributed to the high biological values of protein of *Moringa oleifera* leaves. The proteins of *Moringa oleifera* have very high biological values and all the essential amino acids present in Moringa are in a greater concentration than that mentioned in the feed reference for soybeans (Zarkadas *et al*., 1995). Similarly, Melesse *et al*. (2011) reported that use of *Moringa* leaf meal in the diet of Rhode Island Red chicks produced significant ($P<0.05$) increase in weight gain, when compared to a control diet. The authors also related these findings to the presence of readily available protein in Moringa leaf meal, which is convenient for monogastric animals and also to the higher levels of methionine and other essential amino acids when compared to the soybean meal of a control diet. Average daily feed intake and feed conversion ratio were significantly ($P<0.05$) affected by the treatment diets, with the animals on test diets having higher values than the animals on the control diet. The progressive increase in feed intake is in agreement with the findings of Bouatene *et al*. (2011) for young post-weaning rabbits fed *Moringa oleifera* leaves. The significant ($P<0.05$) increase in feed intake among the test diets could be attributed to the biological function of *Moringa oleifera* leaf meal that have been essential for vitality and health of the animals. The leaves of *Moringa oleifera* are rich in minerals (C, Ca, Fe and P), vitamins such as A, B, C and E and balanced protein with good profile of essential amino acids (Makkar and Becker 1996; Fahey, 2005). These high biological values could explain the improvement in body weight, feed intake and feed conversion ratio of rabbits fed the diet containing MOLM. The feed conversion ratio (FCR) values in this study are a true reflection of how the diets were utilized for growth as evidenced in their increased weight gain in T3 and T4.

The organ characteristics of grower rabbits fed dietary levels of *Moringa oleifera* leaf meal is presented in table 4. The slaughter weight, carcass weight and dressing percentage were significantly ($P<0.05$) influenced by the treatment diets. Rabbits fed the diet containing *Moringa oleifera* leaf meal had higher ($p<0.05$) slaughter and carcass weight than the rabbits fed the control diet. Carcass weight is a very important parameter of carcass characteristics hence the higher the carcass weight the higher the degree of meatiness and economic value of that carcass. Animals on T3 and T4 diets were similar ($P>0.05$) but significantly ($P<0.05$) different from T1 and T2 which were ($P>0.05$) similar for dressing percentage. The dressing percentage ranged between 52.69 to 62.16% with the highest in T4 (30% MOLM) animals (62.16%) and lowest in T1 (0%MOLM) animals (52.69%). The observed significant ($P<0.05$) difference may be due to differences in the body weight of the rabbits at slaughter The high dressing percentage observed in this study may also be related to the high meatiness and fat values recorded with the carcass. This finding is in agreement with the report of Fielding (1991), who stated that the dressing percentage of rabbits normally ranges from 50 to 56% and tends to be greater if the rabbits are fully grown and have some fat. In a feeding trial, the weight of some internal organs especially liver and kidneys are commonly used to determine the effect of toxicity on the animals. Bone (1979) reported that if there is any toxic element in the feed, abnormalities in weights of liver and kidney would be observed. This abnormal increase in weight could be as a result of increased metabolic rate of the organ in attempt to reduce these toxic elements or anti-nutritional factors to non-toxic metabolites. The significant (P<0.05) lower values of liver and kidney values of the rabbits on the test diets (*Moringa oleifera* leaf meal) over the control rabbits suggest that the test diets did not contain any appreciable toxin and thus supported the normal metabolic and physiological function of the animals; a view corroborated by Fahey (2005). However, the values for the spleen, lungs and heart were not significantly (p>0.05) affected by the dietary treatments, which suggests the safety of the *Moringa oleifera* leaf meal as a non-conventional feedstuff capable maintaining the normal metabolic function and reducing cost of production in rabbit.

CONCLUSION

From the results, it could be concluded that rabbits fed diets containing *Moringa oleifera* leaf meal recorded the best weight gain, feed intake, conversion ratio and organ weight. Therefore, *Moringa oleifera* leaf meal could be used as a cheaper protein source to enhance rabbit production without any detrimental effects on performance and carcass characteristics of rabbits.

Table 1: Composition of the Experimental Diets

	Dietary levels (%)			
Ingredients	**T1**	**T2**	**T3**	**T4**
Maize	37.00	37.00	37.00	37.00
Wheat offal	9.00	9.00	9.00	9.00
Palm kernel cake	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00
Soybean	35.00	25.00	15.00	5.00
MOLM	0.00	10.00	20.00	30.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50
Vitamin premix	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**

Moringa oleifera leaf meal

Table 2: proximate compositions of the experimental diets and *Moringa oleifera* leaf meal

		Dietary levels			
Parameters	**T1 0%**	**T2 10%**	**T2 20%**	**T2 30%**	**MOLM**
Dry matter	94.05	93.98	95.06	94.79	92.19
Crude protein	19.92	19.12	18.12	18.03	29.06
Crude fibre	14.99	15.64	16.02	16.87	17.54
Ash	10.75	10.89	11.05	10.96	12.27
Ether extract	7.85	8.34	8.60	8.99	8.59
NFE	40.54	39.99	41.27	39.94	24.73
Metabolizable energy (kcal/kg)	2783.35	2777.75	2809.65	2793.10	2612.80

MOLM=*Moringa oleifera* leaf meal

Table 3: Growth and feed intake of Grower Rabbits Fed Diet Containing *Moringa oleifera* Leaf Meal

		Dietary levels			
Parameters	**T1 0%**	**T2 10%**	**T2 20%**	**T2 30%**	**SEM**
Initial body weight (g)	550.00	623.60	602.30	576.90	101.40
Final body weight (g)	1235.00	1434.00	1500.00	1470.34	112.64
Total weight gain (g)	685.00^{c}	810.40^{b}	897.70^{a}	893.44^{a}	36.60
Average daily weight (g/day)	16.71^{b}	19.77^{ab}	21.90^{a}	21.79^{a}	1.14
Total feed intake (g)	3246.50^{b}	3478.46^{a}	3569.57^{a}	3683.51^{a}	166.51
Av. daily fed intake (g)	79.18^{d}	84.84^{c}	87.06^{b}	89.84^{a}	4.74
Feed conversion ratio	4.74^{a}	4.30^{ab}	4.00^{b}	4.12^{b}	0.78

$^{a, b, c, d}$ means in the same row being different superscripts are significantly different (P<0.05).

Table 4: Carcass and Organ Characteristics of Grower Rabbits Fed Diets Containing *Moringa Oleifera* Leaf Meal

	Dietary levels (%)				
Parameters	**T1 0%**	**T2 10%**	**T2 20%**	**T2 30%**	**SEM**
Slaughter weight (g)	1178.20^{c}	1382.32^{b}	1446.72^{a}	1421.12^{a}	119.15
Carcass weight (g)	620.74^{c}	744.19^{b}	865.64^{a}	883.43^{a}	67.29
Dressing percentage (%)	52.69^{b}	53.83^{b}	59.83^{a}	62.16^{a}	3.67
Organ weight (% of carcass weight)					
Spleen (%)	0.40	0.39	0.42	0.40	0.11
Liver (%)	2.82^{c}	2.58^{b}	2.45^{b}	2.29^{a}	0.34
Lung (%)	0.70	0.71	0.72	0.69	0.17
Heart (%)	0.57	0.40	0.48	0.46	0.13
Kidney (%)	1.15^{b}	1.10^{ab}	1.03^{a}	1.02^{a}	0.26

$^{a, b, c}$ means in the row with different superscripts are significantly different (P<0.05)

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EFFECTS OF GRADED LEVELS OF GINGER (*Zingiber Officinale*) ON HAEMATOLOGY OF BROILER CHICKENS

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ABSTRACT
A total of 120 Broiler chickens were used in an experiment to determine the effect of haematology of broiler chickens fed diets supplemented with ginger (Zingiber officinale) in a complete randomized design which lasted for eight weeks. Diet 1 (Control) contained no ginger, diets, 2, 3, 4 and 5 contained 0.5%, 1.0% ,1.5% and 2.0% ginger respectively. Blood samples were collected and analyzed for Hematological attributes Results on the hematological values obtained from the experimental birds showed significant (P<0.05) dietary treatments effect. Notably, the birds consuming 1.5% ginger had the highest values for PCV (27.57±0.49 , 27.75±1.56, 26.58±0.58, 20.77 ± 0.69 and 20.03±2.79 %) and Hb (9.52±0.13 ,9.35±0.29 ,9.32±0.30 ,8.35± 0.42 and 7.23±0.96 g/dl). It can be concluded that the inclusion of ginger (Zingiber officinale) to the broiler diet enhances the health statue. The chickens can tolerate ginger root powder up to 1.5%.
Keywords: Ginger, Broilers, Haematology

INTRODUCTION
Feed additive are added in animal feed to improve their nutritive value, boost animal performance by increasing their growth rate, better feed conversion efficiency, greater livability and lowered mortality in poultry birds (Zomrawi *et al.*,2013). Ginger (*Zingiber officinle*) has been widely used as a condiment and as a herbal medicine to treat a wide range of disorders (Ali *et al,* 2008). Recently Ahn *et al*, (2002) showed that, use of plants extracts as natural antioxidants has gained increasing interest because of the global trend of restriction in the use of synthetic substances (Zhang *et al*, (2009). These preparations have been shown to activate digestion, strengthen the immune system and have antibacterial properties. Medicinal plants are used as primary health care aid among eighty percent of the world's population in the form of plant extracts or their active component (WHO, 2008). The objective of the study is to evaluate the response of ginger, (*Zingber officinale*) diets on the physiology of birds in the humid zone of southern Nigeria.

MATERIALS AND METHOD
Design, Experimental Birds and Experimental Diets
A total of 120 Anak broilers were used for the experiment. Twenty four (24) birds were randomly selected based on their average initial weights to each of the five treatment diets. Each treatment group contains three replicates with eight (8) birds per replicate and they were assigned to the five treatment diets in a complete randomized design (CRD).Diets T1 were formulated to contain 0% (control diet), diets T2 contain 0.5% ginger, diet T_3contain1.0% ginger,T4 1.5% ginger and T_5 contain 2.0% ginger respectively.
Blood sample collection
Blood sample was collected before and after the end of the experiment. The birds were fasted over night and blood was collected from the Jugular veins. Specimen for haematological studies were collected separately in a bottle containing dipotassium salts of ethylene diamine tetra-acetic acid (EDTA) as anticoagulant while, anticoagulant free tubes were used for collecting blood samples for biochemical analyses. The blood samples were analysed using routinely available clinical methods. These include packed cell volume (PCV) or haematocrit, red blood cell (RBC) count and white blood cell (WBC) count and haemoglobin concentration (Hb), using Witrob's micro-haematocrit, improved Neubaur haemocytometer and cyanomethaemoglobin methods, respectively. The erythrocyte indices, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCHC) were computed according to Jain (1986).
Experimental design and statistical analyses
All data obtained were subjected to analysis of variance to investigate the effect of treatment on serum biochemistry and lipid profile, using the General Linear Model of SAS (1999). Duncan's Multiple Range Test was used to separate the means that are significantly difference (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION
Blood parameters results are presented in Table 1.Parameters includes hemoglobin concentration (Hb), packed cell volume (PCV)%, erythrocytes (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC)% were significantly (p<0.05) affected by dietary treatments. Results in the current study observed higher values of PCV and Hb values for birds fed 1.5%

ginger root powder did not agree with the findings of Al-Homidan (2005) and Ademola *et al*. (2009) who found a significant decrease in blood parametrs when feeding chicks up to 6% ginger. However, the results of the present study were consistent with the results of Al- Kassie, (2009), who found that the group fed with cinnamon and thyme oils had significantly higher (PVC) counts compared with the control group.

Table 1: Chemical composition of experimental broiler finisher diets (%)

Ingredients (%)	**T1(Control)**	**T2(Ginger)**	**T3(Ginger)**	**T4(Ginger)**	**T5(Ginger)**
Crude protein	18.00	18.00	18.00	18.00	18.00
Fats/oil	6.00	6.00	6.00	6.00	6.00
Crude fiber	6.00	6.00	6.00	6.00	6.00
Calcium	1.00	1.00	1.00	1.00	1.00
Phosphorus	0.45	0.45	0.45	0.45	0.45
Salts	0.30	0.30	0.30	0.30	0.30
Metabolizable energy (Kcal/kg)	2900	2900	2900	2900	2900
Ginger	0.00	0.5	1.0	1.5	2.0

Table 2:Haematological Parameters of Experimental Birds

Parameters	**T1(0.0%)**	**T2(0.5%)**	**T3(1.0%)**	**T4(1.5%)**	**T5(2.0%)**
WBC($\times 10^3$/µl)	71.05 ± 1.71^b	74.20 ± 0.14^a	54.35 ± 8.81^d	64.63 ± 2.18^c	68.53 ± 0.99^{bc}
RBC ($\times 10^6$/µl)	2.68 ± 0.19^a	1.88 ± 0.28^d	2.33 ± 0.11^c	2.50 ± 0.01^b	2.33 ± 0.00^c
PCV(%)	20.77 ± 0.69^c	20.03 ± 2.79^d	27.75 ± 1.56^a	27.57 ± 0.49^a	26.58 ± 0.58^b
Platelet ($\times 10^3$/µl)	27.00 ± 2.27^a	26.01 ± 0.32^b	21.88 ± 2.77^c	20.20 ± 0.45^d	26.13 ± 1.00^{ab}
Hb(g/dl)	8.35 ± 0.42^b	7.23 ± 0.96^c	9.35 ± 0.29^a	9.52 ± 0.13^a	9.32 ± 0.30^a
MCV(fl)	10.50 ± 0.40^d	10.53 ± 0.23^d	11.83 ± 0.28^a	11.05 ± 0.33^c	11.32 ± 0.25^b
MCH(pg)	36.25 ± 0.41^c	36.95 ± 0.33^c	38.73 ± 0.35^a	37.13 ± 0.46^b	35.98 ± 0.42^d
MCHC(gdl)	35.00 ± 0.51^{ab}	35.28 ± 0.42^a	32.63 ± 0.60^d	34.80 ± 0.64^b	33.28 ± 0.73^c

abc means along the same row with different superscript are significantly different ($P < 0.05$)

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MUTATION BREEDING: A ROBUST ADJUNCT TO CLASSICAL BREEDING

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ABSTRACT
One strategy for inducing novel genetic variation in both sexually and in apomictic species is mutagenesis. In this study, dry maize seeds were exposed to different doses of gamm-rays (75-600 Gy) to determine the optimum radiation dose for mutation induction. M_1 generation was raised and studied with respect to different morphological parameters such as germination, growth, survival and seedling height. The developed seedlings response were dose dependent compared to the control. The calculated LD_{50} value based on survival percentage may serve as a baseline for mutation induction and for the specie improvement programme.
Keywords: Mutation, Breeding, Robust, Adjunct

INTRODUCTION
Since the turn of the 21st century, the successes and recognition of mutation technologies was unprecedented due to a rapid and better understanding of the technique. Retrospectively, the term "mutation breeding" was first described by Freisleben and Lein (1944) as a deliberate induction and development of mutant lines for crop improvement, although the technique was originally defined in a series of articles by de Vries (1901, 1903 and 1905) as a sudden heritable change in the genetic material of an organism. Through all these years, the technology has played a significant role in increasing and improving food production and quality. It could and have induced new agronomic traits in crop plants that either may not be found in nature or have been lost during evaluation. In nature, a mutant normally occurs as errors during DNA replication, but the frequency of genetic variation is rather minimal, necessitating the need for mutation induction. To achieve genetic variability in plants through conventional breeding; hybridization, crosses and recurrent selection techniques are used by breeders to recombine and integrate favourable gene combinations into elite genotypes. However, conventional breeding often fails to achieve desirable results, necessitating additional approaches such as genetic engineering and mutation breeding.

Amongst the two methods of mutagenesis (physical and chemical), chemical mutagenesis is acclaimed to be more effective and an important strategy in creating genetic variability in crop plants. Presently, gamma-rays and alkylating agents (ethyl methane sulphonate (EMS), -1-methyl-nitrosourea (MNU) and -1-ethyl-nitrosourea (ENU)) are the prime choice of mutagens, however, x-rays and ion-beams are now contending agents. Currently, mutation breeding has produced over 3,220 mutant cultivars in over 220 crop species (http://mvd.iaea.org). However, the interest placed on gamma-ray mutagenesis for the past ninety five years has been on its ability to generate large populations of mutant cultivars of which over 60% has been released.

Crop yield is of prime importance to farmers and some of the challenges facing food security globally are the continuous increase in human population and changing climatic conditions. Changes in climatic conditions are associated with increased risk of crop failure and uncertainties in the form of storms, flooding, extreme temperatures, drought and salinity. Such changes in weather condition trigger new incidences of pests and diseases. To circumvent this development, mutation induction comes to the rescue. This becomes a possibility because mutation induction is rapid and could create new crop varieties with diseases and drought resistance etc. Compared to spontaneous mutations that is severely limited by their low frequency and rare occurrence in nature, induced mutations can be increased greatly by treatments with mutagens to produce 10^3 times more mutants compared to spontaneous mutations (van Harten, 1998).

METHIODOLOGY
Seeds of local cultivar of maize (*Zea Mays*) were used for the experiment. The healthy seeds were equilibrated in a vacuum desiccator over glycerol (60%) and left at room temperature for 5 days in order to lower the seed moisture content to 12-14%.

Twenty seeds each were exposed to 75, 150, 300, 450, and 600 Gy doses of gamma rays from a cobalt 60 gamma radiator. The corresponding exposure time was 38, 79, 161, 243 and 325 seconds respectively. Seeds were sown in a prepared seed bed at the green house in the Seibersdorf research laboratory, Vienna, Austria in three replicates. Unirradiated seeds were also planted in the experiment as control. Germination, seedling height and survival percentages against different doses of gamma irradiation were recorded after 2 and 4 weeks of sowing.

RESULTS AND DISCUSSION

The schematic representation of the protocol is as presented in Fig. 1. Result shows that the growth parameters were dose dependent and that the decrease was proportional to the increase in dosage (Fig. 2). In plant experimental mutagenesis, seedlings are exceptionally sensitive to mutagenic agents and provides an easy means of assessing treatment effects (Kodym et al., 2011) and is usually used as an index in determining the biological effects of various physical and chemical mutagens in M_1 population (Cheema and Atta, 2003; Harding et al., 2012). In this experiment, seedling height decreased with the increase of the mutagen dosage (Fig. 2). Physical mutagen (gamma-rays) can directly cause double stranded-DNA breaks (DNA DsBs) thereby inducing physiological damage in the growth parameters of the M_1 generation. The observed response is associated with variation in auxin level, changes in the specific activity of several enzymes and physiological injury in the seeds and seedlings as a result of the exposure to gamma-rays (Reddy et al., 1992).

The percent growth and seedling height curves using a simple linear regression (Excel 2007) for different doses of gamma irradiation are as shown in Figs 2A and B. LD_{50} value was calculated as 348. LD_{50} usually produces maximum variability with minimum numbers of undesirable mutants. Defined as the dose at which 50% of the irradiated biological objects die after irradiation, it is also considered as a dose at which highest frequency of mutation occurs. The calculated LD_{50} value based on survival percentage may therefore serve as a baseline for mutation induction and for the specie improvement programme.

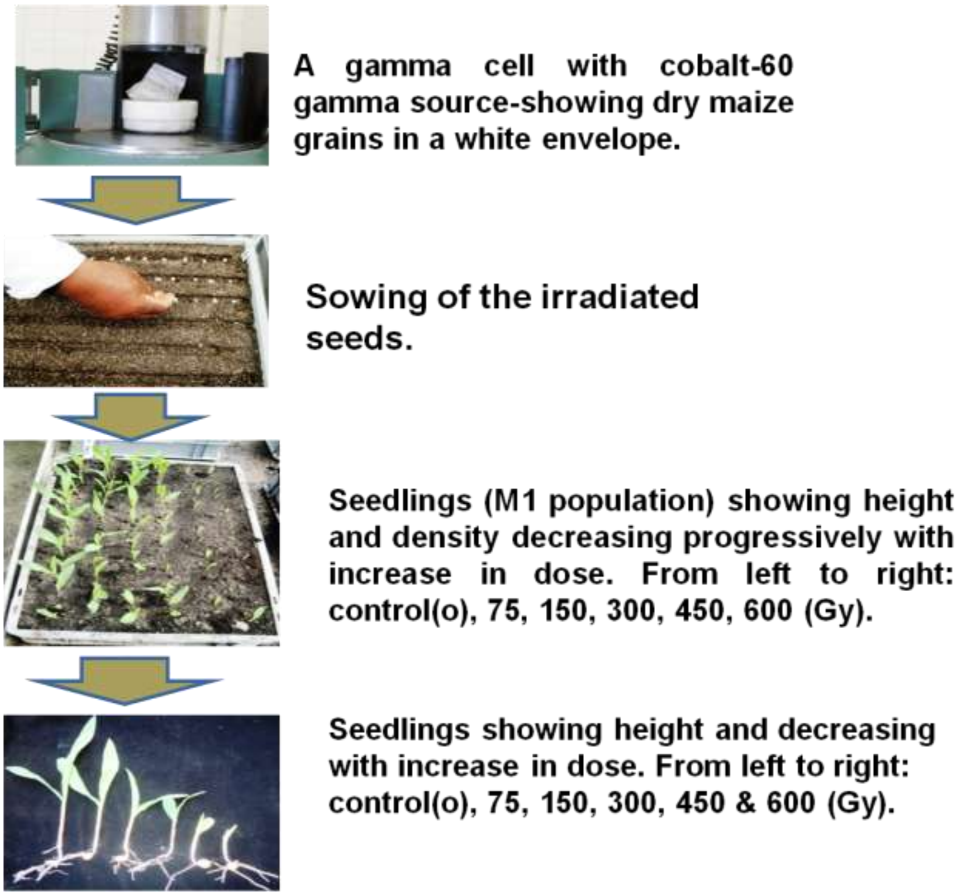

Fig. 1: Scheme for irradiation, sowing and development of seedlings for mutation breeding programme

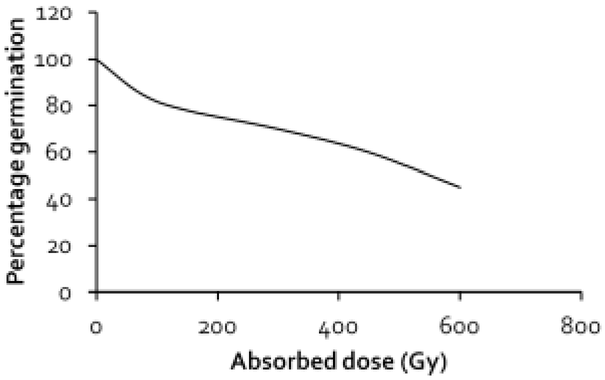

Fig. 2A: Effect of gamma irradiation on germination of white maize variety at 7 days after planting.

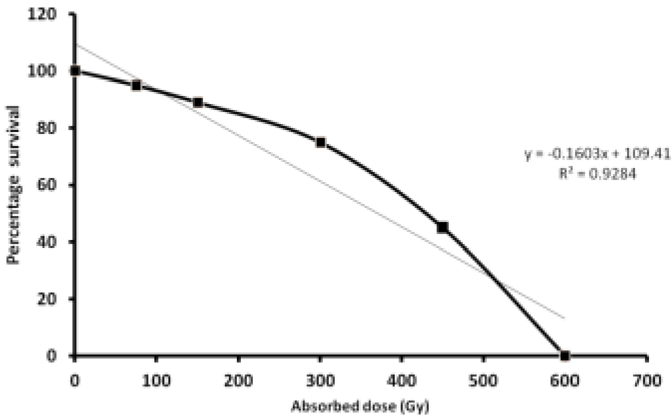

Fig. 2B: Effect of gamma irradiation on the seedlings survival at 14 days after planting

CONCLUSION

The technique has already developed "sustainable" crops that are resistant to drought, insect diseases and salinity making it an irresistible adjunct technique to classical breeding. We therefore conclude that a major advantage of mutation breeding is speed and this is becoming increasingly important with respect to responding to rapid changes in agriculture brought about by changing climatic conditions.

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AMELIORATIVE EFFECT OF ETHANOL EXTRACT OF *SOLENOSTEMON ROTUNDIFOLIUS* LEAVES ON EXPERIMENTAL ACUTE DIARRHOEA IN RATS

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ABSTRACT
Solenostemon rotundifolius (*Lamiacea*) is a tuber crop in Nigeria consumed as supplementary energy food and the leaf is used in ethnomedicine for the treatment of dysentery and diarrhoea; however this claim is yet to be validated by suitable experimental model. *In vivo* antidiarrhoeal activity of ethanol extract of *Solenostemon rotundifolius* leaves was investigated on castor oil induced diarrhoea model in albino rats against , diarrhoea frequency Preliminary acute toxicity test of the leaf extract was conducted on albino rats, The plant leaf extract was administered orally to rats at dose rate of 300, 500 and 1000mg/kg. Loperamide (a standard drug) given orally at 2 and 3mg/kg was used as the positive control. The results over 4h showed significant ($p<0.05$) reduction in frequency of defecation, watery texture of faeces and cumulative wet faecal mass in rats treated with ethanol extract of *Solenostemon rotundifolius*. The plant extract significantly ($p<0.05$) reduced the weight of intestinal content and prolonged the latent time for diarrhoea induction in rats. The purging indices and faecal frequencies decreased with increase in dose up to 500mg/kg. Preliminary acute toxicity studies revealed no sign of toxicity and no death up to dose of 5000mg/kg suggesting relative safety of the plant extract at high doses. These results showed that leaves of *S. rotundifolius* possess anti-diarrheal properties which substantiate the use in the treatment of diarrhoea in traditional medicine.
Key words: *Solenostemon rotundifolius*, leaves, ethanol extract, anti-diarrhoea activity

INTRODUCTION
Diarrhoea and the associated faecal urgency and incontinence result from an imbalance between the absorptive and secretory mechanisms in the intestinal tract accompanied by hypermotility. This results in excess loss of fluid and electrolytes in faeces. (Ezenwali *et al,* 2009) Among the disease causing death in children under the age of five, diarrhoea is the second leading cause of death in developing countries (Saralaya *et al.* 2010). The World health Organization has encouraged studies into traditional medicine practices and prevention approaches with the aim of improving the management of diarrhoea (Md. Khalilur, 2013). Hence there is the need to identify and evaluate commonly available traditional drugs for their anti diarrhoea potential.
Solenostemon rotundifolius (Poir) J. K. Morton (Synonyms: *Plectranthus rotundifolius* Poir, *Coleus rotundifolius)* is of the mint family *Lamiatae* and is being reported under the genera *Coleus,Plectranthus and Solenostemon.* Its common names include Hausa potato, Frafra potato, Sudan potato, Zulu round potato, Coleus potato, Chinese potato; and the leaves are used in ethnomedicine for the treatment of dysentery, blood in urine and eye disorder (Enyiukwu *et al.*, 2014).
This study seeks to evaluate the effectiveness of the acclaimed anti diarrhoea potential of this plant using appropriate scientific model in furtherance of our search for potent medicinal agent from plant.

MATERIALS AND METHOD
Drugs: Loperamide (Square pharmaceuticals Ltd., Bangladesh), Castor oil
Chemicals: All chemicals and reagents were of analytical grade and were mainly products of Sigma-Aldrich.
Plant material: Fresh leaves of *S. rotundifolius* were collected in the month of October, 2014 from the demonstration farm of National Root Crop Research Institute Umudike and identified by experts in the Institute. The leaves were dried under room temperature, milled into powder and extracted with ethanol by continuous extraction using Soxhlet apparatus. The extract was evaporated at room temperature and gave a yield of 2% of a semi solid ethanol extract.
Animal:
Male albino rats (65-120g) obtained from the animal facility of the Faculty of Biological Sciences, University of Nigeria, Nsukka were acclimatized to normal laboratory conditions for two weeks, fed with standard rodent pellet and water *ad libitum*. All animal experiments were in accordance with the National Institute of Health Guide for Care and Use of Laboratory Animal (Pub No. 85-23 revised 1985).
Acute toxicity test:
Acute toxicity of ethanolic extract of *S. rotundifolius* was determined in albino rats using the method described by Ezenwali *et al*. (2009) with slight modification. The test was divided into two stages. In stage one, nine

randomly selected rats were divided into 3 groups (n = 3) and received 100, 200 and 300 mg/kg of the extract respectively and observed for number of deaths in 24 h. After 24 h, based on a record of zero death in the stage one test, a fresh batch of animals were divided into 3 groups (n = 3) and received 1000, 3000 and 5000 mg/kg of the extract. The animals were also observed for 24 h for deaths. No death was observed in all doses.

Castor oil-induced diarrhoea test

The effect of *S. rotundifolius* on diarrhoea was evaluated in rats using the castor oil-induced diarrhoea method (Ezenwali *et al.,* 2009 and Salaya *et al.,* 2010). The parameters observed included the latent period (the time between castor oil administration and the appearance of first diarrhoea drop) , the number of both wet and dry stools and weight of the wet stools. All these were noted every 1h and the paper changed after each evaluation. The percentage of rats that responded to diarrhoea in each group was calculated; the mean of the stools passed by the treated groups were compared with that of the control and the mean number of diarrhoea faeces pooled by the control group was considered as 100%.

The percentage inhibition of wet faeces and frequency of stool caused by ethanol extract of *S. rotundifolius* were calculated relative to the control using the relation:

Inhibition of defecation (%) = $[(NFe_C - NFe_T)/NFe_C] \times 100$

Where: NFe_C = mean number of faeces of control group

NFe_T = mean number of faeces of treated group.

The level of reduction (%) in defecation of watery faeces was calculated using the relation:

Inhibition of diarrheic faeces (%) = $[(NDF_C - NDF_T)/NDF_C] \times 100$;

Where: NDF_C = mean number of diarrhoea faeces of control group;

NDF_T = mean number of diarrhoeic faeces of treated group.

The purging index (PI) was calculated using the formula (Teke *et al*, 2010):

$$PI = \frac{\text{\% respondent x average number of stool}}{\text{Average latent period}}$$

RESULTS

Diarrhoea may be defined in terms of stool frequency, consistency, volume, or weight (Thomas *et al*, 2003). Evaluation of the effect of ethanol extract of leaves of *Solonestemon rotundifolius* on diarrhoea experimentally induced by castor oil in rodents showed significant (P<0.05) reduction in the weight, number, wetness of diarrhoea stools and in frequency of defecation. Castor oil is a suitable model of diarrhoea in rats since it allows the observation of measurable changes. After oral ingestion of castor oil, ricinoleic acid is released by lipases in the intestinal lumen. The freed ricinoleic acid irritates the intestinal mucosa causing inflammation and release of inflammatory mediators, such as prostaglandins and nitric oxide, which in turn stimulate gastrointestinal secretion, motility, epithelial permeability and oedema of the intestinal mucosa thereby preventing the re-absorption of Na^+, K^+ and water (Ammon *et a*l., 1974; Mahesh *et al.*2010) Active intestinal secretion is driven predominantly by net secretion of chloride or bicarbonate, inhibition of net sodium absorption, or increase in luminal osmotically active molecules (osmotic pressure) (Shah 2004). The extract at various doses reduced the purging index, the degree of wetness of the stool and significantly increased the latent period of diarrhoea which is suggestive of inhibition of hyper gastrointestinal secretion.

The acute toxicity test of the extract on albino rats established high LD_{50} suggesting the plant to be relatively safe at high dose.

CONCLUSION

The leaves of *Solenostemon rotundifulius* may have potential to reduce the diarrhoea in rats, therefore may contain bioactive principle that can be explored for the management of diarrhoea

Acute toxicity test: No death was observed up to dose of 5000mg/kg body weightTable 1: Effect of *S. rotundifolius* at various doses on castor oil-induced diarrhoea in experimental rats

Treatment group	Dose	Respondent to diarrhoea (%)	Latent period of diarrhoea onset (hr)	None diarrhoea faeces
Olive Oil	1ml	66.67	1	0
Water	1ml	100	1	0
Loperamide	2mg/Kg	66.67	3	4.2
Loperamide	3mg/kg	0	4	0
S. rotundifolius	300mg/Kg	66.67	3.5	6
S. rotundifolius	500mg/kg	16.67	5	6
S. rotundifolius	1000mg/kg	83.33	<1	0

< = Less than

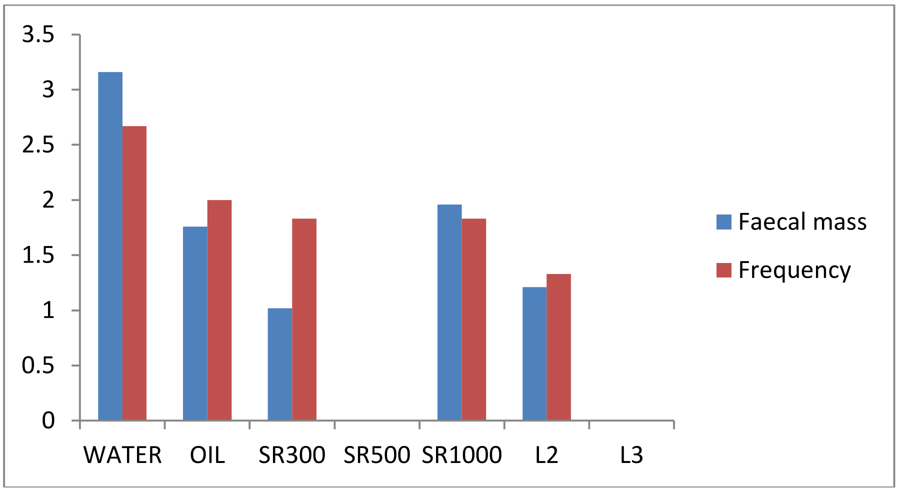

Fig 1: Effect of *S. rotundifolius* at various doses on faecal characteristics in castor oil-induced diarrhoea in experimental rats

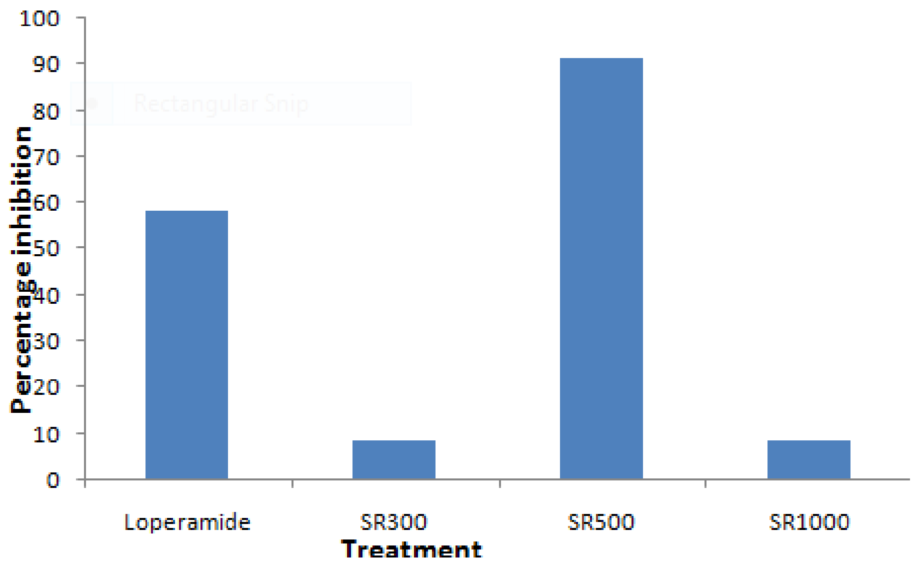

Fig 2: Inhibition potential of *S. rotundifolius* on diarrhoea induced with castor oil on experimental rat

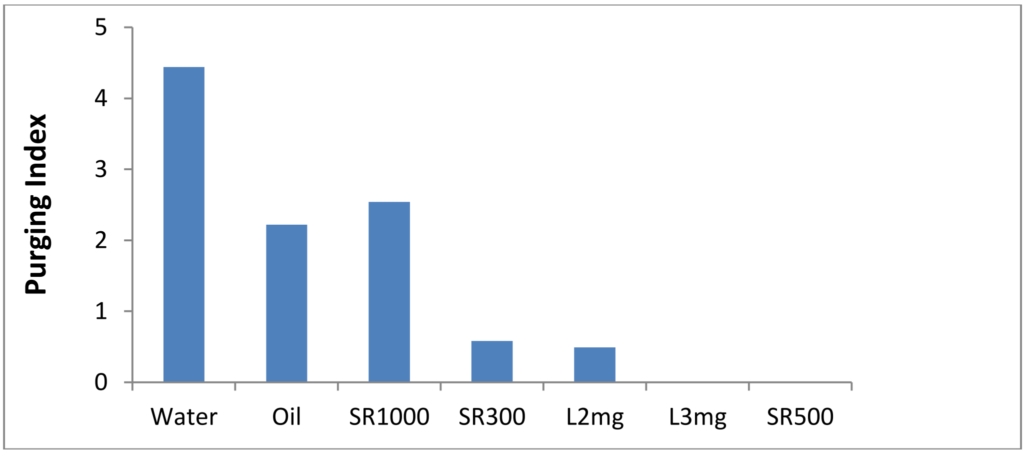

Fig 3: Effect of *S. rotundifolius* on purging index

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EFFECT OF EBOLA DISEASE OUTBREAK IN NIGERIA ON BUSHMEAT ENTERPRISE IN NSUKKA AGRICULTURAL ZONE OF ENUGU STATE, NIGERIA

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ABSTRACT
This study was designed to determine the effect of Ebola Virus Disease outbreak in Nigeria on bush meat enterprise in Nsukka agricultural zone of Enugu state. The specific objectives was to determine the effects of the disease outbreak on mean level of sales and consumption of bush meat before, during and after the outbreak Random sampling technique was used in the selection of respondents. Data were collected using structured questionnaire from 40 sellers and 60 consumers of bush meat. Data were analyzed using descriptive statistics like frequency, means and t-test. The t- test for both sales and consumption were significances at 5% probability level, which made the null hypothesis to be rejected, indicating a drop in the levels of sales and consumption and consequent loss in income among sellers due to the outbreak. In view of these findings, there is a need for stakeholders to put in place agencies and relevant sensitization mechanism to educate the people on the necessary Ebola disease preventive measures and precautionary behaviours to adopt to still enjoy their bush meat in case of any future outbreaks.
Keywords: Ebola, bushmeat enterprise, agricultural zone, effect.

INTRODUCTION
In West Africa, consumption of bush meat is an ancient food tradition that is essential for supplying the necessary nutrition because of the low traditional the livestock production capacity of the people. Bush meat is eaten as a major source of protein and sustenance, especially in the rural areas, while major towns and cities treated bush meat as a luxurious delicacy in their diets (Hogenboom, 2014).
The term bush meat is commonly used for meat of terrestrial wild or feral mammals, killed for sustenance or commercial purposes throughout the humid tropics of the Americas, Asia, and Africa; in West Africa, primarily Ghana, Ivory coast and Nigeria (Nasi et. al., 2008). However, bush meat is a vector of some serious tropical diseases spread to human (Karesh and Noble 2009; Subramanian, 2012), for instance Ebola Virus Disease (EVD). The Ebola virus, for which the primary host has been identified as fruit bats, is a major concern in bush meat consumption and public health. Primates which have been suspected to be an intermediate host may carry the disease, after contracting the disease from bat droppings or remnants of fruits eaten by the bats.
According to Bausch (2014), the 2014 West Africa Ebola outbreak was the largest of its kind since the discovery of Ebola Virus Disease epidemic (EVD) in West Africa. The outbreak began in the Republic of Guinea in February of 2014. Since its initial outbreaks, the virus has already spread to the republic of Liberia, the Sierra Leone and then Nigeria. Though there was no recorded case of Ebola disease in most parts of Nigeria like Nukka area, there was a massive decline in the consumption of bush meat around the country, [and particularly in Nsukka area that notably have a robust marker and consumers,] making the bush meat enterprise to suffer major setback in sales (Ajayi, 2014). It was on this premise that this work was set out to study the effects of the disease outbreak on bush meat enterprise in Nsukka area of Nigeria. The following research hypothesis guided the study:
H_O: The outbreak had no significant effect on bush meat enterprise in Nsukka agricultural zone.
H_a: The outbreak had a significant effect on bush meat enterprise in Nsukka agricultural zone.

METHODOLOGY
Nsukka agricultural zone is one of the six agricultural zones in Enugu state. It is made up of three local government areas (LGAs) namely: Nsukka, Igboetiti and UzoUwani Local Government Areas (ENADEP, 2012). Rainfall distribution is between 168mm - 1700mm. The area has tropical climates marked by two distinct seasons. The vegetation is of derived savannah and people in this area are predominately farmers; farming constitutes their major economic activity. However, some of the urban areas like Nsukka town have more civil servants and petty traders. Their predominant crops include cassava, maize, cocoyam, yam, vegetables and economic fruits. Nsukka Agricultural Zone has a robust bush meat market, with many bars and restaurant where different varieties of bush meat are sold.
Out of the three local governments in the zone, two local governments, Nsukka and Igboetiti Local Government Areas were randomly selected for this study. From each of the local governments, 20 sellers were randomly

selected from the list of sellers from the bush meat trade union and 30 consumers were also randomly selected from the different bars from those present at the time of administering the questionnaire. This gave a sample of 40 sellers and 60 consumers.
Primary data sources were used for the data collection. Primary data for the study was collected through personal interview conducted with the use of well structured questionnaires. Two set of questionnaires were structured for both the sellers and the consumers. The questionnaire contained information on the level of sales and consumption before, during and after the Ebola outbreak for the sellers and consumers respectively. Data was analyzed using descriptive statistics; frequencies, means and t-test.

Model Specification
The t-test is an analytical tool employed to compare the periods before after the ebola disease outbreak in Nigeria. It is given as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} - \frac{S_2^2}{n_2}}} \qquad n1 + n2 + 2 \text{ degree of freedom}$$

Where:
t = t- test statistic.
$\bar{x}_1$ = Mean sale/consumption before the disease outbreak
$\bar{x}_2$ = Mean sale/consumption after the disease outbreak
S_1^2 = variance of sale/consumption before the disease outbreak
S_2^2 = variance of sale/consumption after the disease outbreak
n_1 = number of respondents before the period
n_2 = number of respondents after the period
The t-test was used to test the stated hypothesis

RESULTS
Levels of Sales and Consumption of Bushmeat Before, During and After the Outbreak
The results as presented in table 1 indicate that the sale of bush meat was booming before the outbreak and so was the rate of consumption. However, during the Ebola outbreak, some of the sellers and consumers recorded zero sales and consumption respectively. It also show that even after the outbreak, some sellers and consumers did not recover from the shock of the outbreak as they still recorded zero sales and consumption. The results show that bush meat sales and consumption in the study area highest before the outbreak, with means of 1762.5 plates (0.5kg per plate) and a mean consumption frequency of 12 times per month. Sales and consumption were lowest during the outbreak; even some sellers stopped sales, while some consumers stopped eating bush meat during the outbreak. However, the enterprise picked up again after the country has been declared Ebola disease free, but not as much as it was before the outbreak, thus, indicating a likely impact by the outbreak on the enterprise. This result is in line with the findings of Akani et al. (2015) and may be related to the ban on bush meat and the incessant awareness by the government on the risks associated with the consumption of bush meat.
Surprisingly, results show that consumption recorded a highest frequency of 60 during the outbreak. This could possibly be due to the fact that there were some consumers who actually ignored the 'bush meat cause Ebola' nuances and went ahead to have enjoy bush meat during the outbreak. These people consumed more due to the reduction in price during the outbreak regardless of the consequence. These could be the poor in the society who may be, could not afford the delicacy while the price was high before the outbreak.
To test the hypothesis of the study, t-test of the difference of two means was used to test for any any significant difference between the mean sales and consumption before and after the Ebola disease outbreak. The results of the test are as presented in Tables 2 and 3.
The results in table 2 and 3 showed that there was a statistical difference in sales an consumption before and after the outbreak. This is in line with findings of Akani et al (2015), Ndem et al. (2015), Agbo et al. (2014), United Nations Development Programme (2014), Mutasad (2015) and African Development Bank Group (2016) which pointed out that the levels of consumption and sales of bush meat in different parts of West Africa were affected by the Ebola disease outbreak. This points out to the effect of the outbreak on both sales and consumption in the study area.

CONCLUSION
The research work has evaluated the effect of the Ebola Virus Disease outbreak in Nigeria on bush meat enterprise in Nsukka agricultural zone of Enugu State. It is apparent that although there was no Ebola case in the study area, the bush meat enterprise there suffered some set back due to the outbreak in the country, as there was

a statistically significant reduction in both levels of sales and customers' patronage. Based on the findings of this study, it is recommended that information and communication department should be embedded in the Ministries of Agriculture and Health and they should be active in dispatching useful and timely information on such outbreaks to sensitize the people on the right preventive measures to take. Government should create more awareness in rural areas through the mass media that Nigeria is free of Ebola Virus Disease and that bush meat is now safe for public consumption. This would help to bring back the bush meat enterprise

Table 1: Mean monthly sales and consumption before, during and after the Ebola outbreak

	SALES (no of plates (0.5kg) of bushmeat sold in a month)			**CONSUMPTION (frequency of consumption in a month)**		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Before Ebola Outbreak	150	6000	1762.50	2.0	50.0	12.283
During Ebola outbreak	0	4500	868.50	0.0	60.0	8.233
After Ebola outbreak	0	5100	1631.00	0.0	50.0	11.833

Source: Field survey, 2016

Table 2: A t- test comparing the mean sales before, during and after the Ebola outbreak

	Mean	**Std.deviation**	**Std.error mean**	**t**	**df**	**Sig.**
Before- During	821.625	1508.325	238.487	3.445	39	0.001
During-After	-762.500	140.062	140.062	-5.444	39	0.000

Source: Field survey, 2016

Table 3: A t- test comparing the mean consumption before, during and after the Ebola outbreak

	Mean	**Std.deviation**	**Std.error mean**	**t**	**df**	**Sig.**
Before- During	4.050	6.280	0.811	4.995	59	0.000
During-After	3.600	6.118	0.789	4.558	59	0.000

Source: Field survey, 2016

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EFFECT OF ENVIRONMENT AND DIETARY PROTEIN LEVELS ON GROWTH PERFORMANCE OF CATFISH – CLARIAS GARIEPINUS FINGERLINGS

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ABSTRACT
One hundred and eight African catfish fingerlings, obtained from a private fish hatchery, were used to assess the effect of environment and dietary protein levels on growth performance of Clarias gariepinus using 3x2 factorial in a completely randomized design (CRD) experiment. Three diets were formulated to contain different protein levels (32%, 35% and 45%) but similar energy (3800MJ/Kg), phosphorus (1.2%) and calcium levels (1.5%) and fed to fish in ponds located outside or inside a building at 36 fingerlings (averaging 70g bodyweight) per treatment. Each treatment was replicated into two at 18 fingerlings per replicate. The trial lasted fifty-nine days with twice daily feeding regime. Data collected were subjected to analysis of variance in 3x2 factorial in CRD and Least Significant Difference used to separate significant means There were significant (P<0.05) differences in protein level (PL) main effect. Clarias gariepinus had similar (P>0.05) average final weight (AFW) (2015g and 1687.5g) on PL45% and PL35% diets respectively but lower (P<0.05) value (1352.5g) on PL32% diet. The %specific growth rate (SGR) (5.668 and 5.283) on PL45% and PL35% diets were similar (P>0.05), but higher (P<0.05) on PL32% diet (4.953). Mean weight gain (MWG) was highest (P<0.05) for fish fed PL45% diet (1945g), followed by fish on PL35% diet (1617.5g) and lowest for fish on PL32% diet (1282.5g). The %relative feed intake (RFI) (2.710 and 2.668) and feed conversion ratio (FCR) (0.898 and 0.858)) of fish on PL32% and PL35% diets were similar (P>0.05) but higher (P<0.05) than RFI (1.970) and FCR (0.623) of fish on PL45% diet. There were significant (P<0.05) differences in environment (En) main effect. Outdoor (EnO) fish had higher (P<0.05) AFW (1953g), MWG (1883g) and SGR (5.622) than indoor (EnI) fish with AFW (1417g), MGW (1347g) and SGR (5.049). EnI fish had higher cost of production than EnO fish (₦220.60 versus ₦188.84).
There were significant (P<0.05) PLxEn interactions. AFW (2305g) and MWG (2234g) of EnOxPL45% were similar (P>0.05) to those (1850g and 1780g) of EnOxPL35% but higher (P<0.05) than those (1705g and 1635g) of EnOxPL32%. EnOxPL32% and EnOxPL45% had higher (P<0.05) AFW (1705g, 2305g) and MWG (1635g, 2234g) than EnIxPL32% (930g) and EnIxPL45% (1655g). SGR followed similar trend as AFW and MWG in all considerations. EnIxPL32% and EnIxPL35% were higher (P<0.05) in RFI (2.875, 3.010) and FCR (0.975, 0.975) than EnIxPL45% (0.625) and EnOxPL45% (0.620). EnIxPL32% and EnIxPL35% had higher cost of production (₦239.01 and ₦227.00) than EnOxPL32% and EnOxPL35% (₦181.40 and ₦190.91).
Keywords: Environment, Performance, Protein, Dietary, Catfish

INTRODUCTION
Aquaculture is growing in Nigeria and becoming an increasingly important source of fish available for human consumption due to the quality protein content. Nutrition and feeding play a central role in sustainable aquaculture and therefore, feed resources as well as costs continue to dominate aquaculture needs (Bahnasawy, 2009). Development of nutritious and cost effective diets is dependent on the knowledge of basic nutritional requirement of organisms. It is also important to meet these requirements with balanced feed formulation and appropriate feeding practices (Tucker, 1998). Protein is an important factor in fish nutrition. Protein provides essential amino acids which are used for tissue repair and growth of the fish. However, maximum utilization of dietary protein for growth depends on the quality of the protein source. Dietary protein has significant importance in aquaculture system because it represents considerable economic investment and a central factor that determines fish growth so long as other physiological requirements needed for growth are fulfilled (De Silva *et al*, 1989; Buttle *et al*, 1995). Also, protein is an expensive nutrient and feed represents the single largest cost input in fish culture (80-85%). The impact of aquatic environment to the growth of fish cannot be overemphasized, and it gives birth for further reduction on protein level. Cold water experienced in Europe might increase the protein requirement of catfish but not in a place like Nigeria or Africa as a whole. The African catfish is recognized as an ideal species for aquaculture due to its continued reproductive performance, ability to efficiently utilize commercial feedstuffs and the capacity to use atmospheric oxygen (Haylor, 1989). Earlier reports on protein requirement for various fishes had been with varying results. Fatuorti *et al*. (1986)

reported the requirement of 40% CP for the growth of *Clarias lazera*. Similarly, Eyo and Falayi (1999) noted the need of 35% CP for *Heterobranchus Iongifilis x C. anguillaris* fingerlings to sub-adult, 37.5% CP for *C. gariepinus* fingerlings (Faturoti & Akinbote, 1986) and 40% CP for *C. anguillaris* fry to fingerlings (Madu and Olurebi, 1987). This study was therefore, aimed at reassessing the protein requirement and environment where *Clarias gariepinus* fingerlings are raised as it affects its growth performance.

MATERIALS AND METHOIDS

One hundred and eight (108) African catfish fingerlings were allocated to three dietary treatments in ponds located outside or inside a building at 36 fingerlings per treatment in a 3x2 factorial in a completely randomized design (CRD) experiment. The fingerlings had average body weight of 70g per treatment. Each treatment was replicated into two at 18 fingerlings per replicate. The fish were obtained from a private fish hatchery, transported in aerated plastic rubber of acclimatized aquatic nature. Twelve plastic tanks (each representing a replicate and containing 18 fingerlings) were used for this trial. Three diets were formulated to contain different protein levels but similar energy(ME= 3800MJ/Kg), phosphorus (1.2%) and calcium (1.5%) levels and designated T32 (CP=32%), T35 (CP=35%), T45 (CP=45%) as shown in Table 1. A total of 1.5kg of each diet was weighed out into a 4-litre rubber and hung on their respective tanks for feeding the fish throughout the period of trial. The trial lasted fifty-nine days and feeding pattern was two times daily and leftover feeds were equally recorded across the diets. The data collected were the initial weight of the fingerlings and its final weight obtained at the end of the trial. After all the arithmetical computations, it was then subjected to analysis of variance (ANOVA) in a 3x2 factorial in CRD. The Least Significant Difference (LSD) was used to separate means, where significant.

RESULTS AND DISCUSSION

Growth performance of *Clarias gariepinus* fingerlings fed diets with varying protein levels and reared in two environments (indoor and outdoor) is shown on Tables 2, 3 and 4. There were significant differences ($P<0.05$) in protein level (PL) main effect. Average final weight (AFW) of *Clarias gariepinus* on 45% protein diet was similar ($P>0.05$) to that of *C. gariepinus* on 35% protein diet but higher ($P<0.05$) than that of those on the 32% protein diet. However, the AFW of fish on the 35% and 32% protein diets were similar. Percent specific growth rate (SGR) of *C. gariepinus* on 45% and 35% protein diets were also similar ($P>0.05$), but higher ($P<0.05$) than that of fish on 32% protein diet. Mean weight gain (MWG) of fish fed the 45% protein diet was the highest ($P<0.05$), followed by that of fish on the 35% protein diet while that of those on the 32% protein diet was the lowest ($P<0.05$). Percent relative feed intake (RFI) and feed conversion ratio (FCR) of fish on the 32% and 35% protein diets were similar ($P>0.05$) but higher ($P<0.05$) than that of fish on the 45% protein diet. An observed general trend in the parameters including MFI but excluding RFI and FCR was that of increasing value as the protein inclusion levels increased while the RFI and FCR values decreased as the protein inclusion levels increased. This shows that increase in dietary protein encourages better performance in *C. gariepinus*. In this study, the 45% protein diet encouraged best performance of the fish.

There were significant ($P<0.05$) Protein level X Environment interactions for AFW, MWG, mean feed intake (MFI), SGR, RFI and FCR as shown in Table 4. Among the fish reared outdoors (EnO), the AFW and MWG of fingerlings fed 45% protein diet (PL45%) were similar ($P>0.05$) to the AFW and MWG of fish fed 35% protein diet (PL35%), but higher ($P<0.05$) than those of fish fed the 32% protein diet (PL32%). Compared on protein level basis, fish reared outdoor at 32% (EnOxPL32%) and 45% (EnOxPL45%) protein levels had higher ($P<0.05$) AFW and MWG than those reared indoor (EnI), while at the PL35% the AFW and MWG were similar ($P>0.05$) for the EnI and EnO fish. On indoor basis only, EnIxPL45% fish had the highest ($P<0.05$) AFW and MWG, followed by EnIx35% fish, while EnIxPL32% fish had the lowest ($P<0.05$) AFW and MWG. SGR followed similar trend as AFW and MWG in all considerations, the only exception being that SGR of fish fed PL45% diet were similar ($P>0.05$) for both indoor and outdoor. Fish fed the PL32%, PL35% and PL45% diets had similar ($P>0.05$) MFI, RFI and FCR for EnI and EnO fish. The MFI of EnIxPL35% fish was higher ($P<0.05$) than only the MFI of EnIxPL32% fish. The RFI and FCR of EnIxPL32% and EnIxPL35% fish were higher ($P<0.05$) than only the RFI and FCR of both EnIxPL45% and EnOxPL45% fish

On economics of production, level of protein inclusion did not elicit noticeable differences in the cost of feed per unit weight gained, but the differences occasioned by reason of environment (outdoor or indoor) in which the effects were highly noticeable. This showed in the interactions such that all the fish in the indoor environment at both 32% and 35% protein levels had higher cost of production than the fish in the outdoor environment, except at the 45% protein level where the differences were not noticeable. The reason of some natural factors like sunlight making for easy dissolution of oxygen and the growth of algae in the outdoor ponds appears logical.

In all the parameters considered a general trend was established. Performance of fish at all levels of protein inclusion was better in all parameters for the outdoor environment than for the indoor environment. This may be a strong confirmation of the earlier adduced reason of some natural factors playing a role. In the outdoor environment sunlight was unimpeded; oxygen was in abundance and could be easily dissolved in the presence of sufficient sunlight; there was no obstruction in aeration and air movement; and the environment was ripe for the development and growth of algae which is natural food for the and modifier of the environment for the fish. The in-house ponds lack access to all these natural factors which usually support fish life and make for their enhanced performance.

Another important trend observed was that the parameters that give strong indication of nutrient utilization (specific growth rate and feed conversion ratio) as well as cost factor that has profit implication (cost/WG) did not differ between the performances of the outdoor fish at both the 35% and 45% dietary protein levels.

Several Authors have carried out similar studies on reassessing protein level requirement of African Catfish. Keremah and Beregha (2014) did same work and their result equally conformed to the finding of the present study. The performance gap in the measured parameters of the lower protein diet (35%) and the higher protein diet (45%), including the cost implication, does not justify going for the higher protein level.

CONCLUSION

For sustainability of fish farming in Nigeria, cost of feed as a major determinant becomes an imperative for unlocking the potentials of nutrients and availability to human consumption. Thus, the need to achieve a cost effective aquaculture system is to have optimum dietary protein level of catfish, avoid wastages and pollution of water by excess crude protein. These potentials could serve as an innovative framework and agribusiness value addition to relief cost to farmers. Therefore, the 35% dietary protein level could be recommended as more economical for the agribusiness firms in livestock industry.

Table 1: Percentage Composition of Clariasgariepinus Fingerling Diets at different protein levels

	Dietary Protein Levels (%)		
Ingredient	*32*	*35*	*45*
Salt	1.3	1.3	1.1
Soya Oil	3.5	3.5	3.9
SBC	20.5	26.0	4.0
Methionine	1.1	1.1	0.5
Lysine	3.7	3.5	2.3
Fishmeal	30.1	30.1	65.4
Cassava Flour	20.0	21.3	20.0
Toxin Binder	0.1	0.1	0.1
Maize Flour	17.3	11.1	2.5
Premix	0.3	0.3	0.3
Limestone	0.7	0.5	-
DLCAPHOS	1.3	1.2	-
Total	100	100	100

Calculated nutrient composition

Crude fiber,%	6	6	6
ME (MJ/Kg)	3800	3800	3800
Calcium,%	1.5	1.5	1.5
Phosphorus,%	1.2	1.2	1.2

NB: Least Cost Formulation method was used to optimize the varying ingredients to produce balanced ration based on the specification of each diet.

Table 2: Growth Performance of African Catfish as influenced by Dietary Protein Levels

	Dietary Protein Levels			
Parameters	***32%***	***35%***	***45%***	***SEM***
Average Initial Weight (g)	70	70	70	-
Average Final Weight (g)	1352.5^{b}	1687.5^{ab}	2015.0^{a}	98.5*
Mean Weight Gain (g)	1282.5^{c}	1617.5^{b}	1945^{a}	98.5*
Mean Feed Intake (g)	1117.5	1362.5	1207.5	90.3
%Specific Growth Rate	4.953^{b}	5.283^{a}	5.668^{a}	0.098*
% Relative Feed Intake	2.710^{a}	2.668^{a}	1.970^{b}	0.161*
Feed Conversion Ratio	0.898^{a}	0.858^{a}	0.623^{b}	0.053*
Cost of Feed (N/Kg)	232.82	245.14	313.24	
Cost/KgWG (N)	210.21	208.96	195.00	

Values with different superscripts within each row are significantly different at p<0.05.

Table 3: Growth Performance of African Catfish as affected by the environment in which they were reared

	Environment (Inside or Outside)		
Parameters	***Outside***	***Inside***	***SEM***
Average Initial Weight (g)	70	70	-
Average Final Weight (g)	1953^{a}	1417^{b}	80.485*
Mean Weight Gain (g)	1883^{a}	1347^{b}	80.485*
Mean Feed Intake (g)	1335	1123	73.739
%Specific Growth Rate	5.622^{a}	5.049^{b}	0.080*
% Relative Feed Intake	2.283	2.615	0.132
Feed Conversion Ratio	0.727	0.858	0.043
Cost of Feed (N/Kg)	263.73	263.73	
Cost/KgWG (N)	188.84	220.60	

Values with different superscripts within each row are significantly different at p<0.05.

There were significant (P<0.05) differences in environment (En) main effect. The fish in the outside ponds (O) had higher (P<0.05) AFW, MWG and SGR than fish in the in-house ponds (I). The explanation to this situation could lie in the accessibility of the fish in the outside pond to natural and good quality light as well as better aeration.

Table 4: Influence of Dietary Protein Levels on Growth Performance of African Catfish Reared in Different Environments (Indoor or Outside)

	32% CP		35% CP		45% CP		
Parameter	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	SEM
Average Initial Weight (g)	70	70	70	70	70	70	-
Average Final Weight (g)	1705^{b}	1000^{c}	1850^{ab}	1525^{b}	2305^{a}	1725^{b}	139.4*
Mean Weight Gain (g)	1635^{b}	930^{c}	1780^{ab}	1455^{b}	2234^{a}	1655^{b}	139.4*
Mean Feed Intake (g)	1330^{ab}	905^{b}	1310^{ab}	1415^{a}	1365^{ab}	1050^{ab}	127.7*
%Specific Growth Rate	5.405^{b}	4.500^{c}	5.545^{ab}	5.220^{b}	5.915^{a}	5.420^{ab}	0.139*
% Relative Feed Intake	2.545^{ab}	2.875^{a}	2.325^{ab}	3.010^{a}	1.980^{b}	1.960^{b}	0.228*
Feed Conversion Ratio	0.820^{ab}	0.975^{a}	0.740^{ab}	0.975^{a}	0.620^{b}	0.625^{b}	0.075*
Cost of Feed (N/Kg)	232.82	232.82	245.14	245.14	313.24	313.24	
Cost/KgWG (N)	181.40	239.01	190.91	227.00	194.21	195.78	

Values with different superscripts within each row are significantly different at p<0.05.

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ASSESSMENT OF IRON AND COPPER IN CASSAVA PEELS FROM UMUNNEOCHI L.G.A. SOUTH EASTERN NIGERIA; IMPLICATION FOR LIVESTOCK FEEDS PRODUCTION

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ABSTRACT
Cassava peels were collected from some farms in Umunneochi and were analyzed for copper (Cu) and iron (fe). The average values for the elements were found to be CU (0.92 mg/kg), and Fe (850mg/kg) using Atomic absorption spectrophotometer. Iron and copper are essential trace elements and therefore are needed in formulation of livestock feeds. Cassava peels are therefore recommended as a good source of dietary iron for livestock feeds.

INTRODUCTION
The current pattern of industrial activity alters the natural flow of materials and introduces novel chemicals into the environment. The rate at which effluents are discharged into the environment especially water bodies have been on the increase as a result of urbanization. Most of these effluents contain toxic substances especially heavy metals such as chromium, iron, zinc, copper, etc. metals like arsenic, mercury, lead, chromium, phosphorus, and antimony are introduced into the environment by use of chemical like pesticides, herbicides and fertilizers (Frink, 1993).
Furthermore, very many of the metallic elements are however likely to be involved at potentially hazardous concentrations in food, largely due to their increasing exploitation by man. Very many of these elements are known to be essential for healthy growth in plant, animals and man at low concentrations and only become hazardous when certain threshold concentrations are exceeded. This study was aimed at assessing the concentrations of iron and copper in cassava peels from Umunneochi and know the implication for livestock feeds production.

MATERIALS AND METHODS
Source of Materials: The samples were collected from some farms in Umunneochi Local Government Area of Abia State.

Sample Preparation
The cassava peels were first sun dried and later oven – dried to reduce the moisture content prior to extraction of the mineral elements.

Methods
Extraction of Copper from the Peels
The method used in extraction and quantitative determination of copper was that described by Pearson (1976).

Determination of Iron
The sample was analyzed using the dry ash method, in which the sample was ashed in a muffle furnace and the cooled ash dissolved with 50cm^3 at 6m HNO_3 and boiled for about 15mins on a hot plate. The resulting filtrate was analyzed using Atomic absorption spectrophotometer.

RESULTS AND DISCUSSION
Table 1 shows the concentration of iron and copper in cassava peels. The iron content was 850mg/kg while the copper content was 0.920mg/kg. The result obtained showed that cassava peels is rich in iron and poor in copper. According to Wagman and Pergrsion (1982) iron is necessary for the formation of hemoglobin in the red blood cells. The recommended daily need of iron for man is 15mg/kg per day according to Lucas (1975).
The level of copper as seen in table 1 is low when compared to iron. The recommended daily need of copper is 2 to 3mg per day. According to Bowen (1979) copper content of normal plant tissues varies according to species but it is usually within the range of 1-250mg/kg dry matter. According to Walsh (1971) copper is toxic to man at concentration of 250mg/kg per day.
The iron content of normal plant tissues varies according to species but it is usually within the range of 20-200mg/kg dry matter. According to Bowen (1979) copper and iron fall within the group essential nutritive - trace elements.

CONCLUSION

Based on the result of the study, cassava peels are rich in iron but poor in copper content. The iron content of 850mg/kg is far above the daily dietary need of livestock such as goats and pigs which is supposed to be 15mg/kg per day. The copper content of 0.920mg/kg is low when compared to the iron content. Iron is a major component of hemoglobin in red blood cells and it is deficiency in animals could result to anaemia. The iron content of normal plant tissues varies between 20 to 200 mg/kg according to Lucas (1979). It falls within the essential trace element group. According to Lucas (1979), the copper content of normal plant tissues varies between 1-25.0mg/kg. Copper is an essential trace elements needed by the animals body in low concentration.

Table 1: Iron and copper concentrations of cassava peels

Minerals Element	ABS	QTY in MG/KG
Iron	0.365	850mg/kg
Copper	0.025	0.920mg/kg

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BUTCHERS BACKGROUND AND ABATTOIR MANAGEMENT IN NORTH-EASTERN PART OF JIGAWA STATE, NIGERIA

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ABSTRACT

The study was conducted at Hadejia Central Abattoir, Jigawa State, Nigeria. Hadejia lies approximately between 10º.10'E Longitude and between 12º.25N and 12º.30'N Latitude. Fifty four (54) copies of structural questionnaires were administered to different butchers to obtain information about their socio-economic background and perception on abattoir management and environment. The data collected were analyzed using simple descriptive statistics. Results showed that all the butchers were male, majority of them were youth, have secondary school leaving certificates and married. Most of the butchers have 3 to 5 years of experience, their main source of water was bore hole, respondents were satisfied with the sanitary condition of the abattoir and commended government effort in the overall management of the abattoir. It is recommended that similar study should be conducted in the north-west and south-south of the state so as to come up with the general trend within in the state.

Keywords: Butchers, abattor management, background, Nigeria

INTRODUCTION

A Butcher is a person who slaughters animals, dresses their flesh, sells their meat or do any combination of these tasks. A butcher may be self-employed, employed by supermarkets, grocery stores, butcher shops or slaughter houses, (Salakoni, 2002).

An abattoir is a composite unit or structure in which animals are slaughter, prepared and made ready for distribution to general public i.e. the meat retails. Different activities are carried out in fully mechanized line. The workers were assigned to specific work station and the carcasses move on a conveyor system, from station to station until slaughter process is completed.

In slaughter line operation, clean and unclean operations are physically separated and individual adhered to avoid contamination of carcasses and edible by products. The unclean operations include stunning, bleeding and skinning (ruminants). The clean operations include evisceration, carcasses splitting and carcasses dressing. In rural setting, slaughtering can be done on basic small-scale facilities. Before building slaughtering facilities a number of factors must be consider such as environmental impact, the availability of a work force and the linkage to the meat markets (Osinero, 2007).Closeness to livestock market, frequent water supply, location away from residential areas, adequate supply of power, good ventilation, ease of cleaning are some of the factors tobe considered in siting an abattoir (Anonymous, 2012).

Mason (2005) classified abattoir as good, poor or fair depending on the facilities available, units and operational sections. The abattoir management system is made up ofa number of independent yet integrated modules confined to the slaughtered processes. Within the abattoir management system it is possible to identify the supplies, date of slaughtered and all relevant classification details, grading information of the byproducts and sale information of any kind that has been captured into the system. The software modules handles data input of the entire processes starting from livestock at the abattoir and ending with the dispatch of the carcasses (Bello and Oyedemi, 2009).

A standard abattoir should consists of lairage, slaughtering/dressing unit, unit for hanging meat and editable offal's for inspection, cooling and chilling room, guttery and trippery section,isolation block for emergency and causality slaughter, laboratory for microscopic examination, detained meat room, offices for meat inspectors,staff toilets, vehicles among others (FAO, 2001). The following equipment are found in an abattoir: Restraint Ropes, Halters, Stunners, Dressing knives and axes, containers for blood collection, Overhead rails for line movement of carcasses during dressing, tables for placing meat, Hooks for hanging dress meat, Scalding vats (pig haring), Refrigerating facilities, cold rooms and Vehicles.

MATERIALS AND METHODS

The study was conducted at Hadejia central abattoir in Hadejia Local Government Area of Jigawa State, Nigeria. Hadejia town is the capital of Hadejia and is located in the central part of the emirate. Hadejia lies approximately between 10º.10'E Longitude and between 12º.25N and 12º.30'N Latitude. The town is served by federal trunk roads linking it to Nguru on the east, Kano on the north -west, Katagum on the south and Dutse (the capital city of Jigawa) on the south-west. The old town is walled with newer physical development having extended outside the walls; it is bounded at the northern sector of the town and through Mallam-Madori.

Hadejia has an average annual rainfall of 75 mm accompanied by heavy wind, the annual temperature ranges between 30 to 40ºC. The area experiences two seasons in a year, it has about 6-8 months of dry season and harmattan is experienced between December to February. The area has a population of 105,628 (NPC, 2006). Majority of the inhabitant are farmers.

Fifty four (54) copies of structural questionnaires were administered to different butchers to obtain information about their socio-economic background and perception on abattoir management and environment. The data collected were analyzed using simple descriptive statistics.

The objective of the study was to analyse Butchers Background and Abattoir Management in North-Eastern Part of Jigawa State.

RESULTS AND DISCUSSION

Table 1 showed the Socio-Economic Background of Butchers. All (100.00%) the butchers in the study area were male that means female do not participant in butchering activity, this may not be unconnected with the socio-cultural background of the area. Majority (38.89%) of the butchers were within the ages of 21 to 30 years which implies that youth dominated the meat trading activity. Most (55.50%) of the butchers have secondary schools leaving certificates, hence the butchers can easily been trained and can accept modern technology, this is in agreement with the work of Umunna *et al.* (2011).It could be interfered, therefore that the respondents were literate. For the purpose of adopting new technology, education is an important factor, which if lacking can have adverse impact on meat trading and processing.The high level of literacy can provide scope for an information interface between animal producers, extension workers, researchers and development agents. Most (55.46%) of the respondents were married, this shows that butchering activities is done mostly by responsible members of the society. Majority (31.48%) of the butchers have weekly income ranging from ₦ 10,000.00k to₦ 14, 999.00k, which may mean that the occupation is rewarding.

Information on Abattoir Environment and its Management is presented on Table 2. The results showed that majority (42.59%) of the butchers have 3 to 5 years of experience in the abattoir.

Most (75.92%) of the butchers in the abattoir used borehole water as their primary source of water. This indicated that the butchers have good and clean source of water.All (100.00%) the respondents were satisfied with the sanitary up keep of the abattoir. Responds (64.89%) from the butchers indicated that the abattoir is cleaned on daily basis that may be the more reason that the butchers were contended with the sanitary condition of the abattoir. This indicated that butchers in the study area carryout regular sanitation exercise. All (100.00%) the butchers are happy with government involvement with regards to abattoir maintenance. This indicated that the abattoir is regularly maintained. Majority (66.67%) of the butchers are satisfied with the facilities in the abattoir. This indicated the facilities in the abattoir are adequate. Most (53.70%) of butchers perceived the condition of the abattoir to be very good. This indicated that the abattoir and its environment are kept well clean.

CONCLUSION

The study concluded that all the butchers in the study area were male, majority of them were youth and have Secondary School Leaving Certificate. Majority of the butchers were satisfied with the sanitary condition of the abattoir as well as acknowledged government intervention in the up keep of the abattoir.

Table 1: Socio-Economic Background of Butchers

Parameter	Frequency	Parameter	Frequency
Gender		Religious Affiliation	
Male	54(100.00)	Islam	54(0.00)
Female	00(00.00)	Christianity	00(0.00)
Total	54(100.00)	Others (specify)	00(0.00)
Age (Years)		Total	54(100.00)
<21	10(18.52)	Marital Status	
21-30	12(38.89)	Single	15(22.78)
31-40	15(27.78)	Married	30(55.56)
41-50	05(9.26)	Divorce	04(7.40)
51-60	02(3.70)	Widow	05(9.26)
>60	01(1.85)	Total	54(100.00)
Total	54(100.00)	Weekly Income (₦)	
Level of Education		<5,000:00	14(25.93)
Primary	05(9.26)	5,000:00-9,999:00	17(31.48)
Secondary	30(55.56)	10, 000:00-14,999:00	19(35.18)
Tertiary	13(24.07)	15,000:00-19,999:00	05(7.41)
Post-Graduate	01(1.85)	Total	54(100.00)
Non-Formal	05(9.26)		
Total	54(100.00)		

Figures in parentheses are the percentages

Table 2: Information on Abattoir Environment and Management

Parameter	Frequency	Parameter	Frequency
Experience (Years)			
<2	08(14.81)	Sanitation Frequency	
3-5	28(51.58)	Daily	35(64.81)
6-8	07(12.96)	Weekly	19(35.19)
9-11	06(20.11)	Forthnigtly	00(00.00)
>12	05(9.27)	Monthly	00(00.00)
Total	54(100.00)	Total	54(100.00)
Source of Water to the Abattoir		Government Maintenance	
Well Water	09(16.67)	Yes	54(100.00)
Rain Water	01(1.85)	No	00(00.00)
Running Water	00(00.00)	Total	54(100.00)
Bore Hole	41(75.92)	Last Maintenance (Years)	
Pipe Borne Water	03(5.56)	1-3	34(62.96)
Total	54(100.00)	4-6	08(14.82)
Sanitation of Abattoir		7-9	04(7.40)
Yes	54(100.00)	>10	08(14.82)
No	00(00.00)	Total	54(100.00)
Total	54(100.00)	Perception of the Condition of the Abattoir Environment	
Rating Abattoir's Facilities			
Adequate	36(66.67)	Excellent	09(16.67)
Fairly Adequate	15(27.78)	Very Good	29(53.70)
Inadequate	03(5.55)	Good	15(27.78)
Total	54(100.00)	Fair	0(00.00)
		Poor	01(1.85)
		Total	54(100.00)

Figures in parentheses are the percentages

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME IX:

FOREST RESOURCES, WILDLIFE & ENVIRONMENTAL MANAGEMENT

ADOPTION OF AGRO-FORESTRY PRACTICES AMONG SMALLHOLDER FARMERS IN MAI'ADUA, KATSINA STATE, NIGERIA

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ABSTRACT
The study was carried out in Mai'Adua metropolis of Katsina State, Nigeria, situated in the dry-land region of the State. Data were collected with pre-tested questionnaires administered to 100 farmers-household heads. Data were analyzed using descriptive statistics and t-test statistics. The t-test result shows a significant difference with respect to the type of agroforestry practices among the respondents. The deliberate retaining of trees on farmland was the most common agroforestry practice in the study area as indicated. The farmers maintained that tree species are retained to provide various uses such as Wind break (8%), Fodder (16%), Fuel wood (6%), Staking material (4%), Source of Income (14%), Soil improvement (28%), Medicinal herbs (10%), Shade (6%) and constructional materials (8%). The result of the t-test shows a significant difference (p< 0.01) in the proportion of those aware of agroforestry practices and those not aware. About 82% maintained that they are aware of the potentials of agroforestry while 18% claimed not to be aware. About 76% of the respondents indicated that they were willing to retained/plant trees on their farm land. Farmers' responses to questions on some reasons for unwillingness to practice agro-forestry technologies were different. Generally none of the reasons provided in the survey could be considered to greatly influence agro-forestry practice. The result indicated that lack of knowledge and lack of seed/planting materials influence the adoption of agro-forestry more than other factors do. Generally, level of awareness is high. Therefore lack of awareness was not one of the main reasons preventing farmers from adopting agroforestry. Since lack of knowledge and lack of seed were said to influence agroforestry practice more than would lack of awareness, limited land, and lack of interest, they perhaps deserve particular attention when planning and implementing agroforestry development.
Keywords: Adoption, Willingness, Agroforestry, Taungya, Smallholder and Farmers

INTRODUCTION

About 70 percent of Nigeria's population live in the rural areas and the majority of these people depend on agriculture for improving livelihoods (Odurukwe 2004). However smallholder agriculture faces many challenges including low productivity, high dependence on rain-fed agriculture, insecurity of the traditional land tenure system and environmental degradation due to unsustainable agricultural practices. As a result of these challenges, smallholder agriculture remains at low productivity and this has led to high incidence of poverty among rural smallholder farmers (Opio, 2001). Part of the solution to address low land productivity is the development of new agroforestry technologies. In Nigeria, agroforestry technologies have been trialled at research stations since 1980 and also on farms since 1984 in collaboration with farmers (Franzel et al., 2002). Nair (1993) pointed out that the presence of woody perennials in agroforestry systems may affect several bio physical and bio-chemical processes that determine the health of the soil substrate. Puri and Bangarawa, (1992) pointed out that the choice of tree species is the most important factor to be considered in agroforestry practices. On the other hand Foroughbackhch (1992) stated that the choice of tree species be made after careful consideration of their adaptability for growth and benefit for rural populace. According to Rogers (2003), adoption occurs when one has decided to make full use of the new technology as a best course of action for addressing a need. Adoption is determined by several factors including socioeconomic, environmental, and mental processes that are governed by a set of intervening variables such as individual needs, knowledge about the technology and individual perceptions about methods used to achieve those needs (Thangata & Alavalapati, 2003). In Nigeria, natural fallows have been a common practice among smallholder farmers for restoring soil fertility. However with rapid population increase and land use pressure, these fallows have been reduced to below the minimum threshold required for the system to sustain itself. As a response to declining land productivity, farmers open up forests to expand to new areas and this has led to loss of extensive forests and subsequent land degradation. As findings on factors that influence adoption of agroforestry vary between studies, it is necessary to further probe the adoption process so as to understand what actually influences adoption of agroforestry as these would be instrumental in furthering their effective promotion and accelerating their equitable uptake. Literature suggests that successful adoption depends on favourable convergence of technical, economic, institutional and policy factors (Feder *et al*., 1985; Rogers, 2003).

MATERIALS AND METHODS

The study was carried out in Mai'Adua local government area of Katsina State. The local government lies between Latitude 13°11′26″N and 8°12′42″E. The area falls within the dry-land region of Katsina State, defined roughly as one of the area lying north of 12^0N latitude in the State. It has a land mass of 228 km^2 (204 sq ml) and a population of 201,178 (NPC, 2006). The method used for this study is survey research method. The survey method was adopted due to the nature of the research, which involves practical issues. The questionnaire was designed to find out views concerning factors influencing the adoption of agro-forestry among smallholder farmers in Mai'Adua Local Government area, Katsina State. The questionnaires were randomly administered to a total of 100 farmers in the study area. Data obtained were analyzed using descriptive statistics that include the use of frequency distributions, means and percentages. Student t-test was used to verify the presence of significant differences between respondents' gender, proportion of those aware of agroforestry practices and those who are not aware using (SPSS version 18) statistical package.

RESULTS AND DISCUSSION

Adoption of agroforestry systems by respondents is presented in Table 1. The t-test result shows a significant difference with respect to the type of agroforestry practices among the respondents. The deliberate retaining of trees on farmland was the most common agroforestry practice in the study area as indicated. The farmers maintained that these species are retained to provide various uses such as Wind break (8%), Fodder (16%), Fuel wood (6%), Staking material (4%), Source of Income (14%), Soil improvement (28%), Medicinal herbs (10%), Shade (6%) and constructional materials (8%). Table 1 shows the level of awareness of agroforestry practices. 82% maintained that they are aware of the potential of agroforestry while 18% claimed not to be aware. The results of the t-test show a significant difference ($p< 0.01$) in the proportion of those aware of agroforestry practices and those not aware. About 76% of the respondents were willing to retain/plant trees. The species retained include *Tamarindus indica* L., *Parkia biglobosa* (Jacq), *Mangifera indica, Prosopis Africana, Acacia senegal* L., *Azadiracta indica* Adr. Juss, *Moringa oleifera* Lam., *Adamsonia digitata* and *Jatrofa Carcus.* The result revealed that 82% of the respondents are aware of the agroforestry as a farming system. This indicates that agroforestry is not a new system of agricultural practice to the farmers in the study area. The responses of farmers show that majority of the farmers (38%) retained trees on their farmlands and the remaining farmers practice various forms of agroforestry such as alley cropping, mulching with tree species and approved Tungya system of land use. Majority of the respondents (76%) maintained that they are willing to plant trees in their farm land and at the same time retained some valuable species of trees. The remaining indicate unwillingness, this may be either due to lack of ownership of land or are not aware of the importance of agroforestry. The study revealed that the respondents either plant trees for additional income, food, firewood, staking materials, constructional materials, soil improvement, fodder, shade, or medicinal herbs. This is in consonance with Adewusi (2006) who stated that farmers plant or retain trees on their farm land, both for food, income, soil improvement, environmental amelioration and for shade during the harsh weather period. The result shows that various tree species ranging from leguminous and non-leguminous, medicinal plants; tree crops and economic trees were either retained or planted by the farmers in their farm lands. Farmers' responses to questions on some reasons for unwillingness to practice agro-forestry technologies were different (Table 2). Generally none of the reasons provided in the survey could be considered to greatly influence agro-forestry practice. Table 2 indicates that lack of knowledge and lack of seed/planting materials influence the adoption of agro-forestry more than other factors. Generally, level of awareness is high. Therefore lack of awareness was not one of the main reasons preventing farmers from adopting agroforestry. Since lack of knowledge and lack of seed were said to influence agroforestry practice more than would lack of awareness, limited land, and lack of interest, they perhaps deserve particular attention when planning and implementing agroforestry development.

CONCLUSION

This study examined the adoption of agroforestry practices in MaiAdua fringe of Katsina State, Nigeria. To effectively in improve rural living standards, agroforestry should form part of an integrated rural development programme and thereby meet more of the farmers basic needs than it presently does. Technical assistance is needed to facilitate the spread of agroforestry practices. More so, adequate information is required to keep farmers abreast of current trends and development in the practices of agroforestry. Provision of economic incentives by the forestry department to farmers participating in agroforestry practices should be considered. Farmers in the rural areas should be encouraged to go into agroforestry by the relevant government agencies so that they can benefit from yield of the crops and additional income from the sales of the tree products such as fruits, oils, staking materials, constructional materials, medicinal herbs soup condiments, wood and other unquantifiable benefits.

Table 1: Awareness and Participation of the Respondents' in Agro-forestry

Response	Frequency	Percent
Awareness of Agro-forestry systems by Respondents		
Yes	82	82
No	18	18
Sub-total	100	100
T-test result	P = 0.001, * significant (P<0.01)	
Type of Agro-forestry practice by Respondents		
Retaining tree on farmland	38	38
Alley cropping	28	28
Mulching with tree species	18	18
Approved Taungya	16	16
Sub-total	100	100
Willingness to plant/retain trees by Respondents		
Yes	76	76
No	24	24
Sub-total	100	100
Purpose of retaining trees by Respondents		
Wind break	8	8
Fodder	16	16
Fuel wood	6	6
Staking material	4	4
Source of Income	14	14
Soil improvement	28	28
Medicinal herbs	10	10
Shade	6	6
constructional materials	8	8
Sub-total	100	100
Types of tree species retained/Density/ha		
Tamarindus indica L.	8	
Parkia biglobosa (Jacq)	16	
Mangifera indica	10	
Prosopis Africana	14	
Acacia senegal L.	8	
Azadiracta indica Adr. Juss	6	
Moringa oleifera Lam.	34	
Adamsonia digitate	16	
Jatrofa Carcus	46	

Source: Field Survey, 2016

Table 2: Distribution of Respondents based on Unwillingness to practice Agro-forestry

Response	Frequency	Percentage
Limited land	14	14
Lack of interest	12	12
Lack of knowledge/skill	30	30
Lack of seeds	24	24
planting materials	20	20
Sub-total	100	100

Source: Field Survey, 2016

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TAUNGYA: AN ECONOMIC LAND USE SYSTEM FOR TROPICAL FOREST RESTORATION

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ABSTRACT
Nigeria has experienced a remarkable degradation and depletion of its forest resources over the years. This process has undermined the socio-economic and socio-cultural importance of the forests for millions of rural people who depend on the resource to support their livelihood. This has exacerbated landlessness, land conflict and rural poverty. Forests can be restored in a wide range of circumstances; it aims to achieve the best possible compromise between meeting both conservation goals and the needs of rural communities. As human pressure on landscapes increases, forest restoration must commonly be practiced as a form of forest management to meet the economic needs of local people. Weed invasion is one of the main challenges in tropical forest restoration project which attribute to high cost of the project (Brancalion et al 2012). However, instead of spending money on herbicides or mechanical weeding, it is possible to save and earn money early in a restoration project by introducing and producing annual crops in a forest restoration system known as "taungya".
Keywords: Forest, Degradation, Restoration, Economic and Taungya.

INTRODUCTION
Forest restoration is action to re-instate ecological processes, which accelerate recovery of forest structure, ecological functioning and biodiversity levels. It is a specialized form of reforestation, but it differs from conventional tree plantations in that its primary goals are biodiversity recovery and environmental protection. Forest restoration may include simply protecting remnant vegetation or more active interventions to accelerate natural regeneration, as well as meeting economic needs of the local dwellers (UNEP 2012). Tree species planted (or encouraged to establish) are those that are typical of, or provide a critical ecological function in the targeted ecosystem. However, wherever people live in or near restoration sites, restoration projects often include economic species amongst the planted trees, to yield subsistence or cash-generating products (Brancalion *et al* 2012). Many restoration projects are now being implemented under the umbrella of "forest landscape restoration" (FLR). This is defined as a process of forest restoration that aims to regain ecological integrity and enhance human wellbeing in degraded forest landscapes (Lamb 2012). FLR recognizes that forest restoration has social and economic functions. It deals with the integrated management of large forest systems. As habitat to an estimated 80 percent of the world's biodiversity, forests provide genetic material important for crop and livestock improvement and are home to many pollinator species (FAO 2012). Forests and trees help to mitigate climate change by absorbing carbon dioxide and storing carbon. They can also help to reduce the vulnerability of people to climate change by providing food, income and other ecosystem services during critical periods of climate driven food shortages (UNEP 2015; Matta and Meins 2012). Its goal is to both regain ecological integrity and enhance human wellbeing. Achieving this objective requires equitable negotiations amongst all concerned stakeholders on: maximum gains in biodiversity protection, catchment protection and provision of economic resources to local communities. The key part of this process is the selection of appropriate criteria, which comprises tools and procedures to integrate site-level forest restoration actions with desirable landscape-level objectives (Lamb 2012), and delivery of a range of utilitarian benefits to local communities. This may including a reliable supply of clean water, environmental protection particularly watershed services (e.g. reduced soil erosion, lower landslide risk, flood/drought mitigation etc.), a sustainable supply of a diverse range of forest products including foods, medicines, firewood etc., monetary income from various sources (Brancalion *et al* 2012). One of the main challenges in restoration plantings in the tropics is the effective control of fodder grasses which can dramatically reduce trees growth. As usual, trees take at least three years to shade the understorey and out-complete weeds, instead of spending money on herbicides or mechanical weeding, it is possible to save and earn money early in a restoration project by producing annual crops such as cowpea, corn, cassava, soybean, okra, and pumpkin, among others, in a forest restoration system known as "taungya".

Taungya Landuse Technique
Depending on local environmental and socioeconomic factors, TAUNGYA: forests trees on farms agroforestry system involves restoration and management of forests, that they made gains in food crops yields and income generation (Brancalion *et al* 2012) , which reduced poverty considerably as compared with non-taungya .
The word "taungya" is a Burmese word coined in Burma, Taung = hill, ya= cultivation. The taungya method spread from Burma to other parts of the world. While the trees are small and widely spaced, the free space

between the newly planted trees can accommodate a seasonal crop. Instead of costly weeding, the underutilized area provides an additional output and income as taungya technique use the between-tree space for a series of crops. The crops become more shade resistant as the tree canopies grow and the amount of sunlight reaching the soil surface declines. If a plantation is thinned in the latter stages, this opens further the between-tree cropping opportunities. This is a modified form of shifting cultivation in which the labour is permitted to raise crops in an area but only side with the forest species planted to it. This labour is responsible for the upkeep of a plantation. The practices consist of land preparation, tree planting, growing agricultural crops for 1-3 years, until shade become too dense for crop production. In some cases crop may be grown one year before the trees are planted. Furthermore, it has needs to develop farm-level analyses of potential economic costs, benefits, associated with agroforestry practices. The technique is a vital prerequisite to the objective comparison of both production-and conservation-driven agroforestry practices with alternative land use options. Research on tree-crop-environment interactions are pursued to provide a scientific basis for optimizing agroforestry designs.

Economic Benefits of Taungya

Economic indices of success include the value of forest products and ecological services generated (e.g. watershed protection, carbon storage etc.), which ultimately contribute towards poverty reduction (Clewell *et al*. 2000), and forest products can provide strong incentives for local people. Forest restoration is appropriate wherever both biodiversity recoveries (wildlife conservation, environmental protection, eco-tourism) and the supply of a wide variety of economic forest products to local communities is the main goals of reforestation.
The key characteristics of the approach are;

- The complementary relations between the different components of landscape mosaics and not just on the management unit.
- It involves all stakeholders in equitable negotiations over outcomes.
- Allows for maximum production in specialized management areas that allowed other benefits to be managed at a larger scale.
- Reduce the opportunity costs of very extensive single use approaches such as large-scale industrial plantations or very extensive protected areas.
- Often yield higher biodiversity pay-offs than further investment in protecting the remote residual forests on poor soils that are often the focus of conservation initiatives.
- It can bring multi-functional forests to areas of high human population density and thus serve a valuable educational and awareness raising function as well as directly contributing to the quality of life of people in densely populated and degraded areas.
- Mitigation of environmental problems as it renders ecological service to the ecosystem through shading of soil surfaces against erosion, floods etc.

CONCLUSION

Taungya is an acceptable, agroforestry practice that offers much income potential, without significantly greater risk, unlike other market-driven land uses it has a better prospects for solving a particular conservation problem compared to other practices. There are many ways in which forests, trees on farms contributed to the survival of forest-dwellers, particularly many indigenous peoples, more so, it an important providers of ecosystem services, including maintaining or restoring soil fertility, protecting watersheds and water courses. Therefore, Institutions which promote rural development should incorporate awareness of taungya system into developmental agenda to enable rural households improve upon their livelihood and know-how of the system (Lamb 2012). Thus, Taungya as a forest restoration technique should be deem economical and sustainable management approach in tropical country like Nigeria.

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DIFFERENT METHODS OF BREAKING SEED DORMANCY IN TWO INDIGENOUS TREE CROPS (*Afzelia africana* and *Monodora myistica*) IN OWERRI, NIGERIA

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ABSTRACT

Afzelia africana *and Monodora myristica are two important indigenous fruit tree crops known for their medicinal, domestic and industrial uses in Southeast Nigeria. This experiment was conducted in the Screen house of the School of Agriculture and Agricultural Technology Owerri Nigeria for 4 and 8 weeks, respectively to investigate the different methods of breaking seed dormancy in two indigenous fruit tree crops. Five pre-sowing treatments: hot water (3, 6, 9, 12 min), Sodium chloride (NaCl) (5, 10, 15 min), 70^{C} Oven temperature (3, 6, 9, 12 min) 98% Sulfuric acid (98% H_2S0_4) (5, 10, 20, 30) and untreated seeds (control) for A. africana and 3 treatments cold water (12, 24 min), 98% H_2S0_4 (5, 10, 15) and control (0) for M. myristica were laid out in a complete randomized design (CRD) with three replications. Data were collected on percentage germination (PG), germination index (GI), mean germination time (MGT) and coefficient velocity of germination (CVG) for A. africana and M. myristica, respectively. These were subjected to ANOVA and least significant differences were use to separate significant means. Pre-sowing treatments used are needed to facilitate germination of A. africana because untreated seed attained maximum PG but increased MGT and reduced CVG. Monodora. myristica PG was enhanced when the seeds were soaked in cold water for 24 h followed by 5 min of 98% H_2S0_4 acid but the scarifying duration of 98% H_2SO_4 should be reduced to avoid damaging of the embryo by the chemical for both the tree crops. The investigation suggests that the type of dormancy exhibited by the two crops is physical dormancy since the treatments could effectively break the hard seed coats.*

Keywords: *Afzelia africana*, *Monodora myristica*, indigenous fruit tree and pre-sowing treatments

INTRODUCTION

Afzelia Africana commonly known as Lucky–bean tree (Akparata–Igbo) belongs to the family Leguminosae. Evergreen, small to fairly large tree up to 40 m tall, bole branches of up to 20 m, usually straight and cyliderical, up to 150-200 m in diameter. Fruit is oblong, flattened pod, dark-brown to black that contains up to 10-seeds; seeds are ellipsoid or oblong-ellipsoid, black with cup-cup and orange aril at base. *Afzelia africana* is useful in varying ways; timber for furniture, fodder plants, leaves as vegetable. The seeds are used in the eastern parts of the country as soup condiments and is rich in oil and used as thickening agent. *Monodora myristica Dunal*-commonly known as African nutmeg. Ehuru (Igbo), belongs to the family *Annonaceae*. The *M. myristica* tree can reach a height of 35m and 2m in diameter at breast height (DBH). It has a clear trunk and branches horizontally. The fruit is a berry of 20cm diameter and is smooth, green and spherical and becomes woody at maturity. Inside the fruit the numerous oblongoid, pale brown, 1.5cm long seeds are surrounded by a whitish fragrant pulp. The odour and taste of the *M. myristica* seed is similar to nutmeg and it is used as a popular spice in the West African cuisine (Louise, 2002). The fruits from these tree crops are collected from volunteered fruit trees in the wild. Seed dormancy is a physiological phenomenon in wild and crop plants, and is more common in wild plants than the crop plants (Farahani *et al*., 2011). Several studies on seed germination and seed emergence revealed the beneficial effects of seed priming by several ways including heat, smoke, soaking, leaching, temperature, scarification and NaCl salinity (Ahmed *et al.*, 2005). The main problem encountered in propagating seedlings of most indigenous tree for afforestation programmes are dormant seeds. The dormancy must be broken before germination can occur (Bewley, 1997). Lack of seed germination at certain times and suitable conditions are a big problem for seed researchers, botanists, and farmers. Therefore, this study investigated different methods of breaking seed dormancy in two indigenous tree crops of Southeastern Nigeria.

MATERIALS AND METHODS

Germination experiments of *Afzelia africana* and *Monodora myristica* were carried out in the Screen House of the School of Agriculture and Agricultural Technology, of the Federal University of Technology Owerri, Nigeria for 4 and 8 weeks, respectively. The seeds were sourced from the wild in Ivo Local Government Area of Ebonyi and Umuahia South Local Government of Abia states respectively. *Afeliaz africana* seeds were treated with five treatments; (98% sulphuric acid ($H_2S0_{4)}$ (5, 10, 20, 30 minutes), Hot water at boiling point (3, 6, 9, 12 minutes), 70^{0}C Oven temperature (3, 6, 9, 12 minutes), Sodium chloride (NaCl) (5, 10 and 15 min) and untreated intact seeds as control. *Monodora myristica* were subjected to three treatments; 98% sulphuric acid (5, 10 minutes), Cold water soaking (12, 24 h) and untreated intact seeds (control). Apart from cold water and untreated intact seeds in both experiments, the seeds were thoroughly washed with tap running water and soaked with distill water for 24 h before sowing in germinating trays, using sawdust as the germinating medium and watered two times in a week.. The seeds were laid out in a complete randomized design with three replications according to specifications. Data collected were percentage germination (PG)

$$\text{Percentage germination (\%)} = \frac{\text{Number of seeds emerged} \times 100}{\text{Number of seeds planted}}$$

Germination index (GI) according to the equation of Kader and Jutzi (2004).

GI= Σ(TiNi). Ti: number of day after sowing and Ni: number of germinated seeds in the day.

Mean emergence time (MGT)

This was calculated based on Ellis and Roberts (1981).

$$MGT = \frac{\sum ni\ di}{\sum ni}$$

ni and di are respectively number of germinated seeds and the number of days from the beginning of germination of the experiment.

and

Coefficient velocity of emergence (CVG)

This was calculated according to Ranal and Santana (2006) and Obiefuna *et al.*, (2012)

$$CVG = \frac{fi}{fixi} \text{ X } 100$$

where fi is number of seeds newly germinating on day i; xi is number of days from the beginning of germination experiment, and k is the last day of germination.

All data collected were subjected to Genstat 2007 model and least significance difference (LSD) was used for separation of significantly different means.

RESULTS AND DISCUSSION

All the germination parameters measured (PG, GI, MGT and CVG) showed significant differences in the treatments (Hot water, NaCl, 70^{C}Oven temperature, 98% H_2SO_4 acid and untreated seeds) evaluated. Seeds soaked in 98% H_2S0_4 acid for 30 minutes recorded significantly the least PG (25%) compared with other treatments that recorded 75%-100% except 98% H_2S0_4 acid for 20 min (50%). Meanwhile, the highest CVG (10.5) was recorded in 5 min H_2S0_4 acid, followed by NaCl for 5 min (9.1), hot water 9 and 12 min (8.2), respectively and MGT of 9.5 days, 11.0 days, 12 days and 11.4 days respectively, compared with control (0) treatment with reduced CVG (3.9) and increased MGT of 20.2 days significantly ($P<0.05$). All the germination parameters measured (PG, GI, MGT and CVG) showed significant differences in the treatments (Cold water, H_2S0_4 acid and untreated seeds) evaluated. Seeds soaked for 24 h in cold water significantly produced 70% seedlings at a reduced MGT (37.7days) with increased CVG (2.6) followed by 98% H_2SO_4 acid at 5 min which produced 60 PG within 43.7 days (MGT) at CVG of 2.6 but 98% H_2SO_4 acid for 10 and 20 min, respectively recorded 30 PG each. Increased number of MGT (54.2 days) was significantly recorded by untreated seeds (control) in the production of 50 PG at CVG of 1.4 and a higher G.I of 271.0. Seed germination starts with the uptake of water by the quiescent dry seed, ending up with the elongation of the embryonic axis (Holdsworth *et al.*, 2008). Most of the treatments attained the maximum PG of 100 even untreated seeds (control) but untreated seeds recorded more MGT and lower CVG, respectively than other treatments used in *A. africana*. Seed dormancy, a seemingly inactive or resting condition of the seed, slows down or stops seed germination of seeds over long time periods. In *M. myristica*, 24 h hydroprimed seeds and 5 min in 98% H_2S0_4 acid increased germination to 70% and 60% respectively more than in untreated seed (control) (50%). This is in line with Peter-Onoh, *et al* (2014) reported that *Measo barteri* seed emergence was improved by several pre-sowing methods and durations. Prolonged duration of 98% H_2S0_4 acid gave low PG, reduced CVG and increased MGT in both tested crop seeds. Lower PG recorded in 98% H_2S0_4 acid on *A. africana* (20 and 30 min) and *M. myristica* (10 and 15 min) could be due to the damage caused to the embryo by the chemical. This is in conformity with the findings of Likoswe (2008). Early germination of pretreated seeds over untreated seeds is probably due to water and gases entering the embryo early through the cracks and causing a series of enzymatic breakdown and resulted in the transformation of the embryo into a seeding early enough than other seed treatments (Odunfa, 1989). Seed dormancy is a physiological phenomenon in wild and crop plants, and is more common in wild plants than the crop plants (Farahani, *et al.*, 2011).

CONCLUSION

Afzelia africana and *Monodora myristica* need pre-sowing treatments to hasten germination. All the pretreatment methods and duration evaluated enhanced germination except 98% H_2S0_4 acid at 20 and 30 min for *A. africana* and 98% H_2S0_4 at 10 and 15min for*M. myristica* recorded poor PG, this could be due to damage caused by the prolonged duration used. Since the treatments used could effectively break the seed coat, it can be concluded that the seed coat was the barrier to germination. The results drawn from this research suggest that the type of dormancy exhibited by *Afzelia africana* and *Monodora myristica* is physical dormancy which is entirely imposed the seed coat.

Table 1 : Effect of seed treatment on *Afzelia Africana*

Pretreatments(minutes)	PG_%	GI	MET(days)	CVG
Hot water 3	100	68	11.2	5.9
Hot water 6	100	75	12.4	5.2
Hot water 9	100	49.3	12.3	8.2
Hot water 12	100	57	11.4	8.2
NaCl 5	100	44	11	9.1
NaCl 10	100	66	11.9	6.1
NaCl 15	100	49.3	12.3	8.2
70^{C} Oven 3	75	42	14.1	7.3
70^{C}Oven 6	75	49	16.1	6.3
70^{C}Oven 9	75	49.3	16.3	6.1
70^{C}Oven12	75	66	22.3	4.6
98%H_2S0_4 5	100	38	9.5	10.5
98%H_2S0_4 10	100	58	10.6	6.9
98% H_2S0_4 20	50	24	12	8.3
98%H_2S0_4 30	25	11	10.7	9.1
Control (0)	100	101.3	20.2	3.9
Mean	85.9	53	13.4	7.1
LSD(0.05)	2.1	5.5	3.6	1.2
CV%	1.5	6.2	16.2	10.5

Table 1 : Effect of seed treatment on *Monodora myistica*

PRE_TRT	GM	GI	MET	CV
ACID_5	60	256	43.2	2.3
ACID_10	30	143	47.8	2.1
ACID_15	30	161.3	60	2.6
CW_0	50	271	54.2	1.4
CW_12	50	249	49.1	2
CW_24	70	271	37.7	2.6
Mean	48.3	225.2	48.7	2.2
LSD (0.05)	16.2	27.1	8.4	1.1
CV%	18.9	6.8	9.7	27.7

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PROBLEMS AND PROSPECTS OF PRIVATE FOREST PLANTATION IN OYO STATE, SOUTHWEST, NIGERIA

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ABSTRACT
Problems and prospects of private forest plantation in Oyo State were investigated. Multistage sampling techniques were employed for this study. Data analyzed were through the use of descriptive statistics. The results show that respondents were males (98.33%) and females (1.67%). The level literacy is high total 96.67%. The predominant age group was in the range of 31-40 years (48.33%) while 55% of the respondents source for fund through their personal savings. The results also revealed that respondents (75%) were more involved in Tectona grandis plantation which contributes widely in timber production, pole production, and pulp production. Based on these findings, private plantation owners should be more encouraged through provision of loan with lesser interest rate, favourable government policy and provision of quality seedlings. This only assures the future prospect of forest plantation which includes high income, provision of employment, provision of plank wood, fuel wood, and protection of environment.
Keywords: Forest, Plantation, Timber, *Gmelina arborea* and *Tectona grandis*

INTRODUCTION

Nigeria (the most populous country in Africa) faces extremely mounting pressures on biodiversity and tropical forests. Wildlife, trees, and many other plants are over-harvested and poached, and the natural environment faces increased degradation from expanding unsustainable agriculture, water pollution, air pollution, and a variety of other anthropogenic factors (David, 2008). Nearly 1,000 forest reserves areas are included in the International Union for Conservation of Nature (IUCN) World Database on Protected Areas (FAO, 2005). Oyo State had 18 out of 78 forest reserves areas in Southwest State of Nigeria (FORMECU, 1990). Many of these have no forests left, and most are highly degraded due to unsustainable extraction of timber, fuel wood, economically important plants, bush meat, and other resources. Nigeria's tropical forests are particularly hard hit. According to the United Nations Food and Agriculture Organisation, the country has the highest deforestation rate in the World (FAO, 2005). Between 2000 and 2005, Nigeria lost 55.7 per cent of its primary forests due to logging, agricultural expansion, and fuel wood collection (FAO, 2005). Forest reserves are areas designated by State governments for the protection of timber and other forest resources. Constitutionally, all lands are owned in trust by the Governor of each State. But the lands outside forest reserves, called "free areas", are claimed by traditional communities, local governments and elite families and individuals. Nigeria does not have land titling and registration systems like those common in western countries. A forest resources study (Beak Consultants, 1998) estimated that the closed forest remaining in the "free areas" totaled 905 000 hectares in 1995. The problem of poor management and inadequate funding of these forest plantation calls for private practice involvement in forest plantation activities. A private forest plantation program attracts most individuals but in developing countries there are usually no encouragements or provision of adequate facility by government that makes it convenient to engage in. The global area of plantations in 2000 was 187million ha, a significant increase over the 124 million ha in 1995 (FAO 2001). These plantation forests accounted for less than 5% of global forest cover, and for less than 22% of global round wood supplies to industry. The greatest threat to forests industry is the conversion of forests into other land uses due to increasing pressure from human populations and aspirations for higher standards of living, without due concern to sustainability of resources underpinning such developments, heighten concerns in this regard (Oduntan, 2009). Increased need for wood products, pressure for converting better forest lands to agriculture, destruction of indigenous forests by shifting agriculture and indiscriminate logging, increased areas being set aside for conservation or other purposes, and the difficulty in managing tropical hardwoods in fragile ecosystems, have all led to a realisation among responsible observers that proper use of private forest plantation is the only way to complement government effort and combat treat to our environment. This study is therefore justifies by the need to ensure continue availability of forest product to the ever increasing human population. Thus, this paper examined the problem and prospect of private forest plantation in Oyo State Southwest, Nigeria. Different types of existing private forest plantation as well as purpose of establishing the plantation in the State were also identified.

METHODOLOGY

The empirical setting for this study is Oyo State, Southwest Nigeria. The state is a fast developing state created in 13th February 1976 with its administrative headquarters in Ibadan, a reputable city known to be the largest in West Africa and the second largest in the Africa after Cairo of Egypt (Wikipedia, 2014). It lies within the latitude of 7.85^0N and longitude of 3.93^0E. It covers a total area of land size of 27,848 square kilometers out of which 6.09% is government forest reserves (FORMECU, 1990). The state has a population of 5,591,589 representing 4% of the country population (NPC, 2006). It is bounded in the south by Ogun state and in the north by Kwara state, while in the west by the republic of Benin. The state is a homogenous state comprises of Oyos, Ibadan and Ibarapas, all belongings to the Yorubas family and speaking same Yoruba dialect, people from within and outside the country trade and settle in the state. The climatic condition is the usual tropical pattern with dry and wet seasons with relatively high humidity. The two identifiable seasons are the rainy season which begins from late March to October and dry season stretching from November to early March. The mean annual temperature varies between 21.1^0 C and 31.1^0 C. The annual rainfall is within the range of 800mm in the derived eco-zone to 1500mm in the rainforest belt. The rainfall is bimodal with its peak in July and September (Faleyimu and Agbeja, 2004). Agriculture is the main occupation of the people of the state. The state soil and climate favours the cultivation of crops like cassava, yam, cereals (maize, millet) grains (rice), cocoa, palm tree, cashew as well as many forest tree plantations. Forestry activities in the state is been administered by forestry department of Ministry of Agriculture & Natural Resources (MANR) of the state on a zoning basis which are Ibadan, Saki, Oyo and Ogbomosho zone. A multistage sampling technique was used to select respondents for this study. In the first stage, following Forestry Department, Ministry of Agriculture and Natural Resources (MANR) Oyo state zoning basis, Oyo state is divided into four (4) zone of Ibadan, Saki, Oyo and Ogbomosho. In the second stage, 15 respondents per zone were randomly selected from the list of registered private forest plantation in the forestry department, making a total of 60 respondents for this study. Primary data were collected using a well-structured questionnaires and interview schedule were personally arranged with the targeted respondents (private forest owners/ farmer) in the various forest zones of the State. Data collected were analyzed using descriptive analyses such as mean, frequency and percentage.

RESULTS AND DISCUSSION

Socio-demographic Characteristics of the Respondents in the Study Area

Table 1 shows that 98.33% of the respondents were male. This might be attributed to the fact that private forest plantation were usually the role of men in the socio-cultural setting of the people under study. Age distribution of the respondents revealed that 48.33% of the farmers in the study area were between 31 – 40 years of age, being within the youthful ages, it is also an indication that they may be amenable to changes and education according to (Fakoya *et al.,* 2007). Maritally, 71.67% of the respondents were married and 25% were single. The level literacy is high, about 50% of the respondents had Secondary School education, followed by 30% of the respondents that had tertiary education. Low level of education had relative adverse effect on man, this high level of literacy therefore enhance good communication and understanding in agricultural practices (Adams, 1982). The respondents were majorly Muslims (56.7%) while (43.3%) were Christian. Majority of the respondents' source for fund to established the private forest plantation through their personal savings (55%), while 33.33% source for finance through Cooperative society's loan. This shows the most nagging problems facing forestry development in Nigeria is paucity of funds. Funding forestry program and projects is capital-intensive. Much money is required for tree planting and forest restoration.

Distribution of Respondents Based on Types of Forest Plantation and Purpose of Establishment in the Study Area

Table 2 shows that majority of the farmers are involved in different forestry plantation, Saki zone *Gmelina arborea* (13.33%) and *Tectona grandis* (86.67%), Ibadan zone *Gmelina arborea* (33.33%) and *Tectona grandis* (66.67%), Oyo zone *Gmelina arborea* (33.33%) and *Tectona grandis* (66.67%) and Ogbomosho zone *Gmelina arborea* (20.0%) and *Tectona grandis* (80%). In total, 75.0% of the respondents involved in *Tectona grandis* plantation and 25.0% involved in *Gmelina arborea* plantation. The Table also shows that majority (86.673%) of the respondents established the plantation for timber production purposes; while 78.33% established the plantation for pole production purpose and 81.67% established the plantation for all purpose. These results also show the multipurpose aspects of species used by inhabitants around the plantation. These trees species planted for timber purposes were used all over the globe for construction of houses, bridges, boats and furniture (Ogunwusi, 2013). These purposes for establishing these plantations directly enhance the respondents' better income, crate employment, provision of plank wood and fuel wood and protection of environment.

Distribution of Respondents Based on Constraints Faced on the Establishment and Maintenance of the Private Forest Plantation in the Study Area

Figure 1 shows that an establishment of private forest plantation faces various constraints. Hundred per cent of the respondents faces the problem of fire outbreak in the plantation, 98.33% faces the problem of inadequate fund, followed by 93.33% that faces the problem of Government Policy, 61.67% had disease outbreak problem. In Nigeria, various factors are obstructing the effective implementation of conservation policies. There is the problem of lack of adequate data on the status of biodiversity and the extent of degradation of the forest in the country (USAID/Nigeria 2008).

CONCLUSION

Based on the findings, the result has shown that the farmers were more involved in *Tectona grandis* forest plantation than *Gmelina arborea* plantation. The plantation tree species serves widely in use as timber production, pole production and all other purposes. Also, findings reveal that, future prospect of forest plantation include provision of employment, provision of plank wood, fuel wood, and protection of environment. Thus, it is therefore recommends that Government should ensure availability of quality seeds even at subsidized rates. The extension agents should encourage farmers to plant forest trees along their agricultural farming activities. Plan must be in place for acquisition of more lands and funds availability for private forest plantation while a public enlightenment campaign encourages mass participation in tree planting.

Table 1: The Socio-demographic Characteristics of the Respondents in the Study Area

Socio-economics Variables N = 60	Freq.	Percentage	Mode	Socio-economics Variables N = 60	Freq.	Percentage	Mode
Gender				Educational Status			
Male	59	98.33	Male	No Formal Education	2	3.33	
Female	1	1.67		Primary Education	10	16.67	
Age				Secondary Education	30	50.00	Secondary Education
21-30	18	30.0		Tertiary Education	18	30.0	
31-40	29	48.33	31-40	Religion			
41-50	10	16.67		Christian	24	43.30	
51-60	1	1.67		Muslim	34	56.70	Muslim
>60	2	3.33		Traditional	2	3.33	
Marital Status				Sources of Finance			
Married	43	71.67	Married	Personal Savings	33	55.00	Personal Savings
Single	15	25.00		Bank Loan	7	11.67	
Widowers	2	3.33		Cooperatives Loan	20	33.33	

Source: Field Survey, 2014

Table 2: Distribution of Respondents Based on Types of Forest Plantation and Purpose of Establishment in the Study Area

Variables	Saki Zone N = 15		Ibadan Zone N = 15		Oyo Zone N = 15		Ogbomosho Zone N = 15		Total N = 60	
Types of Forest Plantation	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Gmelina arborea	2	13.33	5	33.33	5	33.33	3	20	15	25.0
Tectona grandis	13	86.67	10	66.67	10	66.67	12	80	45	75.0
Purpose of Establishment										
Timber Production	12	80.0	13	86.67	13	86.67	14	93.33	52	86.67
Pole Production	10	66.67	12	80.0	12	80.0	13	86.67	47	78.33
All Purposes	14	93.33	13	86.67	12	80.0	10	66.67	49	81.67

Source: Field Survey, 2014; **Multiple Response*

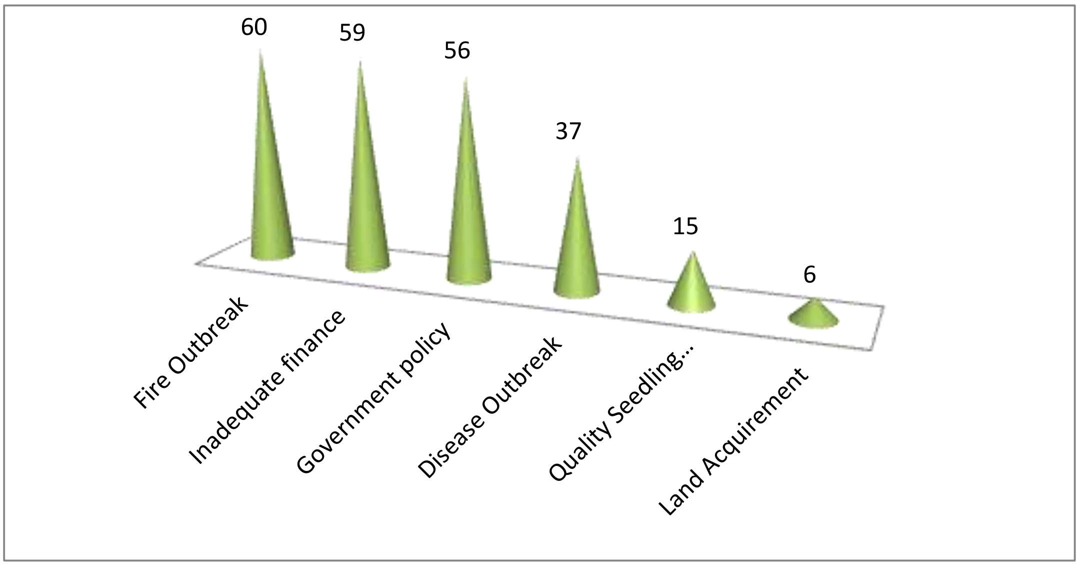

Fig. 1: Distribution of Respondents Based on Constraints Faced on the Establishment and Maintenance of the Private Forest Plantation in the Study Area

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DETERMINANTS OF ADOPTION OF AGROFORESTRY TECHNOLOGIES AMONG FARMERS IN JOS SOUTH LGA OF PLATEAU STATE, NIGERIA

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ABSTRACT
The study examined the adoption of improved agroforestry technologies among farming households in Jos South LGA of Plateau State. Well-structured questionnaire were designed and administered to ninety farmers who were selected using a multistage random sampling technique. Data collected were analyzed using Tobit regression analysis and descriptive statistics. Findings shows that the main determinants of the adoption were farmers' age (P<0.05), educational level (P<0.1), household size (P<0.1), farming experience (P<0.1), farm size (P<0.05), income (P<0.05), access to credit (P<0.01) and extension contact (P<0.01) and this variables were all significant. Apart from age of the farmers which was negatively related to adoption of agroforestry technologies all other variables mentioned affected the adoption rate of agroforestry technologies positively. Also, the agroforestry technologies practiced in the study area had many benefits including; Wood fuel/Firewood (97%), boundary marks/ Live fence (88%), Food/Fruits (64%), Wind breaks (50%), income (56%), fodder for animals (33%), soil conservation (28%), shade (24%), aesthetic (17%), and herbal medicine (31%). Based on the findings of this study, it was strongly recommended that farmers be provided with loans at concessionary interest rates to solve their financial problem of adopting innovations, planting stocks (inputs) should be subsidized for the farmers. Furthermore there is need to increase extension contact with the farming households in the study area.
Keywords: Agroforestry Technology, Adoption, Determinants and Benefits

INTRODUCTION

Adoption is a decision made by an individual or group to use an innovation in a continuous manner (Akubuilo *et al*., 2007). Technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Akubuilo *et al*., 2007). This includes new ideas, inventions, innovations, techniques, methods and materials. Agroforestry is an agricultural approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock (enwikipedia.org/wiki/agroforestry). It combines agriculture and forestry technology to create more integrated, diverse, productive, profitable, healthy and sustainable land use system. It incorporates several plant species into a given land area and creates a complex habitat that can support a wider variety of birds, insects and other animals. Agroforestry is an aspect of farm forestry that encourages the deliberate integration of woody perennials with agricultural crops and/or animals on the same management unit, with the aim of enhancing soil fertility and increasing farmers' income through the use of economic trees (Akinbili *et al*., 2007). Agroforestry addresses many of the global challenges such as deforestation, unsustainable cropping practices and hunger, poverty and malnutrition (Udofia, 2001).The agroforestry technologies prevalent in the study area are; snail rearing, apiculture, mushroom production, Woodlots, Tree planting on the homestead, Home gardens, Hedge planting and Boundary marking however, the adoption of these technologies over the years has not been encouraging. The reason for the increasing concern of stakeholders on the adoption of agroforestry technologies is due largely on the interactive benefits of agroforestry and other farming activities (Adekoya *et al*.,). Agroforestry is widely recognized as a branch of agricultural science that is rapidly becoming a science in its own right and many studies have been conducted in this area, most of which has been from the biophysical perspective, research on the determinants of adoption of agroforestry technologies have been inadequate, this has caused a void in research. Previous studies on the adoption of agroforestry technologies (Ajayi et al., 2006) focused more on the linkage between research organizations and extension, with neglect to the linkage between extension and farmers, and farmers are central to adoption of innovations as they are the supposed users of the technologies (Aboh and Akpabio, 2008). According to them, ineffective linkage between extension and farmers is responsible for low adoption of agroforestry technologies by farmers. It is against this background that the study addressed the following research questions; i. What are the factors affecting the adoption of agroforestry technologies by farmers in the area? ii. What are the benefits of adopting agro-forestry technologies among the respondents?

MATERIALS AND METHODS

This study was conducted in Jos-South Local Government Area of Plateau state. The site lies on latitude of 80 43'N and Longitude 80 46'E with an altitude of 1293.2m above sea level. Jos-South Local government area(LGA) is one of the seventeen Local government areas in Plateau state of Nigeria. It is made of four districts; these include Vwang, Du, Gyel and Kuru. The Local government has an average land area of 1, 037km2. Rainfall from April to August constitutes the rainy season in the study area with an average temperature of 27^0C. The multistage random sampling technique was adopted for this study. In the first stage, Jos south LGA was purposively selected due to the prevalence of farmers who adopted agroforestry practices. In the second stage two districts were randomly selected. Finally, ninety farmers were randomly selected at a constant proportion of 0.10, from a compiled list of nine hundred farmers who had adopted any of the various forms of agroforestry technology by the local extension agents in the selected districts. Data for the study was analyzed using Tobit regression analysis and descriptive statistics. The Empirical Tobit Model is expressed as: $Y_{ij}= \beta_{ij}x_{ij} +u_i$

Where; Y_i=agro forestry technologies adopted, X_i = vector of the explanatory variable, β_i = vector of the coefficient, u_i = random error term .The explicit model of the regression is as follows: Y = f(X_1, X_2, X_3, X_4, X_5, X_6,X_7,X_8,e).

Where; Y= Agroforestry Technologies (Woodlots, Tree planting on the homestead, Home gardens, Hedge planting and Boundary marking), X1= Farmers Age (years), X2= Farmers Educational level (years), X3= Household Size of Farmers (Number of Persons), X4= Farming Experience of Farmers (Years), X5= Farm Size of Farmers (Hectares), X6= farmer income (₦), X7= Farmers access to credit (Dummy variable, Yes =1, No = 0), X8= Farmers contact with extension agents (Dummy variable, Yes =1, No = 0), E= Error term.

RESULTS AND DISCUSSION

Factors influencing the adoption of agro forestry technology

From the results of the Tobit regression analysis the log likelihood was 79.10 indicating that the independent variables (X_1, X_2… X_8) jointly explained 79.1% of the variation in the dependent variable (Y). Consequently the interpretation of the regression result indicates the following: Farmers' age (X_1) is negatively related to adoption of agroforestry technologies, meaning that younger farmers adopted the technologies more than the older farmers. This relationship is significant at the 5% level of probability. Farmers' educational level (X_2) has a positive relationship with adoption of agroforestry technologies implying that the more educated farmers had higher tendencies to adopt agroforestry technologies. Farmers' household size (X_3) is positively related to the adoption of agroforestry technologies indicating that farmers having larger households adopted the technologies more efficiently due to increased farm labour supply. This relationship is significant at the 10% level of probability. Farmers' experience (X_4) has a positive effect on the adoption of agroforestry technologies showing that the more experienced farming households adopted the packages more than the less experienced farming households. This relationship is significant at the 10% level of probability. Farm size of farmers (X_5) is positively related to adoption of agroforestry technologies implying that as the farmers' farm sizes increase they adopt more of agroforestry technologies, and vice versa. This effect is however significant at the 5% level of probability. Farmers' income (X_6) is positively related to adoption of agroforestry technologies meaning that farming households with higher remunerative income adopted the technologies more than the farming households with low remunerative income. The effect is significant at the 5% level of probability. Farmers' access to credit (X_7) has a positive effect on adoption of agroforestry technologies indicating that farmers with access to credit adopted the technologies more than those without access to credit. This effect is statistically significant at the 1% level of probability. Farmers' contact with extension agents (X_8) is positively related to the adoption rate of agroforestry technologies showing that farming households with higher number of contacts with extension agents adopted the agroforestry technologies more than farmers with less contact with extension agents. This relationship is statistically significant at the 1% level of probability.

Benefits of adopting agro forestry technology

The results (Table 2) shows the benefits the respondents derive from adopting the various agro forestry technologies in the study area. The agroforestry technologies practiced in the study area had many benefits including; Wood fuel/Firewood (97%), boundary marks/ Live fence (88%), Food/Fruits (64%), Wind breaks (50%), income (56%), fodder for animals (33%), soil conservation (28%), shade (24%), aesthetic (17%), and herbal medicine (31%).

CONCLUSION

The major aim of the study was to analyze the determinants of adoption of agroforestry technologies in the study area. The research study concluded that: Agro forestry technology adoption in the study area was relatively high and there were a variety of Agro forestry technologies that have been adopted. The major factors influencing agroforestry adoption in the study area were age, educational level, household size, experience, farm size, income, access to credit, and extension contact. The agroforestry technologies practiced in the study area had many benefits including; wood fuel/Firewood, boundary marks/ live fence, Food/Fruits, Wind breaks, income, fodder for animals, soil conservation, shade, aesthetic, and herbal medicine. Based on the findings of this study it is recommended that there is need for further studies on the specific economic benefits from each of the Agro forestry technology adopted. Also, farming households should be provided with low interest agricultural loans to solve the problem of inadequate finance. Furthermore, Inputs like planting and starting stocks should be subsidized so that the poor rural farmers will easily adopt the technologies by affording to buy the inputs. In addition, extension activities should be intensified to sensitize and motivate farmers to adopt agro-forestry technologies.

Table 1: Factors influencing adoption of agro forestry technology

Variables	Coefficient	Standard error	t-value
Constant	0.665***	0.279	2.383
Age(X_1)	-0.597**	0.210	-2.842
Education (X_2)	0.439**	0.281	1.562
Household size (X_3)	0.397***	0.226	1.756
Farming experience (X_4)	0.286***	0.190	1.505
Farm size (X_5)	0.550**	0.186	2.956
Income (X_6)	0.458**	0.167	2.742
Access to credit (X_7)	0.675*	0.182	3.708
Extension contact (X_8)	0.747*	0.153	4.882
Log likelihood = - 61.130223			

* = 1% (P<0.01), ** = 5% (P<0.05), *** = 10% (P<0.1) significance level

Table 2: Distribution of respondents based on their benefits of adopting agro forestry technology*

Benefits	Frequency	Percentage (%)
Wood fuel/Firewood	87	96.7
Boundary marks/ Live fence	79	87.8
Food/Fruits	58	64.4
Wind breaks	45	50
Income(timber, poles)	50	55.5
fodder for animals	30	33.3
Soil conservation	25	27.7
Shade	22	24.4
Aesthetic	15	16.6
Herbal medicine	28	31.1

* = Multiple responses allowed

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COMPARATIVE ASSESSMENT OF MODERN AND TRADITIONAL BEEKEEPING METHOD

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ABSTRACT
The study was carried in Ikwuano to compare honey produced by Bee honey hunters and bee keepers (Traditional and modern beekeeping method). A total sample size of 60 respondents (30 bee hunters and 30beekeepers were used for the study. Information was collected from the respondent with the use of structural questionnaire. Data were analyzed using cost and return analysis. Result showed that profit from bee hunting/traditional beekeeping is 26.67. While that of the beekeepers (modern) is 66.67. The result shows that modern beekeeping is more profitable than traditional bee hunting. The result called for policies that will encourage establishment of hives by farmers in the rural areas since honey is a free gift by nature.
Keywords: Beekeeping, comparative assessment, traditional, modern

INTRODUCTION
Beekeeping is practiced all over the world it is maintenance of honey bee commonly in hive by human. A colony is made up of three caste, workers, the queen and drones. A beekeeper or Apiarist Keeps bees in order to collect honey and other bee products such as beeswax, propolis, pollen and royal jelly (Bradbear, 2003). There are two categories of bee-farmers in Nigeria, the modern beekeepers and the traditional honey bee hunters (Anyaegbunam *et al.*, 2006). Modern beekeepers are organized bee-farmers that use scientific and improved method of beekeeping in which hives are constructed for the bees to inhabit, produce honey and other bee products. This method involves the use of movable comb hives ranging from top-bar hive to frame hive, on the other hand the traditional bee farmers (honey hunters) harvest the honey by cutting down and burning the whole or part of the tree where the honey is produced. This often results to the physical destruction of the nest location (Spore, 2007). The honey produced through traditional beekeeping method is often of low quality when compared to honey produced through modern beekeeping method and this affects the curative and nutritional quantity of the honey (Anyaegbunam, 2006)

METHODOLOGY
The study was conducted at Ikwuano L.G.A in Abia State, the respondent comprised of traditional and modern beekeepers in Ikwuano. The sample size was sixty respondents made up of thirty members of beekeepers and honey hunters. Information was collected from the respondents with the aid of structural questionnaire. The analytical frame work incorporated the concept of gross margin analysis and complete costing as described by Reddy *et al.,* (2004). There is a direct relationship between cost and outputs. All the accounting cost element such as direct labor, material and expenses are embodies in the products, the gross margin analysis will deduct the variable cost of production from the revenue generated per litre.

GM = TR – TVC
Where
GM = Gross margin
TVC = Total variable cost
TR = Total revenue

Complete costing valuates the profitability of beekeeping production.

RESULTS AND DISCUSSION
The study has shown that the annual bee honey produced by modern beekeepers total revenue and profit generated were 66.67 greater than those produced by the traditional honey hunters which is 26.67 modern beekeeping method is more profitable and variable than traditional beekeeping method, this is consistent with Farinde *et al.,* (2005) who reported that bee honey production was a viable and highly profitable enterprise. Table one (1) shows that modern beekeepers harvested a mean yield of 66.67 litres of bee honey valued at N800 per litre while the traditional beekeeper had a mean yield of 26.67 valued at N500 per litre. It also shows that both traditional and modern beekeepers harvest at least three times per season. The traditional beekeepers has been into beekeeping business for seven years on the average while the modern beekeepers has been in the business for five years. Table 2 shows that modern beekeepers has mean yield of 66.67 litres of bee honey valued at N800 per litre while the traditional beekeepers had a mean yield of 26.67 litres valued at N500 per

litre this confirmed the fact that modern beekeeping is an organized enterprise unlike the traditional beekeeping which is a game of chance (Anyaegbunam, 2006).

CONCLUSION

The comparative study revealed that modern beekeeping is a high income generating enterprise compare to traditional method of beekeeping. To improve the living standard of the people, modern beekeeping should be encouraged and the government should as a matter of urgency introduce modern beekeeping method to the rural farmers which will be sustained taken into account the abundance of bee plants in the locality.

Table 1: Average annual output of honey produced by modern beekeepers and traditional beekeepers

Items	Modern Beekeepers (mean value)	Traditional beekeeper (mean value)
Honey output (litres)	66.67	26.67
Frequency harvesting (number)	3.60	
Experience	5.	7.0

Source: Field survey, 2012.

Table 2: Estimated cost and gross margin of bee honey producer by modern beekeepers and traditional beekeepers in Ikwuano L.G.A

Item	Modern beekeepers	Traditional beekeepers
Gross output/gross revenue	Quantity (litre) price value((₦) 2000.00 800 1600,00	Quantity(litres) price value (₦) 800 500 400,000
Mean Gross revenue	66.67 53,33 800	26.67 500 13.333
Variable cost attendant	20,000	-
Harvesting/process	30,000	5000
Transportation for sales	15,000	price 10,000
Packaging materials	25,000	8000
Total variable cost (TVC)	500	-
Mean total variable cost (MTVC)	80,000	23,000
Mean gross margin (MGM) = MGR – MTVC	2,666.33	766.67

Source: Field survey, 2012.

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EVALUATION OF THE SOCIO-ECONOMIC POTENTIALS OF BAMBOO PROCESSING IN EKITI STATE, NIGERIA

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ABSTRACT
Bamboo is a valuable non-timber forest product yet to be fully explored in Nigeria. In this regard, this study evaluated the socio-economic potentials of bamboo processing in Ekiti state, Nigeria. A three-stage sampling techniques was used to elicit information from 120 bamboo processors in Ekiti State, Nigeria. Descriptive statistics, costs and returns, multivariate regression and Kendall's coefficient of concordance were used for data analysis. The results of the study show that 83.3% were males while 16.7% were females. Average age of the respondents was 43years. About 76.7% of the respondents were married, 6.7% were single. The study further revealed that, most bamboo processors were men who utilize improved method of processing. They rely heavily on cooperatives and local money lenders as their source of credit and they utilize family labour. The major profitability determinants of bamboo processing in the study area include quantity and cost of bamboo processed, labour and fuel at P=0.01 level of significance. The net returns to bamboo processing were estimated at ₦345,485.84 ($1919.366) per year. The major challenges to bamboo processing include inadequate bamboo culms, labour shortage and non-availability of credit among others. The study recommends that research institutes should develop higher yielding varieties which will be made available to bamboo processors at affordable costs. Cooperation among bamboo processors should be encouraged to enable them acquire improved tools and equipment needed for bamboo processing so as to enhance ease of processing and enhance productivity.
Keywords: Bamboo, Potentials, Processing, Socio-economic, Nigeria

INTRODUCTION

Bamboo (*Bambusa vulgaris*) is a group of perennial evergreens in the true grass family *Poaceae* and includes the largest members of the grass family. There are more than 70 genera of bamboo divided into about 1,450 species, of which only around 50 species are routinely cultivated (Hunter, 2003). Native bamboo grows in many parts of the world, including East Asia, Sub-Saharan Africa and the Americas. Bamboo is not limited to tropical climates, with some species able to withstand frost and survive in Northern Europe (Hunter, 2003).

Bamboo is an ancient woody grass widely distributed in tropical, subtropical and mild temperate zones. Traditionally seen as the "poor man's tree", in recent years bamboo has risen to a high-tech, industrial raw material and substitute for wood. Although the commercialization of planted bamboo has been slow, bamboo is becoming an increasingly important economic asset in poverty eradication, economic and environmental development (FAO, 2005).

Bamboo is an extremely fast growing plant, with some species obtaining growth surges of 100cm per 24 hour period. Most bamboo species grow to their full height within a single growing season. Over the following seasons the walls of each culm (or stem) dry and harden, reaching maturity within 3 to 5 years. After a maximum life, which varies by species and climate, the individual bamboo culm will collapse and decay, although the plant itself may survive. Furthermore bamboo tolerates poor soils, which makes it useful for planting on degraded land (Hunter, 2003).

In spite of the numerous uses of Bamboo and its low investment uptake, there is a gross dearth of investment on Bamboo development and processing in Nigeria. In addition, the potentials of Bamboo as raw materials for industries, generation of employment and poverty alleviation are yet to be fully explored. These issues necessitated this study by evaluating the socio-economic potentials of Bamboo processing in Nigeria.

MATERIALS AND METHOD

The study was carried out in Ekiti state, Nigeria. The state is in Southwest Nigeria. The state has a total land area of 6,353 square kilometres with a population of 2,737,186. Agriculture is the main occupation of the people of Ekiti, and it is the major source of income and employment for more than 75% of the population of Ekiti state. The land is buoyant in agricultural resources with cocoa as its leading cash crop. The land is also known for its forest resources, notably bamboo and timber. Because of the favourable climatic conditions, the land enjoys luxuriant vegetation it has abundant resources of different species of timber (Ekiti State Government, 2008; NPC, 2007). Ekiti, State is one of the four states of Nigeria that have indicated interests in bamboo cultivation (RMRDC, 2011). A three-stage sampling technique was used for this study to select 120

Bamboo processors. Data were collected with the aid of a structured questionnaires administered to respondents at the Bamboo processing sites in the study area.

Data collected were analysed using descriptive statistics such as frequency, mean, mode average and percentages. Net Returns to Processing equals Gross margin –Average Total fixed Costs-------------Eq 1

Gross margin analysis estimated as:

Gross margin= Average Total Revenue (ATR) – Average Total Variable Cost (ATVC)--Eq 2 Average total revenue includes the returns from bamboo and all other products. Average total variable cost (ATVC) includes costs of variable inputs such as cost of bamboo culms, fuel, labour and costs of other variable inputs.

Multivariate Regression Model was also used for analysis with the implicit and explicit models used for this analysis are given as follows:

The implicit model Y_1:

$Y_1 = \beta X_1 + e$--------------------------Eq 3

Where:

Y_1 = Net farm income (₦),
β = Coefficient to be used for the model,
X_1 = Age of the respondents (years), and
e = Error term.

The explicit model Y_2:

$Y_2 = \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 + e$-------Eq 4

Where: Y_2 = Net farm income (₦),
β = Coefficient to be used for the model,
X_1 = Cost of bamboo (₦),
X_2 = Cost of labour (man-day),
X_3 = Quantity of bamboo processed (kg/cm^3),
X_4 = Quantity of fuel (litres),
X_5 = Depreciated cost of land (₦), and
e = Error term.

The Kendall's Coefficient of Concordance

The Kendall's Coefficient of concordance was used to rank the challenges faced by bamboo processors as estimated below:

W = $12S/P^2\,(n^3 - n) - P^T$--------------------------------Eq5

Where:

S = Sum of squares,
P = Number of predictor variables,
n = Number of respondents,
T = Correction factor.

RESULTS AND DISCUSSION

Cost and Return Analysis

The costs and returns to bamboo processing per year are presented in Table 1. For the analysis, the average total fixed cost was ₦405,051.63 per year include costs of land, cutlass, chainsaw, slicer machine, generator and vehicle while the average total variable cost was ₦1,406,360.51 per year include labour, fuel, electricity and bamboo processed. The average total revenue ₦2,156,897.98 was gotten from the summation of all the prices of bamboo products processed. The net returns (net profit) of ₦345,485.84 ($1919.366) per year calculated as Gross margin minus average total fixed cost. The result indicates the Bamboo processing is profitable. This will result in an average monthly net returns of₦28,790.49 to a processor.

Therefore, from the results presented so far, it may be inferred that bamboo processing is a profitable venture. Bamboo processing though largely un-developed has been described to be profitable providing income to rural households. The findings from this study corroborated earlier studies (IFAD, 2013a,b; Sythud, Zhang, and Mukete 2015; INBAR, 2015a and b).For example, in Tanzania, studies have shown that bamboo has improved the lives of several thousand people and is also being used by these communities to reverse land degradation(IFAD, 2013a; INBAR 2015a). These activities have created new income streams in several rural areas, where communities produce crafts and desks for local schools. Charcoal briquette production and selling that generate income and slow deforestation employs over 5000 women, many of them single mothers, who now have stable incomes (INBAR, 2015a;b) . In Ecuador, bamboo grants have sparked a number of public-private partnerships that make furniture, flooring, crafts and construction products. IFAD, 2013a, INBAR, 2015a and b). These models have now also been shared with neighboring regions in Northern Peru, with some 2000 people now employed. These value chains and enterprises, produce affordable and earthquake and flood resistant housing which reduces risks to climate change and transforms coastal and peri-urban areas with better quality homes for low-income communities IFAD, 2013a and INBAR 2015a).

In order to know the major determinants of the profitability of bamboo processing, multivariate regression analysis was carried out. As shown in the table, cost of bamboo (X_1) has significant influence on the profitability of bamboo processing, this implies that the higher the cost of bamboo, the lower the profit. Cost of labour (X_2) also has a significant influence on the profitability of bamboo processing, which implies that, as the cost of labour increases, it will amount to decrease in profitability of bamboo processed.

The quantity of bamboo processed (X_3) is one of the major determinants of the profitability of bamboo processing, in the sense that, the higher the quantity of bamboo processed, the higher the profit incurred from bamboo processing. Also, the quantity of fuel (X_4) has a major influence on the profitability of bamboo processing. The lower the quantity of fuel consumed by the various machines and generator, the higher the profitability of bamboo processing. The depreciated cost of land (X_5) is also a major determinant of the profitability of bamboo processing because the lower the cost of land, the higher the profitability of bamboo processing.

The other determinants of the profitability of bamboo processing are: quantity of labour (man-day), depreciated cost of generator (kg/cm^3), and tertiary education. They also have influence on the profitability of bamboo processing. The quantity of labour (man-day) determines the profitability because the higher the efficiency of labour, the higher the profitability of bamboo processing.

The R^2 value of 0.47 determines the variation in profitability of bamboo processing, which is explained by the explanatory variables or the determinants of profitability of bamboo processing that have been mentioned above. The F-value is 80.1.

Proportion Estimation Of Bamboo Products Processed

These are the proportion estimation of bamboo products processed by the various respondents in their communities. The major bamboo products processed are bamboo scaffold, bamboo stakes and bamboo fencing planks (and also ply bamboo). They are produced in large quantities than other bamboo products. The remaining bamboo products processed by the respondents in the study area are; bamboo pots for inputs, bamboo benches for sitting in farm houses, bamboo window blinds, bamboo chairs, ornamentals, medicinal leaves, bamboo floor tiles, bamboo tables, bamboo flower vase, bamboo bed, bamboo stool and firewood but most times, the unprocessed bamboos are used for firewood. These products were line with earlier identified bamboo products from previous studies (Mekonnen et al 2014; Sythud, Zhang and Mukete 2015).

CONCLUSION AND RECOMMENDATIONS

This study shows that bamboo processing is a profitable business. Its production is affected mainly by quantity and cost of bamboo culms availability, labour shortage and fuel inputs. There is however a number of constraints limiting the processing of bamboo products in the area inadequate bamboo culms, labour hiring problem and non-availability of credit. Based on the findings of this study, for the productivity of bamboo processing to increase, the bamboo processors should have a way of coming together as cooperative society in order to acquire improved tools and equipment needed for bamboo processing so as to enhance ease of processing and increase productivity.

Table 1: Analysis of Costs and Returns

Items	Average quantity(q)	Average cost/unit (₦) (c)	Total value of q*c
Fixed Items			
Land (Rent)	-	10, 260.50	10, 260.50
Cutlass	8	1055.15	8,441.18
Chain saw	1	42,352.90	42,352.90
Slicer machine	1	30,882.35	30,882.35
Generator	1	45,420.16	45,420.16
Vehicle	1	250,176.47	250,176.47
Depreciation		17,518.07	17,518.07
Average Total Fixed Cost (ATFC)			**405,051.63**
Variable Items			
Labour	181man-day	1,605.04	290,512.24
Fuel	5765litres	120	691,800
Electricity bill payment	-	105,072.27	105,072.27
Bamboo processed	2848pieces/stand	1120	318,976.
Average Total Variable Cost (ATVC)			**1,406, 360.51**
Average Total Revenue (ATR)	-	2,156,897.98	
Gross Margin(GM)= ATR−ATVC		750,537.47	
Net Returns= GM−ATFC		345,485.84	

Table 2: Determinants of Profitability of Bamboo Processing

Predictor Variables Of Profit	Coefficient	Standard Error	t - value	P Value
Constant	12173	76288	0.16	0.874***
Cost of bamboo (₦)	−2.19	0.89557	−2.45	0.016***
Cost of labour (₦)	−17.98	6.116945	−2.94	0.004**
Quantity of bamboo processed (kg/cm^3)	153.73	24.00834	6.40	0.000**
Quantity of labour (man-day)	28963.12	10330.78	2.80	0.006***
Quantity of fuel (litre)	89.83	7.422499	12.10	0.000***
Depreciated cost of generator (₦)	63.02	21.22946	2.97	0.004***
Depreciated cost of land (₦)	−257.16	42.20439	−6.09	0.000***
Tertiary education	−65815.03	33470.98	−1.97	0.052***

R^2=0.47; F=80.1 (P=0.001)

Note: Only significant variables are reported. Double (**) and triple asterisks (***) indicate significance variables at p=0.05 and 0.01.

Source: Field survey

Table 3: Proportion Estimation of Bamboo Products Processed

Identified Bamboo Products Processed	Yes		No	
	Frequency	Percentage	Frequency	Percentage
Bamboo scaffold	120	100.0	0	0.0
Bamboo yam stakes	120	100.0	0	0.0
Bamboo fencing planks	120	100.0	0	0.0
Bamboo pots for inputs	11	9.2	109	90.8
Bamboo benches in farm houses	120	100.0	0	0.0
Bamboo window blinds	26	21.7	94	78.3
Bamboo chairs	87	72.5	33	27.5
Bamboo ornamentals	111	92.5	9	7.5
Bamboo frames	63	52.5	57	47.5
Bamboo medicinal leaves	108	90.0	12	10.0
Bamboo floor tiles	46	38.3	74	61.7
Bamboo tables	95	79.2	25	20.8
Bamboo flower vase	34	28.3	86	71.7
Bamboo bed	51	42.5	69	57.5
Bamboo stool	116	96.7	4	3.3
Bamboo firewood	111	92.5	9	7.5

Source: Field survey.

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INVESTIGATING THE EFFECT OF NON-PERFORMING LOANS IN THE NIGERIAN BANKING SYSTEM ON THE PERFORMANCE OF THE FORESTRY SUB-SECTOR OF THE ECONOMY

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ABSTRACT
Rising trends in Non-performing loans (NPLs) adversely affected availability of credit to economic agents in the Nigerian economy specifically agricultural sector thereby constraining financial intermediation and economic activities. The study sought to investigate the effects of NPLs in the Nigerian banking system on the performance of the forestry sub-sector of the economy from 1981-2015. Time series data were collected from annual statistical bulletin of the Central Bank of Nigeria. Results from the trend analyses substantiated by graphical presentation indicated that NPL and forestry performance showed an average downward trend with undulated fluctuations and distinct crests and troughs throughout the period of study. The exponential growth rates in NPLs and performance of the forestry sub-sector were -6.11% and -3.39% respectively. The Pearson correlation coefficient and analysis of bilateral Granger causality revealed insignificant relationship between NPLs and forestry's performance in Nigeria. The results of auto-regressive estimates also indicated that, non-performing loans in the Nigerian banking system had insignificant negative relationship with the performance of the forestry sub sector in Nigeria. Policy on increased participation of specialized financial institutions to increase volume of loans while insurance companies could intensify de-risking investments in forestry sub-sector should be introduced and enforced by CBN.

Keywords: Loans, Nigerian banking, forestry, economy

INTRODUCTION

Various studies have pointed to the key roles which the banking system plays in any economy. These crucial roles predominantly include among others; the provision of loans and advances to the different economic agents in the various sectors namely: agriculture, industry, services and others. Agricultural sector consists of crops, livestock, forestry, fishery and agro processing. (CBN, 2014). Loans and advances from the banking system are granted to the various economic agents in these Sub-sectors in order to expand scale of operations or initiate new agro-economic activities which will add values to agricultural growth over time in the country.

In Nigeria, forestry sub-sector has high employment opportunities, foreign earnings via exported timbers and other investment windows (FAO, 2001; Faleyimu, 2013). Yet in 2003, forestry sub-sector contributed only 0.6% to the gross domestic product (GDP). Nigerian forests provide a huge quantum of forage and fodder which are not only vital to the country's livestock production but a sufficient boost toward enhanced agricultural growth. Woods obtained from the forests are not only used for domestic purposes but for commercial. These woods are used as fuel wood and charcoal. The different commercial uses of forest wood include saw wood, paper products, furniture making and electrical, marine transportation and others. Faleyimu, (2013), in a study on the declining contributions of forestry to the gross domestic product of Nigeria: cause and cure noted that there was a declining role of export of forest products in Nigeria. In another study, Yusuf, Rufai and Komolafe (2013), evaluated externalities linked in the Nigerian forests. The result indicated the value of some positive externalities worth N 265,833 billion.

Bank loan constituted a major source of business capital and its availability may increase production efficiency whiles its inadequacy or non -availability can hamper productivity (Umoren, 2008). The performance of the forestry sub- sector of agricultural sector is crucial to the growth and development process of the economy and seemed to have been influenced by the availability of loans and advances from the banking system. The dismal performances of the sub-sector may be linked with high default rate associated with agricultural activities and poor health of the banking system resulting in high prevalent of Non Performing Loans (NPLs) (Elegbe, 2013). The non- repayments of loans over a prolong period of time ranging from 90 days and beyond constitutes non-performing loans (NPLs) (Badar and Javid, 2013, CBN, 1991). Some of the major causes of NPLs include: excessive credits creation by the banks, insider abusive, relaxed credit condition and poor loan recovery strategies, business cycles, volatility in macroeconomic and bank specific factors which are gross domestic products, inflation, interest rate and liquidity of the banks. The existence of NPLs affects lending to various economic agents in agriculture and other sectors. This seems to contribute to the problem of declining agricultural activities (CBN, 2003) which persisted in economies of many Subs –Saharan countries including Nigeria in the 1990s (Fofack, 2005). Following the importance of forestry sub- sector to Nigerian economy, this study investigates the effects of Non-performing loans in the Nigerian banking system on the performance of the forestry sub-sector.

MATERIALS AND METHODS

Study Area, Data Source and Analytical Technique: The study was conducted in Nigeria; a country situated on the Gulf of Guinea in the sub- Saharan Africa. Nigeria lies between 4^0 and 14^0 North of the Equator and between longitude 3^0 and 15^0 east of the Greenwich. The country has a total land area of about 923,769km^2 (or about 98.3 million hectares) with 853km of coastline along the northern edge of the Gulf of Guinea and a population of over 140 million people (National Population Commission, 2006). Secondary data used in the study were collected from the statistical bulletins of the Central Bank of Nigeria (CBN). The study employed trend analysis, Granger causality test and simple regression model to explore the relationship between the non-performing loans and performance of forestry sub- sector in Nigeria from 1981 to 2015.

The trend Analysis of Non-performing loans and Forestry performance Sub-sector's Performance in Nigeria (1981 – 2015)

The study investigated the nature of relationship, movement and growth rate in Non-performing loans and Forestry Sub- sector's performance in Nigeria. An exponential trend equation was specified as thus:

$log_e FOR_t = b_0 + b_1 T + U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$

Where 'T' is the time expressed in year; FOR_t is the forestry sub sector performance proxy by the percentage share of forestry sub sector GDP in total agricultural GDP in Nigeria. The exponential growth rate in forestry Sub-sector (FOR) is given as:

(r) $=(e^{b1} - 1) * 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$

Note, the trend equation was estimated for the non-performing loans ($NPLs_t$) likewise

Bilateral Granger Causality Test on Non-performing loans and Forestry Sub- sector's performance in Nigeria

The primary model in Vector Autoregressive Regression forms are represented as thus:

$$\left\{\begin{aligned} \Delta \boldsymbol{LnFOR_t} &= \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\sum_{i=1}^{n} \Delta \boldsymbol{LnFOR_{t-1}} + \boldsymbol{\beta_2}\sum_{i=1}^{n} \Delta \boldsymbol{LnNPL_{t-1}} + \boldsymbol{\varepsilon_{1t}} \ldots .(3) \\ \Delta \boldsymbol{LnNPL_t} &= \boldsymbol{\delta_0} + \boldsymbol{\delta_1}\sum_{i=1}^{n} \Delta \boldsymbol{LnNPL_{t-1}} + \boldsymbol{\delta_2}\sum_{i=1}^{n} \Delta \boldsymbol{LnFOR_{t-1}} + \boldsymbol{\varepsilon_{2t}} \ldots .(4) \end{aligned}\right\}$$

From the specification, there is bilateral granger causality from NPLs to forestry sub- sector's performance, if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} = 0$. Similarly, there is granger causality from the crop Sub sector Productivity to NPL if $\boldsymbol{\beta_2} = 0$ and $\boldsymbol{\delta_2} \neq 0$. The causality is considered as bidirectional if $\beta_2 \neq 0$ and $\boldsymbol{\delta_2} \neq 0$. Finally, there is no link between forestry sub sector performance and NPL if $\beta_2 = 0$ and $\boldsymbol{\delta_2} = 0$. (Guranti and Sangeetha, 2007)

RESULTS AND DISCUSSION

Augmented Dickey Fuller Unit Root Test Result

The stationarity of series was examined by the Augmented Dickey Fuller (ADF) unit root tests. The results are presented in Table 1.

The result showed that NPLs and forestry sub- sector's performance are non-stationary at levels but stationary (at 1% significance level) at first difference for the ADF equation that contains constant and constant and trend equations. The result implies that data for forestry sub- sector performance and non-performing loan cannot be specified at their levels without the risk of obtaining spurious regression. Also, the result indicates that, there is need to difference the variables before they are used in the model specified, so as to ensure stability.

Exponential Trend Analysis of Non-performing loans and Forestry sub- Sector's Performance in Nigeria (1981 to 2015)

The exponential trend equations for Non-Performing Loans and forestry sub- sector performance specified in equation 1 is presented in Table 2. The regression estimates for each of the variables is followed by the calculated exponential growth rate derived from the respective long run exponential trend equation. The results reveal that trend in NPLs show negative significant association with time in Nigeria. This implies that a change in NPLs is negatively influenced by time. NPLs have average exponential growth rates of -3.39%. This means that the growth in NPLs reduces over time in Nigeria. Similarly, the forestry sub-sector exhibits negative significant relationship with time. This indicates that the forestry sub- sector's performance decreases over time in Nigeria.

To further verify the previous assertions graphically; the linear trend in FOR and NPLs is showed in figure 1. Movements in both graphs are in consonant with the trend equations. However, the pattern of fluctuations in the two variables were remarkably different over time. It is suggested that, fluctuations in both variables are consistent with various policies and intervention programmes implemented in the country. For instance, the banking sector consolidation and other reforms helped shaped the undulated nature of NPLs in Nigeria. Also, the agricultural policies and programmes determined the orientation in the trend of forestry performance Nigeria.

Since these variables are highly dispersed and do not showed significance level of coherence, it is suggested that, there may be no significant relationship between the NPLs and Forestry sub-Sector's Performance in Nigeria. Fluctuations were undulated in NPLs with distinct crests and troughs in the trend. On the part of forestry sub-Sector performance, the trend assumes a progressive decline till 2005 when growth was stagnated.

The linear and symmetric relationship between Non-performing loans and Forestry sub- sector performance in Nigeria was tested using Pearson correlation coefficient. The results reveal that the correlation coefficient of 0.275 (not significant at conventional levels, 2-tailed test). This implies that NPLs has a weak linear and positive relationship with forestry sub- sector performance in Nigeria. In other words, the movement in forestry sub sector's performance is not significantly detected or correlated by NPLs in Nigeria.

Bilateral Granger Causality Test for Non-performing loan and Forestry sub-Sector's Performance in Nigeria

The Granger causality relationship between Non-performing loans and performance of the forestry sub- Sector in Nigeria is shown in Table 3.

The results presented indicate that there is no evidence of Granger causality between the two variables. Hence, the null hypothesis is accepted for the two proposed relationships. To further test the relationship between the NPLs and the forestry sub sector's performance in Nigeria, a simple log linear autoregressive model was estimated at the first difference of variables. The result is presented in Table 4. Though the diagnostic tests do not show reliable estimates, yet the preliminary results reveal insignificant negative relationship between NPLs and forestry sub –sector's performance in Nigeria.

The result indicated that, NPLs and the performance of forestry sub- sector do not have significant causation relationship in Nigeria. Precisely, the Non-performing loans in the Nigeria's banking system have insignificant negative relationship with the performance of the forestry sub sector in Nigeria. The results support previous results as earlier reported using correlation, trends and bilateral Granger causality analyses. Hence, increase in the NPLs in the Nigeria banking system does not significantly increase activities in the forestry sub sector in Nigeria. The result has several implications. Firstly, it suggests that most of the loans disbursed to various economic agents in the economy were not given to the agricultural sector. Secondly, it is likely that activities in agricultural sector and the sector's performance were not significantly influenced by the level of default or NPLs. Thirdly, it could be that, other sectors accounted for the large percentage of NPLs in the country; as such its effect was not significantly felt in the agricultural sector. Another possible reason for this result which is also prominent in the literature is the fact that, more than 90% of agricultural activities in the country are anchored by resource poor farmers who do not have collaterals and access to credit facilities. Hence, the issue of NPLs which is affiliated to formal banking system does not practically apply to them. However, the results has revealed that the performance of forestry sub sector is invariant with the NPLs in the Nigeria's banking system.

Conclusion and Recommendations: There was no significant effect of NPLs on the performance of forestry sub-sector in Nigeria during the period of the study. NPLs and Forestry sub-sector's performance exhibited an average negative trend during the study period. The Pearson correlation analysis, bivariate Granger causality and simple regression estimation, all pointed to a weak and non-significant relationship between the NPLs and performance of the forestry sub-sector in Nigeria. This result might suggest that banks' loans and advances to the Forestry sub-sector were inadequate probably due to none or insufficient collateral requirement needed as one of the pre-conditions to access such facilities. Banks might have been more adverse to grant loans to the economic agents in the sub-sector because of increased risk of defaults among other reasons. Policy on increased participation of specialized financial institutions to increase volume of loans while insurance companies could intensify de-risking investments in forestry sub-sector should be introduced and enforced by CBN.

Table 1: Result of the unit root test for Non-performing loans and Forestry sub Sector's Performance (Augmented Dicker Fuller Test for unit root)

Logged Variables	With Constant			Constant and Trend		
	Level	**1st Diff.**	**OT**	**Level**	**1st Diff.**	**OT**
$LnNPL_t$	-1.2393	-6.3153***	1(1)	-3.0555	-6.2823***	1(1)
$LnFOR_t$	-2.4859	-7.8486***	1(1)	-2.2063	-8.1602***	1(1)
1% (CV)	-3.6394	-3.6463		-4.2529	-4.2627	

Note: OT means order of integration. Critical value (CV) is defined at 1% significant level and asterisks *** represents 1% significance level. Variables are as defined in equation 1.

Table 2: Exponential Trend Analysis of NPLs and Forestry sub-Sector's Performance in Nigeria (1981 to 2015)

Variables	**Forestry sub- Sector Performance**	**Non-Performing Loans**
Constant	1.04654 (7.127)****	4.07336 (23.19)***
Time	−0.0339034(−4.766)****	−0.0611362 (−7.1851)***
F- cal.	22.71148***	51.62592***
R-square	0.407662	0.610049
Exponential GR (%)	**-3.390**	**-6.113**

Note: Values in bracket represent t-values. The asterisk *** represent 1% significance level. Variables are as defined in equation 1.

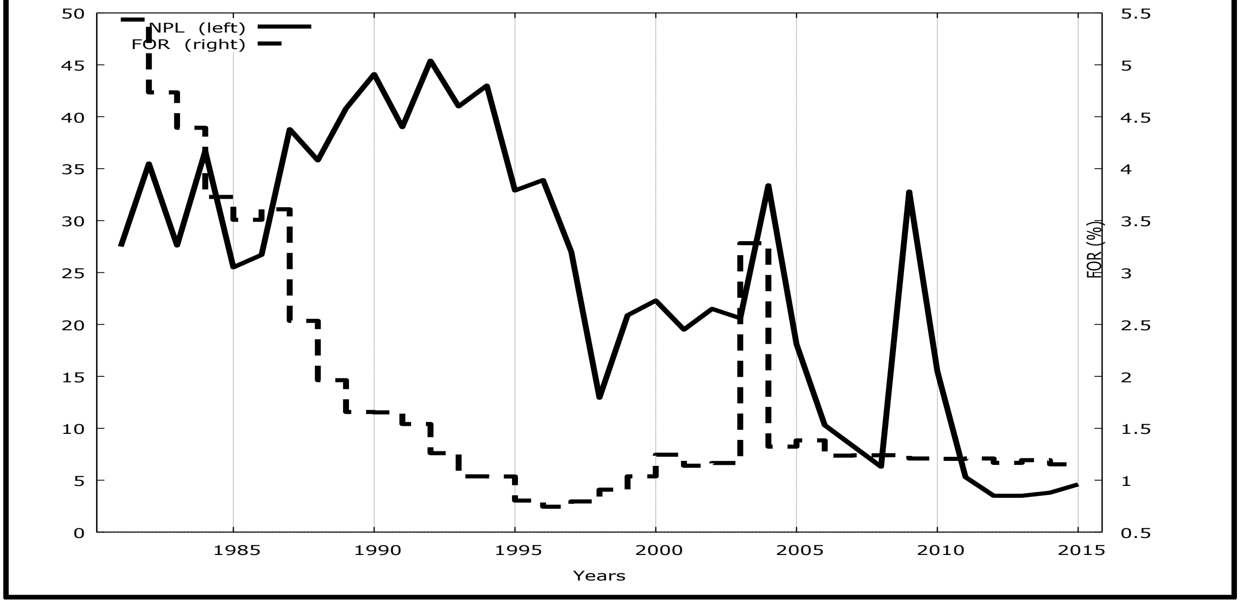

Figure 1: Trend in FOR and NPL in Nigeria (1981 to 2015)

Table 3: **Pairwise Granger Causality Tests for Non-performing loans and Forestry sub- Sector Performance in Nigeria (1981 to 2015)**

Hypotheses	**Lag**	**Observations**	**F-Statistic**	**Prob.**	**Decision**
FOR does not Granger Cause NPLs	2	33	1.28616	0.2922	Accepted
NPLs does not Granger Cause FOR	2	33	0.26338	0.7703	Accepted

Source: Computed by authors using EView.

Table 4: A Simple Regression Estimates (Non-performing Loan and Forestry sub-Sector Performance in Nigeria, 1981-2015)

Variable	Coefficient	standard error	t-value
Constant	−0.0597678	0.0466964	−1.2799
NPLs	−0.0487547	0.102869	−0.4740
FOR_{t-1}	−0.307867	0.177461	−1.7348*
R^2	0.115362		
F-Cal	1.956093		
Normality test	19.1928***		

Source: Note; Variables are expressed in log difference. Computed by authors using EView.

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EVALUATION OF THE ENVIRONMENTAL COST OF QUARRY ACTIVITIES ON SURROUNDING COMMUNITIES OF ISHIAGU, EBONYI STATE, NIGERIA

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ABSTRACT
Quarrying activity is a necessity that provides much of the materials used in traditional hard flooring. However, nothing is gained without some costs to individuals and the environment. Rock quarrying and stone crushing is a global phenomenon, and has been the cause of concern everywhere in the world, including advanced countries. Therefore, an assessment of the environmental impact of quarrying activities on the inhabitants of ishiagu in Ebonyi State, South Eastern Nigeria was carried out using questionnaire administration and physical count. Additional information was also obtained from a major health facility in the community. Indices studied centered on socio-economic characteristics of respondents, social negative effects of quarrying operations on the community, health problems associated with quarrying activities and the environmental impact of quarrying. Results of questionnaire administration indicated the existence of a strong relationship between the influx of people into Ishiagu, obviously in search of better job opportunities offered by the quarry industry and increased crime rate and teenage pregnancies. Results revealed that the prevalent health problems associated, with quarrying operations were catarrh, hearing problems, respiratory diseases, and heart problems. Similarly, the devastating environmental effects of quarrying included road destruction, industrial pollution, agricultural land degradation, noise pollution, contamination of water sources and cracking of buildings. Considering the various health risks associated with inhalation of particulate matter, environmental impact assessment should be made mandatory for all quarries. Although quarrying is an age-long economic activity, evidence of its negative impacts should influence more comprehensive policies and strict enforcement of such policies within the areas of operations of quarry sites. Quarry industries should be compelled to adopt modern techniques of dust strapping such that a negligible quantity of dust escapes from the various operations at quarry site. Particulates released can be controlled with scrubbers, precipitators, and filters, which can be retrofitted to dust stacks for pollutant removal from emissions.

Keywords: Quarry activities, environmental cost, communities

INTRODUCTION
Quarrying is the process of obtaining quarry resources, usually rocks, found on or below the land surface (Banez *et al*; 2010). On the other hand, quarrying is an open or surface excavation for the extraction of building stone, ore, coal, gravel or mineral deposits from the earth's crust (Brucce, 1989). Quarrying industries are therefore, those industries that are generally referred to as extractive industries which undertake the extraction of construction materials such as crushed rock aggregates, road bases, sands, clays and dimension stones. The search for granites in Ishiagu started in 1970 (Aja, 1998), but it was not until 1972 that commercial quarrying activities began. The exploration for more granite deposits between 1977 and 1978 led to the discovery of large granite deposit at Ugwu-Chime which comprises of three villages of Ngwogwo, Amokwe and Okue, all in the larger Ishiagu Community. Since then, granite has been discovered by different quarrying industries in Ishiagu with Crushed Rock being the major operator. Others include Crushed Stone, MCC, Biwa Dams, Fougerole, Marble Stone, Geominox and Macgrek line. Their products include dimension stone, granite, lead and zinc.
One of the biggest negative impacts of quarrying on the environment is the damage to biodiversity (Anand, 2006). Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms. Odiete (1999) reported that quarrying activities with excessive blasting operations cause cracking of buildings and equally affects human beings. Quarrying carries the potential of destroying habitats and the species they support (Mabogunje, 1980). Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts – such as changes to ground water or surface water that causes some habitats to dry out or others to become flooded. Even noise pollution can have a significant impact on some species and effect their successful reproduction.
Increasing attention is being paid to the impacts of dust on human health, as finer particles can be inhaled and breathed into the lungs and cause harm. Particulates are tiny solid or liquid particles that are suspended in air and which are usually individually invisible to the naked eyes (Baird, 1992). Particulates include soot, smoke,

ash from fuel (mainly coal) combustion, dust released during industrial processes like quarrying and other solids from accidental and deliberate burning of vegetation (Montgomery, 1992). Particulate matter(dust) inhaled penetrate deeply into the lungs and are capable of making their way to the air sacs deep within the lungs where they may be deposited and cause respiratory problems (Zheng *et al*; 2011). Air pollutants such as dust are unhealthy particles (solids, liquid gas mixtures) that are liable to harm both living and nonliving things (Ward *et al*; 1993). Fine rock and mineral dust of many kinds have been shown to be carcinogenic when inhaled (Montgomry, 1992). According to Banez *et al*, (2010) inhalation of dusts can cause "pneumoconiosis" which is a term that refers to a group of lung diseases. After several decades of quarrying operations in Ishiagu with the attendant environmental hazards occasioned by dust emission, there has been little empirical information (as no previous study has been documented) on the effects of this activity on the physical and socio-economic environments and the health of the people living in the community. It is envisaged that the results of this study will help to audit the environmental implications of this project for scientific use and policy formulation. In this study, we assess the environmental impacts of quarrying activities in Ishiagu, Ebonyi State, Nigeria.

METHODOLOGY

The study area is within 2kilometer (km) radius of the quarry site in Ishiagu, Ivo Local Government Area of Ebonyi State, South East Nigeria. The town is about 10km from the Ishiagu junction of Enugu – Port Harcourt Express way. An area of moderate relief with an average height of about 300m above sea level; in a derived savanna of south east agro-ecology with characteristic sparse vegetation. The community lies within latitude 5^0 and 6^1 N and longitude 7^0 and 8^1 E with annual rainfall in the range of about 1,200-1,600mm and mean temperature range of 27^0C – 33^0C. Nine villages of Ishiagu viz Amaokwe, Okue, Ngwogwo, Ihietutu, Amaeze, Amata, Amonye, Ihie and Ogwor, which are nearest to the point sources of the perceived impact, were purposively selected as target population for the study. Thus, ten (10) respondents from each village were selected at random and interviewed by questionnaire administration. A total of ninety (90) respondents formed the sample size for this research. The respondents were interviewed (using questionnaire) to obtain primarly information on the socio-economic impact of quarrying in the study area. Physical count of the number of pot holes on devastated roads was also undertaken.

The data collected from the survey were analyzed using descriptive statistics. The major constraint in this study was the distribution of questionnaire, which involved a lot of movement and expenditure.

RESULTS AND DISCUSSION

Social characteristics of respondents

Results of responses show that questionnaire administration cut across every strata of the population for a determination of the socio-economic impact of quarrying in Ishiagu with Table I indicating that the total population of respondents consisted of 60% (54) males and 40% (36) females.

Table 2 revealed that the highest proportions of respondents were in the age bracket of 18 – 30 years constituting 36.67% of the population, followed by the age group of 31 – 40 (30%). Only 22.22% of the studied populations were of the age bracket of between 41-50 years. People in this category are known to shoulder great family responsibilities. The least population (50 years and above) constituted only 11.11% of the entire population. From this result, it is therefore, apparent that the sampled population is a very active one with great majority of the respondents less than 40 years.

The distribution of respondents based on their educational attainments (Table 3) showed that 14.44% (13) had no formal education. Those who dropped out of primary school were only 3 (3.33%) while 8.89% obtained primary education. Among the respondents, 28.89% and 44.44% acquired secondary and tertiary education respectively. This result indicates a high literacy rate in the study population.

Social negative effects of quarrying operations on community life

An assessment of the influx of people into Ishiagu as a result of the activities of the quarry industry is shown in Table 4. Eighteen (18) respondents representing 20% of the sampled population rated very high the contributions of quarrying operations to the influx of people into Ishiagu, while 30% (27) and 43.33%(39) scored as high and moderate respectively the influence of quarrying industries on human movement into the community. Only very low population 4.44% shared contrary opinion. That is therefore, a confirmation of overwhelming contributions of the industry to the influx of people into the community.

In Table 5 are presented the negative social effects with regards to crime rate resulting from the presence of quarrying activities in Ishiagu. In the opinion of 10% of the studied population, the presence of quarry industry has engendered very high crime rate. A reasonable percentage (21.11%) of respondents were of high opinions concerning the contributions of quarrying operations to increased crime rate, 24.44% were moderates, while 34.44% were of low opinion and 10% scored crime rate as very low in the community due to quarry industries.

Table 6 indicates that 24 representing 26.67% of the sampled population rated teenage pregnancy as very high 23 (25.56%) scored it as high due to the negative social influence of quarry industry, while 20% held moderate opinion. Only a lowly 12 (13.33%) and 13 (14.44%) of the population rated teenage pregnancy in the study area low and very low respectively. By this result, the prevalence of the high rate of teenage pregnancies is a cause for worry.

The results of the negative social effects of quarrying on community life were just stating the obvious. Considering the scope of quarrying activities by the Crushed Rock Industries in Ishiagu, it is expected that a high volume of employment will be generated by way of direct employment to different categories of workers and indirect employment opportunities offered to the haulage industry, loaders, agents, contractors etc with the attendant influx of people. It is only normal for people to migrate from different places in search of such employment opportunities with the consequent increase in such negative social vices as increased crime rate and teenage pregnancies. Current results suggest the existence of a strong relationship between the influx of people into the community in search of better opportunities and increased crime rate and teenage pregnancies. Current findings may corroborate the evidence of Odiete (1999) that quarrying activities have adverse impact on land use, physical and biological environment and the socio-economic life of the people. He went further to suggest on inter-relationship between quarrying, social economic and technological advancement. Furthermore, NEST (1991) reported that environmental problems associated with quarrying have drastically affected the socio-economic welfare of the rural people.

Health problems associated with quarrying activities

Health problems associated with quarrying industries are illustrated in Table 7. It is apparent that the most prevalent health problem associated with quarrying was catarrh, which drew the attention of 30% of the respondents. Industrial acadents accounted for 27.78%, 18.89% of the studied population had respiratory diseases, while 14.44% and 8.89% population of the study area encountered hearing and heart problems respectively. Similarly, from the hospital records obtained from the General Hospital Ishiagu, the following were the health problems or ill health effects associated with quarrying in the last 5 years; serious cough and catarrh – 185 cases, respiratory diseases – 141 cases, heart problems/chest pain – 130 cases, and industrial hazards/accidents – 18 cases.

The results of the study from respondents were similar and substantiated by the records obtained from the General Hospital (secondary sources) the high prevalence of catarrh and respiratory diseases may not be unconnected with particulate dusts generated by quarrying operations in the study area. Oyegun (1998) reported a case of death arising from complications that began with catarrh and respiratory problems allegedly resulting from unrestrained inhalation of quarry particulate dust. Dusts from quarry sites is a major source of air pollution, which is not, only a nuisance (in terms of deposition on surfaces) but also its possible effects on health, in particular for those with respiratory problems (Guach, 2001). Similarly Zheng *et al*; (2001) stated that particulate matter (dust) inhaled penetrate deeply into the lungs and are capable of making their way to the air sacs deep within the lungs where they may be deposited and cause respiratory problems.

Environmental impacts of quarrying activities

Table 8 indicates that 17.78% of the studied population were for industrial pollution, 15.56% were for road destruction/devastation, 13.33% of the population scored for noise pollution, 8.89% responses for agricultural land degradation, 11.11% rated water sources contamination, while the highest percentage population (33.33%) of the study area were for cracking of buildings.

With regard to road destruction, an additional independent data was obtained. A distance of 2kilometers covered in each section and the result indicates that from the crushed rock junction to Ivo river, 4 pot holes were recorded whereas from the same junction to the Railway line (towards Enugu – Port Harcourt Expressway) 23 pot holes were observed.

Cracked buildings are common sites in the community and may be a consequence of explosives (dynamites) used in quarry operations (Odiete, 1999). He consequently cautioned that ignorance or inadequate attention to such quarrying destructions can lead to high accumulation of solid wastes, production of unpleasant odours, contamination of ground water for industrial and domestic use, noise pollution, soil erosion, and destruction of wild life, farm structures, and cracking of buildings, loss of aesthetic landscapes, poverty and ecological imbalance. The sections of the road more frequently used by quarry trucks are comparatively more devastated than the other sections. Support could be found in the previous work of Mayer and Maghum (1994) in South Africa who reported that the blasting and crushing areas and the surrounding lands have been rendered useless to other land uses including agriculture as a result of quarrying and heavy vehicular movements and activities. Like many other man-made activities (anthropogenic factors), quarrying activities cause significant impact on the environment (Okafor, 2006). The quarry industry, unfortunately discharge dust that settles not only on land, plants and trees but also on surface waters used for drinking and other domestic chores by the community (Osha, 2006).

CONCLUSION

It is evident that quarrying industries have contributed to the development of Ishiagu. Indeed, quarrying has brought about both benefits and costs to the community. The benefits include employment creation, infrastructural development and revenue generation for Local Authorities. A major socio-economic problem in Nigeria, which is unemployment, has been reduced substantially in the community with the advent of quarrying operations, with the attendant influx of people and the consequent increase in social vices like crime rate and teenage pregnancies. The devastating negative environmental effects of quarrying include road destruction, industrial pollution, and agricultural land degradation, noise pollution contamination of water sources and cracking of buildings. Inhalation of dust resulting in respiratory diseases, catarrh, heart problems and other health effects or hazards also add to the list of the negative effects of quarrying in Ishiagu. Health data has also supported the deadly effects of quarrying activities on the people in the study area. Although, quarrying industries may have contributed to the socio-economic wellbeing and rural development of the community, it may be necessary to establish better industry – community relationship including hazard mitigation strategies. In addition, dust suppression measures especially during the dry season must be effectively implemented. All these will enhance or foster proper and sustainable development of Ishiagu and consequently stem the tide of riots and demonstrations carried out by the natives against the quarry industry.

Table1: Distribution of respondents according to gender

Gender	Frequency	Percentage(%)
Male	54	60.00
Female	36	40.00

Table 2: Age brackets of respondents

Age bracket	Frequency	Percentage(%)
18 – 30	33	36.67
31 – 40	27	30.00
41 – 50	20	22.22
50 and above	10	11.11

Table 3: Educational attainment of respondents

Educational attainment	Frequency	Percentage(%)
No formal education	13	14.44
Primary school drop out	3	3.33
Primary education	8	8.89
Secondary education	26	28.89
Tertiary education	40	44.44

Table 4: Impact of quarrying on the influx of people into the community

Influx rate	Frequency	Percentage(%)
Very high	18	20.00
High	27	30.00
Moderate	39	43.33
Low	2	2.22
Very low	4	4.44

Table 5: Negative social effects of quarrying on crime rate

Crime rate	Frequency	Percentage(%)
Very high	9	10.00
High	19	21.11
Moderate	22	24.44
Low	31	34.44
Very low	9	10.00

Table 6: Teenage pregnancies as social negative effects of quarry industries

Teenage pregnancy	Frequency	Percentage (%)
Very high	24	26.67
High	23	25.56
Moderate	18	20.00
Low	12	13.33
Very low	13	14.44

Table 7: Health problems associated with quarrying activities

Health problems	Frequency	Percentage(%)
Respiratory diseases	17	18.89
Heart problems/diseases	8	8.89
Catarrh	27	30.00
Industrial accidents/hazards	25	27.78
Hearing problems	13	14.44

Table 8: General hospital Ishiagu 5 – year record of health problems associated with quarrying activities.

Health problems	Number of cases recorded
Serious cough/catarrh	185
Respiratory diseases	141
Heart problems/chest pain	130
Industrial accidents/hazards	18

Table 9: Environmental impacts of quarrying activities

Negative impacts	Frequency	Percentage(%)
Industrial pollution	16	17.78
Road devastation	14	15.56
Noise pollution	12	13.33
Agricultural land degradation	8	8.89
Contamination of water sources	10	11.11
Cracking of buildings	30	33.33

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

SUB-THEME X

FISHERIES & AQUACULTURE PRODUCTION, IMPROVEMENT PROCESSING & PRESERVATION

MORPHOLOGICAL VARIATION OF FOUR *TILAPIA GUINEENSIS* POPULATION IN SELECTED COASTA RIVERS IN SOUT-WEST, NIGERIA

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ABSTRACT

Multivariate analysis was used to morphologically differentiate four populations of Tilapia guineensis from Epe, Badagry, Igbokoda and Ilaje in Lagos and Ondo states of Nigeria using 13 morphometric and 5 meristic characters. Principal component analysis (PCA) revealed two principal components (PC- I and PC- II) that accounted for 65.3% of observed variation in morphometric and 59.3% in meristic attributes respectively. Dendrogram revealed two clusters for morphometric and two clusters for meristic variables which indicate variability among the studied populations which could be attributed to either genetic differences or environmental factors. The observed morphometric differences came from the dorsal, caudal and pectorial fin rays. The morphometric and meristic study has differentiated T. guineensis from the four populations into two morphological groups indicating phenotypic heterogeneity among the populations.

Keywords: *Tilapia guineensis*, morphometrics, meristics, principal component analysis.

INTRODUCTION

Species identification and population discrimination are important in the conservation of biodiversity, natural resources and fisheries management. Determination of population structure of exploited species is an essential component in successful management of fisheries. Purely environmental, genetic characters or those that may reflect both genetic and environmental variation can be used to identify fish stocks (Swain *et al*., 2005). Morphometrics and meristics are the two types of morphological characters that have been most frequently used to delineate stocks of a variety of exploited fish species (Turan, 2004).

Tilapia guineensis, an important Cichlid species is a valued food fish in many tropical and sub-tropical countries. It provides one of the most important sources of animal protein and income throughout the world (Sosa *et al*., 2005). The species is usually found in creeks, lagoons, adjoining rivers and other coastal waters of West Africa (Philippart and Ruwet, 1982). Lagos and Ondo are among the coastal states in Nigeria where *T. guineensis* has continued to contribute immensely to the nutritional needs, economic growth, and development of the populace. Despite the wide acceptance of this fish due to it's nutritional and economic importance, It is still facing identification problem especially when found in mixed of other tilapia species. The need to identify and differentiate different populations of *T. guineensis* from South west part of the coastal regions in Nigeria for fisheries management necessitated this study.

MATERIALS AND METHODS

A total of 200 samples of both male and female *Tilapia guineensis* fish weighing 20-357g were randomly collected from four selected coastal rivers in two coastal states of Nigeria. Their geographical location in terms of longitude and latitude is shown in Table 1. Fifty fish samples from each location were obtained from the respective locations through the help of fishermen at the landing sites and were first frozen and transported to the Biotechnology Laboratory of Nigerian Institute for Oceanography and Marine Research, Lagos, in ice and were identified by a fish taxonomist from the Institute then stored at -20^{o}C until used for detailed analyses. A total of 18 morphological characters were measured which included 13 morphometric variables and five meristic characters which were directly counted and measured to the nearest 0.1 cm using a thread and measuring board. Measurements of body parts were made with the head of fish pointing left. However, to avoid possible biases produced by size effects on the morphometric variables, all morphometric characters were standardized by dividing the measurement by the standard length of each fish to minimize the effect of fish size (Allendorf *et al*, 1987).

Statistical Analysis

Analysis was carried out separately for morphometric and meristic characters using statistical tool for Agricultural Research (STAR) version 2.0. The body shape data were subjected to principal components analysis (PCA) in order to reduce the variables to principal component that can explain most of the variation observed in the data.

RESULTS AND DISCUSSION

Morphometric Analysis

Analysis of morphometric data showed that the first principal component (PC-I) accounted for 56.61% while the second (PC-II) accounted for 8.66% giving a total of 65.28% of the variations in morphometric measurements data and were used to explain the variations (Table 2). Principal component analysis showed that samples are on separate quadrants from one another reflecting morphological difference among the populations. Cluster analysis illustrated by the dendrogram in figure 1 revealed two major clusters also indicating variability among the populations. The variation might be attributed to distinct genetic structure and environmental conditions. Since Munasinghe, 2014 reported that distinct genetic and environmental structures have been deemed responsible for morphological variability among different geographical populations. Thus, species with same morphometric characters are often believed to constitute same stock. This idea has found wide usefulness in stock identification or differentiation in fisheries. This result is in accordance with the report of Ramakrishnan *et al*., 2013 that observed two distinct groups of estuarine stocks in his morphometric study. Erguden *et al*. (2009) made similar observation in a morphometric and meristic analyses of chub mackerel, *Scomber japonicas* throughout the Black, Marmara, Aegean and northeastern Mediterranean Seas.

Meristic Analysis

Two components explained 59.27% of the variability (PC-I= 30.82%, PC-II= 28.45%) (Table 3). The dendrogram for meristic characters (Figure 2) showed three populations (Epe, Igbokoda and Badagry) clustered together reflecting low variability in meristic characters compared to morphometric characters. This is in agreement with the result of Samaradivakara *et al*, (2012) that showed the existence of low variability in meristic characters compared to morphometric characters in tilapia populations from Sri Lanka. Murta, 2000 made similar observation in studies on meristic characters of horse mackerel, Munasinghe and Thushari, 2010 also reported that in shrimp, meristic traits were less informative, when compared with the morphometric ones. Because of the observed morphological (morphometric and meristic) variation that exist in this study, the four populations may be considered as two distinct stocks. The PCA loadings (Table 4) showed that dorsal fin (DFC), caudal fin (CFC) and pectorial fin rays were found to be important discriminating characters that differentiate *T. guineensis* populations in the study. This is consistent with the report of Yakubu and Okunsebor (2011) that identified three discriminating variables that differentiate two fish species (*Oreochromis niloticus and Lates niloticus*).

CONCLUSION

From the current study, it could be deduced that morphometric characters differentiate the *T. guineensis* populations from south-west, Nigeria more than the meristic attributes. This indicates that the observed variation among the populations probably reflects environmental factors rather than genetic. Also, the studied populations could be considered as two distinct morphological stocks.

Table 1: Principal Component Analysis of Morphometric Variables

PC#	Eigen value	Variance (%)	Cumulative (%)	Std Deviation
1	7.359	56.61	56.61	2.71
2	1.126	8.66	65.28	1.06
3	1.059	8.14	73.42	1.03
4	0.970	7.46	80.88	0.99
5	0.789	6.07	86.96	0.89
6	0.421	3.24	90.20	0.65
7	0.392	3.02	93.21	0.63
8	0.306	2.36	95.57	0.55
9	0.195	1.50	97.07	0.44
10	0.133	1.02	98.09	0.36
11	0.101	0.78	98.87	0.32
12	0.089	0.68	99.55	0.29
13	0.059	0.45	100.00	0.24

Table 2. Principal Component Analysis of Meristic Variables

PC#	Eigen values	Variance (%)	Cumulative (%)	Std. Deviation
1	1.541	30.82	30.82	1.24
2	1.423	28.45	59.27	1.19
3	1.052	21.04	80.31	1.03
4	0.564	11.28	91.51	0.75
5	0.421	8.41	100.00	0.64

Table 3. Principal component loadings for morphometric and meristic characters of *T. guineensis* populations

Morphological characters	PCA Loading
TL	0.05826
PDL	0.03959
PAL	0.0543
PPL	0.01477
PPEL	0.03519
DFL	0.06655
CFL	0.03743
AFL	0.00252
HL	0.04453
IOW	0.00404
ED	0.02806
DFC	0.6755
AFC	0.2774
PFC	0.4005
PVFC	0.2681
CFC	0.4652

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OPERATIONAL REQUIREMENTS, MODE AND INVESTMENT PATTERN IN TRAWLING VESSELS IN NIGERIA

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ABSTRACT
This study examined operational requirements, mode and investment pattern in trawling vessels. Random sampling techniques were used to select 60 trawling vessels classified according to ownership- Nigerian- Owned Companies, Foreign-owned companies registered in Nigeria, Vessels Chartered by Nigerian Owned companies, Vessels chartered by Foreign-owned companies registered in Nigeria. Data were collected with aid of a questionnaire and personal interview with the captains of vessels. The study revealed that for vessels to operate in Nigeria, they should be licensed by Federal Department of Fisheries (FDF), registered by Nigerian Maritime Administration and Safety Agency (NIMASA), call for inspection by FDF at expected time of arrival, landing of all catches in Nigerian ports, maintenance of catch data and membership of Nigerian Trawler Owners Association(NITOA). Vessels operate as Nigerian flagged registered vessels fishing in Nigeria's waters, Nigerian flagged registered vessels fishing in foreign waters, Foreign flagged registered vessels chartered by Nigerians fishing in Nigeria's waters and Foreign flagged registered vessels chartered by Nigerians fishing in foreign waters but all landings in Nigerian ports. The study further revealed that ownership and investment in trawl fisheries is dominated by the private sector with government only playing a regulatory role. To prevent the maritime sector from being dominated by foreigners. This study recommended the urgent implementation of the Cabotage Vessel Fund whereby Nigerians can access loans to buy their own distant water vessels at a single digit interest rate, amongst other things..
Keywords: Trawling, Fishing , Shrimping, Vessels, Maritime

INTRODUCTION
Trawling vessels are specialized ships designed for fish capture. Before the advent of trawlers, the exploitation of marine fish stocks was carried out by artisanal fishermen in their dug-out canoes. This method of fishing was characterized by drudgery, low volumes of catch per man, sea accidents and limitation of fishing distance. Trawling therefore emerged as a technologically efficient method in the exploitation of the marine fishery resource relative to artisanal fisheries. The emergence of trawling has helped in no small way in increasing domestic fish production in Nigeria. Today, fish supplies in Nigeria comes from both the artisanal sub-sector comprising coastal and brackish water, inland rivers and lakes and fish farms (aquaculture), industrial trawlers as well as imports (NBS,2005).
According to (NBS,2005), Nigeria is still unable to produce at least 60% of her annual fish demand presently estimated at 2.66 million metric tonnes. The country is at present producing about only one third of the quantity of fish she requires to feed her citizens. The shortfall in domestic fish production is augmented through importation. Massive importation of fish puts Nigeria in an unfavourable balance of trade position. It is believed that massive investment in trawling can go a long way in boosting fish supplies thereby reducing reliance on fish imports. This study examines ownership/investment pattern in trawling vessels and the implication for domestic fish production. A study of this nature is expected to provide a lee way for facilitating meaningful investment decisions which could stimulate increased investment in the marine capture fishery sub-sector and hence make possible the realization of the objectives of national fisheries policy.

METHODOLOGY
The study area is located within Nigeria's territorial (marine) waters and the Exclusive Economic Zone (EEZ) - the operational base of trawling vessels. Nigeria has territorial marine waters of thirty (30) nautical miles which come into operation in 1967. The EEZ extends from the extreme limits of the territorial waters of Nigeria up to a distance of 200 nautical miles from the baseline from which the breadth of the territorial waters of Nigeria is measured. Nigeria has a coastline of about 853 kilometres bordering the Gulf of Guinea in the Atlantic Ocean. It also has territorial (fresh) waters in Lake Chad. Most of the vessels have their operational base at Apapa Port where they do berth and land their catches.
A multi-stage sampling procedure was used in selecting the sample for the study. First, the list of licensed vessels operating in Nigeria was obtained from the Federal Department of Fisheries (FDF) from which 60 vessels were randomly selected. The second stage involved the use of stratified sampling where the vessels were classified according to ownership viz Nigerian- Owned Companies, Foreign-owned companies registered in Nigeria,

Vessels Chartered by Nigerian Owned companies, Vessels chartered by Foreign-owned companies registered in Nigeria. The third stage involved the random selection of 15 vessels from each of the ownership categories. A total of 60 copies of questionnaire was administered to captains of the trawling vessels using the above criteria. Relevant information for this study was gathered through a combination of personal informal interviews, discussions and interview with a questionnaire. Secondary data for the study was obtained from Federal Department of Fisheries (FDF), Nigerian Trawler Owners Association (NITOA) and Nigerian Maritime Administration and Safety Agency (NIMASA).

RESULTS AND DISCUSSIONS

Table 1 shows the operational requirements for vessels in Nigeria . Vessels are expected to be licensed by the Federal Department of Fisheries (FDF). Before this is done, prospective owners of fishing vessels are expected to first check with FDF and get a written assurance that the vessel will be given a fishing license before arrangements for the purchase of the vessel is concluded.

For vessels to operate for fishing in Nigeria's territorial waters, it should not be longer than 25.3 meters length overall (LOA) and of gross registered tonnage (GRT) not more than 150. And if it is to operate for shrimping, it should ideally not be above 76 ft LOA with a GRT not exceeding 100.However, vessels of greater GRT are permitted to fish in the Exclusive Economic Zone. All the vessels surveyed (60) were observed to possess an operational license. This implies that there is a strong inspectorate unit in place that ensures vessels do not operate illegally. A vessel may be granted license to fish in Nigerian territorial waters and the EEZ or it may be granted license as a distant water fishing vessel. Out of the 60 vessels surveyed only 40 registered with (NIMASA). This shows that the enforcement of the Cabotage Act which specifies registration for all classes of vessels including trawlers is weak. While most of the foreign owned vessels are registered, a proportion of unregistered vessels with NIMASA were mainly Nigerian owned.

All vessels surveyed call for inspection on their expected time of arrival (ETA). Areas of inspection includes fishing gear to ensure compliance with laid down regulations on mesh size, undersized fish, tonnage caught, installation of by-catch reduction devices (BRD), turtle exclusion devices, facilities for processing and storage of fish etc. with this type of arrangement. It is possible for vessels to delay calling for inspection until things that would make them FAIL inspection is removed. All the vessels belonged to the Nigerian Trawler Owners Association (NITOA) where their common interest and goal is being pursued. This association parleys with government in the formulation of policies affecting the industrial fishery sub-sector. They also collaborate with relevant stakeholders in the industry to ensure a conducive environment for their activities. Even though membership of NITOA is not compulsory, virtually all the vessels were members.

Table 1 further revealed that there was full compliance by all the vessels in landing of all catches in Nigerian ports. This implies that none of the vessels surveyed exported nor shipped away their catches from Nigeria at sea. This provision is difficult to monitor nor enforce by the inspectorate unit of the FDF as vessels land their catches in different jetties in Lagos instead of a central dedicated fishery harbor. Similarly, all the vessels surveyed maintained accurate record of catch data on all fishing activities which is usually required by FDF for planning purposes.

Table 2 shows that Nigerian flagged registered vessels fishing in foreign waters where Nigeria has bilateral agreement but landing all its catches in Nigerian ports constitute the highest with 33.3 percent. This followed by Nigerian flagged registered vessels fishing in Nigerian waters and foreign flagged registered vessels chartered by Nigerians fishing in foreign waters but landing all catches in Nigerian ports which constitute 25 percent. According to the sea fisheries Act 1971, for a vessel to be Nigerian flag registered, it must have a clean bill of sales to a Nigerian corporate body registered to the prevailing rules and regulations of Nigeria and must be registered with the Federal Ministry of Transport. Similarly, any vessel fishing in the high seas, or any vessel on charter carrying frozen fish by straight importation into the country is considered as a distant water fishing vessel. Such vessels can be licensed without being Nigerian flagged registered (FDF, 1982). The least (16.7) percent are foreign flagged registered vessels chartered by Nigerians fishing in Nigeria's waters (the Exclusive Economy Zone). FDF classifies all fish landings by distant water fishing vessels as imports (those fishing in foreign waters). These vessels were observed to occasionally involve in direct importation of frozen fish into the country. Fish landing by vessels fishing inshore and in the Exclusive Economic Zone is considered as domestic production.

Presently, total fish demand in Nigeria is 2.66 million metric tonnes while domestic production is only 0.62 metric tonnes. This leaves a wide supply gap of about 2.04 million metric tonnes to be filled by imports. In 2007, total fish amounted to 0.74 million metric tonnes. The huge import bill relative to exports account for a wide balance

of payment deficit. The decline in domestic fish production in the industrial fishing sub-sector according to FDF (2008) can be attributed to the following factors.
(i) Illegal exploitation of the marine fisheries resources particularly by foreign vessels. (ii)Piracy at sea and incessant harassment of fishing trawlers by militants thereby warranting vessel owners to withdraw their vessels. (iii)Monitoring, control and surveillance mechanism not fully developed. (iv)Poor management and non-effective utilization of most of Nigeria's numerous water bodies.
The Table 3 shows ownership and investment pattern of trawler vessels operating in Nigeria. Among the vessels surveyed there was no government owned vessel whether Nigerian or foreign .Rather all the category of vessels surveyed was privately owned. This result shows that globally trawling business is dominated by the private sector in view of their immense capacity for efficient management of resources. Most vessels owned by the Nigerian government in the past were grounded on account of poor management. That all the foreign owned and chartered vessels are owned by the private sector reveals that globally, the private sector is playing a leading role in investment in industrial marine capture fisheries. Government's role is to provide an enabling environment for businesses to thrive. Chartered vessels are vessels that are placed on charter arrangement for companies who do not own distant water vessels. Investment in trawling vessels is capital intensive. Funds are needed not only to cover the cost of the vessels, gear and equipment but also for the developing of the essential supporting shore based infrastructures such as cold rooms, ice plants, landing jetty and marine workshop (Essien, 1982). This may be responsible for the limited number of Nigerian investors. The Cabotage Act came into effect in 2005 and is an attempt by government to encourage increased participation of Nigerians in marine business. This is meant to discourage the maritime sub-sector from being dominated by foreigners as is presently the case. According to Amire (2009), investment profile in industrial fisheries sub-sector which is private sector driven is in the neighbourhood of N30 billion and directly employs over 5000 Nigerians. However, it should be appreciated that entry into open access fishery in Nigeria is limited not by resource scarcity but more by the dearth of investment funds (FDF 1989). This fact may have been responsible for establishing the Cabotage Vessel Fund to provide investment fund to Nigerian entrepreneurs to be able to acquire vessels at a single digit interest rate. The Cabotage Act specifies that where a Nigerian goes into partnership with a foreigner, Nigerians should own not less than 60 percent equity share. Similarly, all crew members of vessels operating in Nigeria should be Nigerians except for the position where no Nigerian is available or qualified for the position. To further ease the burden of investors, there are some government established fishing terminals and other shore-based facilities for the fishery industry.

CONCLUSION AND RECOMMENDATIONS

In an attempt to diversify the Nigerian economy in the light of dwindling oil revenue, investment in trawling vessels could be a viable option in view of its capability to contribute to food security, employment and income generation, foreign exchange as well as raw materials for livestock and feed industry This study recommends the urgent implementation of the Cabotage Vessel Fund whereby Nigerians can access loans to buy their own distant water vessels at a single digit interest rate. This will prevent the maritime sector from being dominated by foreigners. This can also serve to replace old vessels with frequent breakdowns and attendant high repair and maintenance cost.

The incidence of piracy constitutes a serious bottleneck to investors in industrial fishery sub-sector and could be responsible for dwindling investment in the sector. The Navy, Air Force and Marine Police should be fully equipped to combat this anomaly. There is need to provide more platforms for security agencies. The Navy should establish Forward Operational Bases along the Nigerian coastline to monitor the activities of fishing and shrimping vessels.

Vessels only call for inspection on their expected time of arrival date. Presently most fishing and shrimping vessels operate out of private jetties at different locations in Lagos. This makes co-ordination of fishing activities difficult. This calls for the establishment of a modern centralized fishery terminal at Lagos. Moreover, the operation of private jetties have serious security implications such as importation of illegal drugs, arms and ammunition as well as smuggling of contraband goods.

Table 1: Operational Requirements for Trawling Vessels in Nigeria

S/NO	Operational Requirement	Frequency	Percentage
1	Vessel licensing by FDF	60	100
2	Vessel Registration by NIMASA	40	66.7
3	Call for Inspection by FDF at expected Time of Arrival (ETA)	60	100
4	Membership of NITOA	60	100
5	Landing all catches in Nigerian Ports	60	100
6	Maintenance of Catch Data	60	100

Source: Survey Data 2015

Table 2: Operational Mode of Vessels Operating In Nigeria

Operational Mode	**Frequency**	**Percentage**
Nigerian flagged registered vessels fishing in Nigerian waters	**15**	**25**
Nigerian flagged registered vessels fishing in foreign waters but all landings in Nigerian ports.	**20**	**33.3**
Foreign flagged registered vessels chartered by Nigerian fishing in Nigerian waters (EEZ).	**10**	**16.7**
Foreign flagged registered vessels chartered by Nigerians fishing in foreign waters but all landings in Nigerian ports.	**15**	**25**
Total	**60**	**100**

Survey Data, 2015

Table 3: Ownership Pattern/Investment in Trawling Vessels

Category of Vessel	**Number of Government Owned Vessels**	**Number of Private Sector Owned Vessels**
Nigerian- Owned Companies	-	15
Foreign-owned companies registered in Nigeria	-	15
Vessels Chartered by Nigerian Owned companies	-	15
Vessels chartered by Foreign-owned companies registered in Nigeria	-	15
Total	**0**	**60**

Source: Survey Data, 2015

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TANKS FISH CULTURE AND INFORMATION SOURCES AMONG FISH FARMERS IN OBIO/AKPOR LOCAL GOVERNMENT, RIVERS STATE, NIGERIA

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ABSTRACT
This study investigated tanks fish culture methods and information sources among fish farmers in Obio/Akpor Local Government Area of Rivers State, Nigeria. Data for the study was obtained through the administration of questionnaire and scheduled interview to 120 sampled fish farmers randomly selected from the study area. Data obtained were analyzed through the use of descriptive statistics which are percentages and means. The results showed that 39.2% of the fish farmers were aware of pen, earthen pond and tanks as fish culture methods. Fish farmers were very conversant with the black plastic fish tank (95%) with a mean score of 2.92 which was above the pooled mean score of 2.0. Majority of the fish farmers (62.5%) got to known about fish tanks from other fish farmers. It is therefore recommended that fish farmers should not depend on themselves alone for information about a newly developed technology but should try and pay attention to the media such as radio or television, posters and bill boards to get information.
Key words: Earthen pond, fish culture, fish farmer, information, tank

INTRODUCTION

The rapid increase in world population has resulted in a huge increase in the need for animal protein and other nutritional requirements. This is particularly crucial in developing countries like Nigeria where there is widening gap between supply and demand of fish leading to the large scale fish importation (Ogunremi and Oladele, 2012). Fish provides roughly 40% of the protein intake for nearly 2/3 of the world's human population (Oyetoro and Akinboye 2010). Fish production from aquaculture is seen as the only way of solving the problem of over fishing of the natural water bodies as capture from the wild kept reducing because rate of recruitment is lower than exploitation of the resource while the human population is on the increase every year. Also, the need to solve over fishing of wild fish stocks is a very strong premise for fish farming (Akinrotimi *et al*, 2011). Nigeria has a high potential of developing fish culture to meet up with its burgeoning fish demand that is costing the nation at least $400 million annually in foreign exchange (Onoja and Achike, 2011). Aquaculture is the fastest growing food-producing sector in the world, with an average growth rate of 8.9% since 1970, compared to only 1.2% for capture fisheries and 2.8% for terrestrial farmed meat production systems over the same period (Dauda *et al*, 2015). Inyang (2001) observed that the concept of fish farming is perceived as a foreign technology by the small scale resource poor farmers, most especially in Sub-Saharan Africa and it is seen as a donor driven development. For developing countries like Nigeria where in emphasis is on oil, fish farming can generate significant employment, enhance the socio-economic status of the farmer as well generate foreign exchange (Oluwasola and Ajayi, 2013).

In agriculture, the role of information in enhancing agricultural development cannot be over emphasized. Information is vital for increasing production and improving marketing and distribution strategies (Oladele, 2006). Information also opens windows of sharing experiences, best practices, sources of financial aids and new markets (Ugboma, 2010). Information is an indispensable factor in the practice of farming and it is the basis of extension service delivery. It is defined as data that have been put into a meaningful and useful context which is communicated to recipient who uses it to make decision (Adereti *et al*, 2006). Fish farming information can be considered as all published or unpublished knowledge in all aspects of culture fish production. Land for aquaculture is highly competitive among many other intending users, also access to necessary information on available culture systems is expected to improve fish production and enhance better standard of living among the fish farmers. The study therefore examined fish tank culture and information sources among fish farmers in Obio/Akpor Local Government Area of Rivers State, Nigeria. The specific objectives of the study include are: (i) identify culture systems among fish farmers

(ii) investigate various tanks fish farmers are conversant with

(iii) identify various sources of information on tank usage among fish farmers.

METHODOLOGY

The study was carried out in Obio/Akpa Local Government Area (LGA), Rivers State of Nigeria. The study area belongs to the South-South region of Nigeria or otherwise known as Niger Delta region. Obio/Akpor being one of the 23 LGA of the state has its headquarters at Rumuodumaya with a total land mass of approximately

311.7/sq.km.. The council area shares boundaries with Emohua, Ikwerre, Etche Oyigbo, Eleme, Okrika and Port-Harcourt Local Government Areas of Rivers State. It is mainly constituted by the people of Ikwerre ethnic nationality but due to its urban status and the hospitality of the people, there is influx of other nationalities to the local government area. The major occupation of the people is farming, fishing and trading. The vegetation found in this area includes Raffia palm, thick mangrove forest and light rain forest.

The sampling frame for this study was obtained from Rivers State Agricultural Development programme (RISADEP) which contained the list and addresses of 300 fish farmers registered in the study area.

Simple random sampling technique was used to select 40% (120) of the fish farmers in the study area. This number of respondents was selected because of the time frame for the research since it will be practically impossible to sample all the fish farmers in the study area in a short period of time. The simple random sampling technique was used to ensure that every fish farmer in the study area was given equal chances of being selected and to avoid bias. A structured questionnaire was used for primary data collection alongside with interview scheduled.

The data obtained in this research was analyzed using descriptive statistics such as frequency, mean and percentages.

RESULTS AND DISCUSSION

From the results presented in Table 1 and it shows that the fish culture methods prominent in the study area include the use of pen, earthen pond and tank culture, having the highest percentage of 39.2%. Earthen Pond culture method had the lowest percentage (8.3%), implying that the respondents in the study area are not so much used to earthen pond culture method. This could be because earthen pond culture sometimes is regarded as an old system of culturing fish. With the advent of new culture methods such as the concrete tanks, most fish farmers have left the use of earthen pond and adopted the new culture methods.

Three out of the four tank types identified by fish farmers had a mean score above 2.0 (Table 2), wooden tank (x=2.28), black plastic tank (x=2.92) and white plastic tank (x=2.26) which suggested that most fish farmers were familiar with these tanks. The mean score of the fiber tank (x=1.83) did not reach the cutoff point (x=2.0). This indicates that most of the fish farmers are not familiar with the fiber tank which could be because it is expensive compare to other tanks. Black plastic tank had the highest mean score of 2.92 and 95.0% indicating that many of the fish farmers were conversant with black plastic tanks for fish culture. This could be because of the fact that black plastics absorb heat and warm the water to suit culturing condition of fish. Despite the high level of awareness of the black plastic tank among the fish farmers, 2.5% of the fish farmers do not know about it. Extension agents could therefore ensure that in all their demonstrations of a new technology, every material that needed to be used for the demonstration is provided so that fish farmers can be familiar which will eventually make adoption process easy.

The result shown in Table 3 reveals that majority of the respondent (62.5%) became aware of fish tanks through other fish farmers. In a similar study, Ufuoku *et al*, (2008) reported high information source among other farmers Only 20% of the fish farmers got information from the Extension Agents. This may imply that fish farmers might be into some form of groups' of cooperative societies where they interact and share ideas as a method of improving their production. An extension agent (20.0%) as source of information is low properly because of the low ratio of extension agents to fish farmers. It is quite evident that when the support from extension service is not adequate, the small-scale operator has to depend upon external sources for information Radio/Television has 4.2% each indicating that the farmers pay less attention to them as information sources probably because of their personal engagements or tight schedules. This may be the reason why fish farmers look out to other fish farmers for information. Internet, as one of the sources, had none of the farmers agreeing to it as a source through which they got the information about fish tank. In a similar study, Ugboma (2010) reported that internet access is not common among fish farmers. The reason could be that the farmers may not have the knowledge of internet accessibility or quite expensive for them to afford. Giving farming to a variety of information sources, which are accessible, affordable, relevant and reliable is the ultimate aim of providing agricultural information services. Harma *et al,* (2015) reported that with the advent of information technologies which has succeeded in eliminating bottle necks in information dissemination constraints to access to information is still a problem. The difficulty encountered in accessing vital fisheries information specially from printed and electronic media sources which would have created a more convenient platform for improved and increased fish yield which by extension translates into higher profit and more job opportunities should be addressed by the government at all levels and non-governmental organizations.

CONCLUSION

Fish farmers are conversant with various types of fish tanks apart from the conventional earthen pond culture systems. Also, major information source on tank as culture method is predominantly from other fish farmers. It is recommended that other information sources among fish farmers should be strengthened as it will encourage many other potential individuals and corporate organizations to invest in fish culture which will reduce the huge amount of money spent on importation of fish into the country.

Table 1: Fish culture methods identified among fish farmers

S/N	Fish Culture Methods	Frequency	Percentage (%)
1	Cage, Pen, Tank	13	10.8
2	Pen and Earthen Pond	19	15.8
3	Pen, Earthen Pond and Tank	47	39.2
4	Earthen Pond	10	8.3
5	Tank and Cage	13	10.8
6	Tank, cage and Earthen Pond	18	15.0

Source: Field Survey 2012

Table 2: Types of fish tanks that fish farmers are conversant with

S/N	Fish Vat Types	VCW	NTCW	DKAI	MEAN	Pooled Mean
1	Fish Glass Tank	22(18.3)	56(46.7)	42(35.0)	1.83**	
2	Wooden Tank	51(42.5)	52(43.3)	17(14.2)	2.28*	
3	Black Plastic Tank	114(95.0)	3(2.5)	3(2.5)	2.92*	**2.0**
4	White plastic Tank	47(39.2)	57(47.5)	16(13.3)	2.26*	

Source: Field Survey 2012

Figures in parenthesis are in percentages

VCW= Very conversant with **NTCW**= Not too conversant with **DKAI**= Do not know about it

Mean score < 2.0 = NA (** Not accepted) Mean score ≥ 2.0 = A (* Accepted)

Table 3: Major Sources of Information about Fish Vat

S/N	Information Sources Variables	Frequency	Percentage
1	Friends and family	11	9.2
2	Other fish farmers	75	62.5
3	Extension Agent	24	20.0
4	Internet	-	-
5	Newspaper/ Pamphlets	5	4.2
6	Radio/television	5	4.2

Source; Field Survey 2012

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

SUB-THEME XI:

FOOD SCIENCE & TECHNOLOGY, HOME SCIENCE, DIETETICS

ANALYSIS OF CALORIE INTAKE AMONG SMALL-SCALE FARMERS IN THE NORTHERN GUINEA SAVANNAH OF NIGERIA

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ABSTRACT
This *study analyses the pattern of calorie consumption and the factors determining the intake of calorie of small-scale farmers in the northern guinea savannah of Nigeria. Data were obtained from 244 small-scale farmers with the aid of structured questionnaire. Data were analyzed using descriptive statistics and multiple regression analysis. The results showed that the average household size of the respondents was 7.5 as the average cultivated farm size was found to be 2.05 hectares. The average total crop output was found to be 2147.61kg between the range 412.5kg to 7915.5kg. The daily calorie intake skewed towards starchy foods as the calorie proportion of meats, fish, fruits and vegetables were found to be very low, with wide variation even among farmers. The results further revealed that total crop production, household size, dependency ratio, total farm income, the age and education level of household heads significantly determine the daily per capita calorie intake. The study therefore recommends that policy interventions should include measures that get farmers increase their level of education, enlighten them about family planning and the provision of nutrition education as all factors that could lead to increasing production and productivity should also be pursued.*
Keywords: Calorie intake, small-scale farmers, northern guinea savannah.

INTRODUCTION

Eating well is essential and vital for a healthy and active life. People in virtually all countries of the world who do not eat well have basically poverty to blame as it has been noted that calorie intake have a strong linkage with both human health and productivity. The human body needs dietary calorie energy to maintain normal body metabolic function and engage in activity related to good health and hygiene. In addition, calorie intake is the main determinant of under nutrition and malnutrition among the people. It is needed for growth and assimilation of micronutrients among children. Inadequate supply of calorie lowers productivity, hinders learning and increases the risk of diseases (Aromolaran, 2004). Aromolaran (2004) further argued that the level of calorie intake (both stock and flow) by an individual should be adequate to sustain his functions and activities over his expected lifetime. When this lifetime calorie consumption pattern falls short of a minimum threshold, the individual is at a health risk. Secondly whenever there is a persistent short fall in the flow of calorie intake relative to the amount required for optimal productive activity, the inflow of other nutrient intakes is likely to be affected since the resources required to acquire these nutrients is obtained from productive work. This situation is especially true in populations where the major income earning asset is human labor efforts, that is, populations made up of poor farm households where non-earned income forms an insignificant component of full income. In such populations, increased calorie intake may imply increased productivity, increased income and thus improved overall nutrition (Strauss, 1986). Increased nutrition is associated with sustained increments in productivity and thus sustained access to food energy intake.

In Nigeria however, there is an overwhelmingly large proportion of Nigerians who are hungry. Recent estimates put the number of hungry people in the country at over 53 million, which is about 30% of the country's total population of roughly 150 million; and 52% live under the poverty line (Ajayeoba, 2010). The proportion of the hungered are spread across both rural and urban settings in Nigeria, though most are in rural areas and among the farming population who produce about 90% of the total agricultural product of the country (Government of the FRN, 2006). This fact is further corroborated by Famine Early Warning System Network, FEWS NET (2007). It is to be noted still that food consumption pattern in the country had undergone remarkable changes over the years. There has been an increase in the consumption of starchy foods like rice, maize, cassava and yams, and some decrease in the consumption of protein based food items such as fish and meats (Oloyede 2005). The daily per capita calorie supply as a proportion of requirement was 90% in 1988-1990 and 85% in the period 1992-1996 (FOS, 1996), and in the last decade, the average protein intake by Nigerians was found to be only at the threshold of adequacy as aggregate protein consumption was 61.1g per capita per day in 2002 (FAOSTAT 2004). These protein consumption figures fall short of the critical human body requirement which was put at 70g per capita per day by Food and Agriculture Organization (FAOSTAT 2004). Food consumption plays an important role in the economic growth and development of both developed and developing nations

(Abdulahi, 1999). It has a considerable impact on the circular flows of income in the economy, meaning that, it has a significant effect on the economic activities of a country.
Furthermore, as Iyangbe and Orewa (2009) put it, there are basically two types of hunger: undernourishment (i.e. a situation where an individual's food intake falls short of the minimum calorie (energy) requirement and malnourishment (when the calorie (energy) intake is sufficient but the protein and other essential nutrient intakes are inadequate). Both types of hunger are present the world over but the incidence is said to be more in developing countries. One out of five persons in the developing countries is unable to meet his or her basic daily needs of life (Lupien and Menza, 2004).
Developing policies and interventions to reduce hunger and malnutrition, and increase food security requires an understanding of factors that determine calorie intake, their inter-relationships and their relevance to particular groups of people (FAO, 2004) and in this case the majority poor small-scale farmers. It therefore becomes very imperative to determine quantitatively, the current level of calorie intake and pattern of calorie consumption in diet of farmers in Nigeria, vis-à-vis the increasing incidence of under nutrition, malnutrition and food insecurity. The matter must be accorded the necessary priority as Bliss and Stern (1978) have observed that small increases in food consumption can bring about substantial improvement in productivity and consequently, improved standard of living. This study is regarded relevant for targeting assistance and for the formulation of policies and measures to cushion the effects of hunger and under nutrition among the Nigerian faming populace.

MATERIALS AND METHODS

This study was conducted in Nigeria's Kaduna state, situated between latitude 11^0 32' and $09^0$2' North of the equator and $80^0$50' and $06^0$15' East of the meridian. Kaduna state is located at the centre of Northern Nigeria and lies within the Northern Guinea Savanna region with tropical climate. It has a political significance as the former administrative headquarters of the North during the colonial era. The state has 23 local government councils. Agriculture is the main stay of the economy of the many tribes of the northern people with over 80% of the people actively engaged in farming. Food crops that are cultivated and produced include: Maize, Groundnut, Cowpea, Guinea Corn, Millet, Rice and Cassava, while cash crops include Gum Arabic, Cotton and Ginger. The people also rear animals like cattle, goats and sheep.
Multi-stage sampling techniques were used for this study. The first stage involved the random sample of four Local Government Areas in the state namely Giwa, Ikara, Zango Kataf and Kachia and equally two randomly sampled communities within the LGAs making a total of eight (8) communities. A 10% sample sizes of the farm households in these villages were then randomly sampled for questionnaires administration, making a total of 244 respondents.
Descriptive statistic was used for this study to describe the socio-economic characteristics of the respondents and the calorie consumption pattern as the tools involved the use of measures of central tendency such as mean, mode, percentages, use of bar and pie charts, while a multiple regression analysis was used to obtain the determinants of per capita daily calorie intake. The Regression model is specified below:

$$\gamma_i = \acute{\alpha}_o + \Psi_1 x_1 + \Psi_2 x_2 + \Psi_3 x_3 + \Psi_4 x_4 + \Psi_5 x_5 + \Psi_6 x_6 + \Psi_7 x_7 + \Psi_8 x_8 + \Psi_9 x_9 + \tilde{u}$$

Where,

γ_i = *Per capita calorie intake*
X_1 =*Age of household head in years*
X_2 = *Education level of household head*
X_3 = *Adjusted household size*
X_4 = *Total cultivated land size in hectares*
X_5 = *Total farm income in naira*
X_6 = *Non-farm income in naira*
X_7 = *Consumer credit in naira*
X_8 = *Total crop production in grain equivalence*
X_9 = *Dependency ratio*
$\acute{\alpha}_o$ = *Constant term*
$\Psi_1 - \Psi_9$ = *Coefficients for the respective variables in the regression model*
$\tilde{u}$ = *Error term*

RESULTS AND DISCUSSION

The mean age of the respondents as presented in Table 1 is 39.1 years showing a virile and agile average farmers' age with the consequent capability of doing a lot of farm work if given proper incentives. Also, about 88% of the respondents are male as the average household size was observed to be 7.5 within the range 1- 27. The household size means the number of people in the house, which includes wives, children and dependents who reside within the family and eat from the "same pot". Education in agricultural production will enhance farmer's ability to make informed and accurate decisions on the management of the farm. This also could be a source of additional income. The level of literacy among farmers in the study area as measured by ability to read or write in Arabic or Hausa languages was high. It was found that only 10.25% of farmers have no formal education. About 24% have Quranic (Arabic) education while 7.38% have adult education. About 24.18, 27.87% and 6.56% have primary, secondary and post-secondary education level respectively. The average farm size was found to be 2.05 hectares while the average total crop production in grain equivalent was found to be 2,147.61kg between the range 412.50kg to7,915.50kg. It is expected that with increasing or high total crop production, farmers will have more access to food, with the consequent positive influence on daily calorie intake of members of the households.

Daily calorie consumption patterns among sampled farm households

Following the identification and aggregation procedure, the daily per capita consumption pattern results was computed. The result is as presented in Table 2. Calories from cereals products form the bulk of the food consumed by the households. The average daily calorie value for cereals was found to be 1386.7kcal per capita, followed by legumes at 460.59kcal per head per day. Root and tubers food products were found to have 248.74kcal while fat and oil products closely followed with 424.11kcal. These groups of food products comprise the bulk of calorie intake of the farm households and except for the leguminous food products, the bulk of the calorie intake as shown from the result are starchy foods. It is to be noted further that the coefficient of variation of leguminous food consumed is high, close to 1, at 0.845 but those of cereals and fat and oil were observed to be low (0.445 and 0.404 respectively). This suggests that there is a high variation in the consumption of legumes among the sampled population. The result further shows that daily calorie intake per capita from proteinous food products were very low and the coefficient of variation, which essentially provides a measure of variation that is corrected for the size of mean, were found to be high, suggesting the inappropriateness of the average to represent the population. Average daily calorie intake from meat products was found to be 178.18kcal (1.019 coefficient of variation), fish products had 49.21kcal (0.898) while other animal protein sources like eggs and milk products was observed to be 43.72kcal (1.655) per capita per day.

Fruits and vegetables proportions of the average daily calorie intake were equally observed to be low at 0.96kcal and 33.51kcal respectively. More worrisome is however, the observation that, even at this low daily per capita proportion level, the measure of variation in consumption within the population were observed to be very high. The coefficient of variation for fruits calorie intake was found to be 1.896 while that of vegetable products daily intake, 1.670. The quantity and quality of calorie intake is important as it has been noted that a short fall in quality lead to malnutrition.

Determinants of daily per capita calorie intake

Cobb-Douglas regression form was found as best fit for the multiple regression that was run. It has multiple R of 79%, R Square was found to be 63%, adjusted R Square 61%, standard error is 0.21, and the F value obtained is 44.01, found to be significance at 1% level. The signs on the coefficients of independent variables also fit *a priori* expectations except for the total farm income coefficient which carries a negative sign. Owing to the fact that the average farm size was found to be 2.05 hectares (low) and a high average household size of 7.5, increasing sale of farm produce to earn income for some other household responsibility could actually decrease the stock left for household consumption. The result is however presented in Table 3. It was found that adjusted household size, total farm income, total crop production in grain equivalent and dependency ratio were found to be significant at 1% level.

The education level of the household head, whose responsibility is to feed his household, was also found to be significant at 5% level, while the age of the household head measured in years was also found to be significant, though at 10% level. The significant result of age of the household head and dependency ratio is similar to a study on the determinants of daily calorie intake among rural and urban low-income households in Edo state, south-west, Nigeria by Orewa and Iyangbe (2009), and Babatunde *et al.*, (2013) similarly observed that the age of household head, his level of education, the household size and crop output were the determinants of calorie intake among farming households in rural Nigeria.

CONCLUSION AND RECOMMENDATIONS

It is indicative from this study that though the average per capita daily calorie intake in the study area was found to be about 2840.46 kilocalories, it only suggests that the area is at the verge of adequacy to the recommended level of 2500 kilocalories per capita per day as a wide variation in consumption from the population was observed. It was further observed that daily calorie intake proportion skews towards starchy food with low intake proportion of proteinous food, fruits and vegetables whose nutritive values included essential amino acids, vitamins and minerals for healthy and productive living. So by disaggregating calorie intake by pattern and proportions, the calorie consumption of the farmers was observed to tend towards malnutrition. It was further observed that total crop production, household size, dependency ratio, and the education level of the household head were found to be the determinants of daily per calorie intake per capita. We therefore suggest that policy interventions should include measures that get farmers increase their level of education, enlighten them about family planning and the provision of nutrition education among rural small scale farmers should be accorded the necessary priority. By the positive influence of total crop output (production), all factors that could lead to increasing production and productivity should also be pursued.

Table 1: Socio-economic characteristics of sampled household heads

Variables	Frequency	Percentage
Age		
≤ 20	4	1.6
21-30	49	20.08
31-40	102	41.80
41-50	44	18.03
51-60	38	15.57
>60	7	2.87
Range 18-68, Mean 39.1,		
Gender		
Male	214	87.70
Female	30	12.30
Household size		
≤ 5	77	31.56
6-10	115	47.13
11-15	44	18.03
>16	7	2.87
Range 1-27, Mean 7.5,		
Education Level		
No Formal Education	25	10.25
Arabic Education	58	23.77
Adult Education	18	7.38
Primary Education	59	24.18
Secondary Education	68	27.87
Post-Secondary Education	16	6.56
Cultivated Land Size		
≤ 1	66	26.94
2-3	145	59.18
4-5	27	11.02
>5	5	2.04
Range 0.5-6.5 Mean 2.05		
Total Crop Production in grain equivalent (kg)		
≤ 1000	45	18.44
1001-2000	99	40.57
2001-3000	57	23.36
3001-4000	19	7.79
4001-5000	8	3.28
5001-6000	10	4.10
>6000	6	2.46

Range 412.50-7,915.50, Mean 2,147.61

Table 2: Daily calorie consumption patterns per capita among sampled households

Food Items in Kcal	Mean	St. Deviation	Coef. of Variation	Range
Root and Tubers	248.74	203.21	0.817	0-2082.19
Cereals	1386.7	617.25	0.445	547.24-4617.22
Legumes	460.59	389.34	0.845	0-2817-67
Vegetables	33.51	55.96	1.670	4.63-555.43
Fruits	0.96	1.82	1.896	0-9.30
Fat and Oil	424.11	171.26	0.404	0-1279.00
Meat	178.18	181.49	1.019	0-1325.75
Egg and Milk	43.72	72.36	1.655	0-598.36
Fish	49.21	44.2	0.898	0-266.87
Beverages	13.43	34.36	2.559	0-191.89
Condiments	1.33	0.66	0.496	0.10-5.07
Total Calorie per capita	2840.46	1168.89	0.412	1379.06-944.03

Table 3: Estimated calorie intake functions for sampled households

Variables	*Coefficients*	*Stand. Error*	*t-Stat*	*P-value*
Constant $ά_o$	7.821980	0.453154	17.26121*	0.000
Age of household head in years (X_1)	0.155547	0.082269	1.8907***	0.060
Education level of household head (X_2)	0.059390	0.024353	2.438776**	0.016
Adjusted household size (X_3)	-0.604330	0.042517	-14.2138*	0.000
Total cultivated land size in hectares(X_4)	0.050640	0.052545	0.963736	0.336
Total farm income in naira (X_5)	-0.238160	0.050732	-4.6945*	0.000
Non-farm income in naira (X_6)	0.001488	0.002728	0.545476	0.586
Consumer credit in naira (X_7)	-0.005780	0.005980	-0.96602	0.335
Total crop production in grain equiv. (X_8)	0.460764	0.062202	7.407558*	0.000
Dependency ratio (X_9)	-0.061542	0.021382	-2.878195*	0.004

Multiple R = 0.79, R Square = 0.63, Adjusted R Square = 0.61, Standard Error = 0.21, F value = 44.01, F Significance = 0.000. Note *, **, *** are significance at 1%, 5% and 10% respectively

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PRODUCTION OF GLUCOSE SYRUP FROM SELECTED YAM LANDRACES USING ENZYME PRODUCED BY MICROORGANISM

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ABSTRACT
Glucose syrup production from selected yam landraces (Okpani, Hemba, Ogoja, Dorban and Ameh) stored for three months in the barn of National Root Crops Research Institute, Umudike, was investigated. The proximate and mineral compositions of the samples were also determined. The proximate composition showed that Ogoja had the highest moisture content (48.78[a]) significantly different (P=0.05) from that of the other samples, with Hemba having the least moisture content (47.41[e]). Crude protein was moderately high in all the samples studied with Ameh (3.81[a]) having the highest value. Ash, crude fiber and crude fat were not so high in all samples with Hemba (1.37[a]), Ameh (1.74[a]) and Okpani (1.03[a]) having the highest contents of ash, crude fiber and crude fat respectively. The carbohydrate contents of all selected landraces were high with Hemba (45.13[a]) having the highest value and significantly different at (P=0.05), from the other samples. The mineral composition of the selected yam landraces investigated showed that all samples were very rich in the macro- and micro- elements evaluated which include potassium, phosphorus, magnesium, calcium, iron, zinc and sodium. Okpani was found to have the highest contents of almost all the elements under investigation. Heavy metals such as copper, cadmium and lead were present in minute quantities in all the samples, and no lead was detected in Ameh. The rate of glucose syrup production from the starches of the selected yam landraces was highest in Okpani (60%) at 24 hours reaction time, followed by Hemba and Ameh (55.0%) respectively, then Dorban (50.0%) and Ogoja (48.0%). Okpani, Hemba, Ameh, Dorban and Ogoja exhibited good potentials as substrates for glucose syrup production.

Keywords:Glucose syrup, amyloglucosidase, yam landraces, starch hydrolysis, proximate/mineral compositions.

INTRODUCTION
Root tubers which are widely cultivated produce abundantly in most developing countries of the tropics such as Nigeria, but due to poor storage facilities, these tubers deteriorate overtime. Despite their importance as one of the staple foods of the people, a large proportion of these tubers are lost yearly. However, these loses can be avoided if these tubers are harnessed into other various useful products such as glucose syrup, maltodextrins, maltose syrup, etc. Starch pastes of all types are susceptible to hydrolysis by amylolytic enzymes resulting in shorter polymer chain lengths and sharply reduced viscosities (Bello-Perez *et al.*, 2002). A diastatic enzyme (alpha-amylase) that rapidly hydrolyzes starch to short, water soluble fragments was used. The starch slurry was adjusted to the desired pH, α-amylase added and a programmed heat cycle set in operation, after which a saccharification enzyme was applied to produce glucose syrup (Omemu *et al.*, 2004). Glucose syrup is a concentrated aqueous solution of glucose maltose and other nutritive saccharides from edible starch (Van der Venn *et al.,* 2005). Glucose syrup is used in large quantities in fruits, liquors, bakery products, pharmaceuticals and brewery products as well as in cosmetics industries
This study is aimed at the production of glucose syrup by the enzyme hydrolysis of the starches obtained from the selected yam landraces.

MATERIALS AND METHODS
Sources of Materials
Chemical: All Chemicals used were of analytical grade.

Yam Species: Yam landraces were obtained from the yam barn of NRCRI, Umudike three months after storage

Enzymes: Alpha-amylase was procured commercially from Agar-Technical (Oxoid).
Amyloglucosidase was isolated from the liquid in which the fungus *Aspergillus niger* AM07 was grown.

Methods:

Proximate The proximate composition (moisture, ash,

Analysis crude fiber, crude protein, crude fat and carbohydrate) were determined using the standard method of AOAC, 2003

Mineral Analysis: The mineral composition of samples was determined according to the methods of AOAC, 2003.

Production of glucose syrup:

Glucose syrup production from various yam species was sub-divided into the following processes according to the method reported by Ji *et al,* 2004.

- **Liquefaction**
- **Saccharification**
- **Purification**
- **Liquefaction:** A starch slurry made with 35% dry solids, pH 6.0 – 6.4 had Calcium added to it in form of Calcium hydroxide to stabilize the enzyme. Alpha amylase was mixed with the slurry and the mixture heated to 100°C for 10 minutes, then cooled to 90°C for 2 hours to further hydrolyze the starch to form dextrin molecules.
- **Saccharification:** After liquefaction, the pH was reduced to 4.0-4.5 and solution cooled to 60°C. Glucoamylase enzymes were added and the mixture was incubated for 24-48 hours based on the concentrations of enzymes used. Glucoamylase released glucose syrup from the dextrin molecules. The formation of glucose was monitored using the glucose oxidase method at different times.
- **Purification:** The resulting glucose syrup was purified by ion exchange chromatography and then concentrated by evaporation under reduced pressure.

Statistical analysis:

The results are expressed as mean ± standard deviation. A one-way analysis of variance (ANOVA) was used to analyze data. A *P- value* of 0.05 was considered as statistically significant. Where a significant difference was observed, data were further analyzed using Turkey's significant different test.

RESULTS AND DISCUSSION

The result of the proximate composition of flour samples of the selected yam landraces are depicted in Table 1. Ogoja (48.78^a) had the highest moisture content, then Dorban (48.68^b). Generally, the moisture content of all the samples was high indicating that the samples are prone to microbial attack in the course of storage. The slightly high ash content exhibited by the samples with Hemba (1.36^a) having the highest value, is an indication that the samples could be rich sources of mineral having nutritional importance. Crude Protein was moderately high in all samples with Ameh (3.81^a) having the highest value. Proteins are polymers of amino acids and are required for the building and repair of damaged tissues (Mac William, 2005). The high fiber content in all samples studies with Ameh (1.74^a) having the highest value showed that the selected yam landraces could be useful as sources of fiber and may play a useful role in providing roughage that aids digestion (Chiarelli *et al.,* 2000). All samples had high contents of carbohydrate as well as high energy values, and thus could be used as rich sources of energy.

The results of the mineral composition of the selected yam landraces are shown in Table 2. All samples were very rich in their macro-elements content, such as potassium with Okpani (900.15^a) having the highest value, phosphorus with Okpani (269.32^a) topping the list, calcium with Okpani (91.36^a) having the highest value and magnesium with Okpani (57.39^a) having the highest value. Sodium was very high in all samples studies. Iron and Zinc were moderately, high in all samples under investigation.

These mineral elements are essential for proper functioning of cellular activities, proper formation of bones and teeth, formation and regulation of blood cells and when properly combined together regulated the blood pressure (Heaney, 2000). However, the samples studied had little or no quantities of the heavy metals (Copper, Cadmium and Lead) and thus regarded as safe for consumption.

The result of the hydrolysis of the gelatinized yam starches with amyloglucosidase from *Aspergillus niger* are presented in Figure I. For the selected yam landraces investigated, the optimum starch hydrolysis (glucose syrup production) was obtained at 24 hours of the reaction time. The glucose concentration increased significantly (P=0.05) at the 24 hours reaction time compared to the values obtained at 4-12 hours of the reaction time. The result also showed that after the maximum production at 24 hours of the reaction time, no significant difference in glucose syrup production was observed at the 36-48 hours of the reaction time. This finding is in contrast to that reported by Zainab *et al,* (2011), that after the optimum production of glucose syrup using starches from selected cereals, the production of glucose syrup dropped or decreased with increase in reaction time.

CONCLUSION

Okpani, which is yellow in colour and highly affected by browning reaction and often not the choice variety for consumption was found in this investigation to be good in nutritional composition as well as in the production of glucose syrup, thus may be recommended for glucose syrup production to avoid waste.

The hydrolysis of the gelatinized starch from the selected yam landraces with amyloglucosidase isolated from *Aspergillus niger* showed an optimal glucose concentration within 24 hours of the reaction time in all samples, and there was no significant increase in the glucose syrup produced with increase in reaction time. It suggested that starch hydrolysis by the enzymes used may be limited to a time range of 4-24 hours

Furthermore, the technologies used for glucose syrup production using the starches from the selected yam landraces and enzymes produced by the microorganism *Aspergillus niger* was successful and can be up-scaled for industrial purposes.

Table 1: **Proximate composition of selected yam landrace (% dry weight)**

	Proximate composition (%)						
Yam species	**Crude fat**	**Crude protein**	**Crude fibre**	**Ash**	**Moisture**	**Carbo-hydrate**	**Energy values (kcal/100g)**
Okpani	1.03^a	3.64^b	1.50^c	1.34^b	47.48^d	44.69^b	202.54^b
Hemba	0.90^b	3.76^a	1.47^d	1.37^a	47.41^e	45.13^a	203.62^a
Ogoja	0.90^b	3.52^c	1.46^d	1.34^b	48.78^a	43.99^e	198.15^e
Dorban	0.90^b	3.01^d	1.55^b	1.29^b	48.68^b	44.59^c	198.46^d
Ameh	0.81^c	3.81^a	1.74^a	1.36^a	47.79^c	44.51^d	200.47^c

Values with different superscript letters are significantly different at p=0.05

Table 2: **Mineral Composition of selected yam landrace**

	Mineral composition (mg/100g)									
Yam species	**P**	**K**	**Ca**	**Mg**	**Fe**	**Zn**	**Na**	**Cu**	**Cd**	**Pb**
Okpani	269.33^a	900.14^a	91.36^a	57.38^a	0.47^a	2.10^a	73.85^a	0.14^a	0.60^a	0.023^a
Hemba	224.80^c	795.80^c	78.73^c	43.63^c	0.34^c	1.83^c	61.52^c	0.12^a	0.12^c	0.020^b
Ogoja	200.14^d	623.59^d	74.31^d	43.51^d	0.30^d	1.71^d	60.54^d	0.11^b	0.11^c	0.017^c
Dorban	239.13^b	804.31^b	80.12^b	54.14^b	0.36^b	1.89^b	70.34^b	0.13^a	0.13^b	0.020^b
Ameh	158.19^e	474.89^e	16.48^e	41.52^e	0.21^e	1.47^e	53.34^e	0.10^b	0.10^c	ND

Values with different superscript letters are significantly different at p=0.05

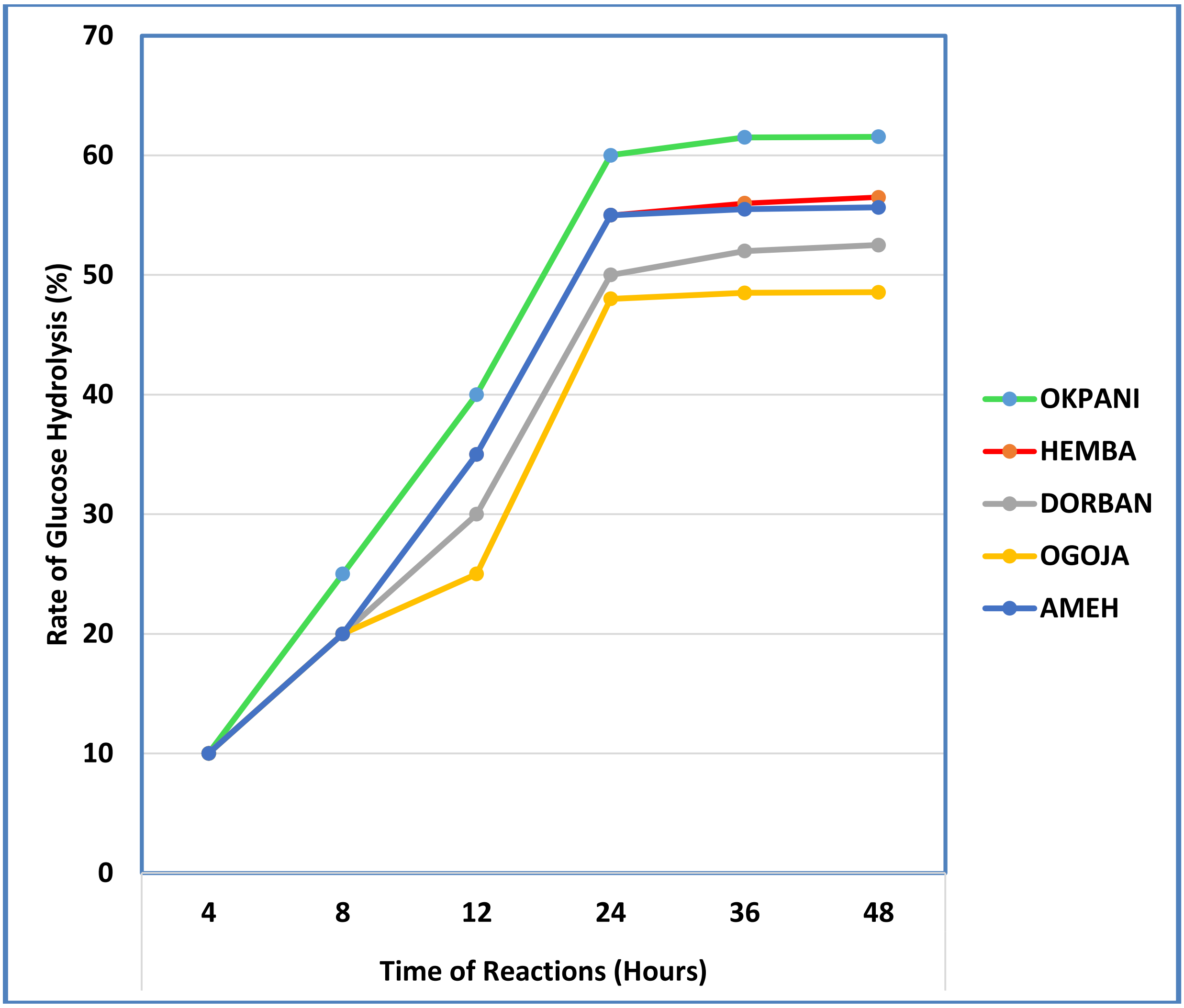

Figure 1: Glucose Syrup production from selected yam landraces

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COMPARATIVE ANALYSIS OF THE NUTRIENTS COMPOSITION OF *MOI-MOI* PREPARED FROM COWPEA PEA (*VIGINA UNIGUCULATA*) AND PIGEON PEA *(CAJANUS CAJAN*)

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ABSTRACT
The objective of this study was to compare the nutrient composition of "moi-moi" prepared from cowpea (Vigina uniguculata) and that of pigeon pea (Cajanus cajan). "Moi-moi" was prepared using a standard method. The proximate and vitamin content of the samples were determined using standard AOAC methods. Mineral elements were determined using wet-acid digestion method for multiple nutrients determination. All tests were carried out in duplicates and the data generated were analysed using standard methods. Crude protein (23.4%), crude fiber (2.5%), ash ((2.4%) and CHO (44.4%) were significantly (p<0.05) higher in cowpea "moi-moi" while crude fat (11.0%), and energy were significantly higher in pigeon pea. Pigeon pea was a better source of the B-vitamins, vitamin C and zinc. The results show that pigeon pea "moi-moi" can be used as an alternative for cowpea moi-moi.
Keywords: Cajanus cajan, Vigina uniguculata, "moi-moi", B-vitamins, Vitamin C

INTRODUCTION

Legumes are a major source of plant protein in the developing countries; they are the next invaluable food crop after cereal (Uzoechina, 2009). Apart from been a good source of plant protein, consumption of legume is associated with the control and prevention of metabolic diseases (Simpson *et al*., 1981; Oloyo, 2004). Cowpea (*Vigna unguiculata*) a member of *phaseolease* and a tribe of the *leguminosae*, is one of the most commonly consumed legume in Nigeria. The economic down turn and resultant inflation in the country is however taking a negative toll on the consumption of cowpea. It has therefore become imperative for researchers to seek for alternative measure that can be used to sustain protein intake in individuals.
Pigeon Pea *(Cajanus cajan)* belongs to the family of *leguminosae* (Ghadge *et al.*, 2008). Among the Igbos In Nigeria, it is commonly called "foi-foi" or "Agbugbu" among the Igbos (Ene-Obong, 1984). Pigeon pea (*Cajanus cajan*) is a legume with nutritional and medicinal potentials that is yet to be fully exploited (Balogun *et al*., 2011). Pigeon pea produced in Nigeria is either consumed alone or consumed with starchy staple food (Ene-Obong, 2002). The hard - to - cook nature of pigeon pea has however been identified as a limiting factor in its consumption in Nigeria. Diversifying the use of pigeon pea by developing it into steam pudding (moi-moi) may enhance its consumption (which in the long run may mitigate the problem of malnutrition in individuals). This work was therefore designed to produce and compare the nutrients composition of moi-moi produced from pigeon pea and cowpea.

MATERIALS AND METHODS

Source and cleaning of materials

Seeds of pigeon pea *(Cajanus cajan)*, cream coloured specie and Cowpea *(Vigna unguiculata)* (Ife brown) were both purchased from *Ose Okwudu* Market, *Onitsha* in Anambra State. The pigeon pea seeds were sorted and cleaned by removing unwanted materials and unhealthy seeds. The pigeon pea was soaked in hot water (70-80^{0}C) for 30 minutes while the cowpea was soaked in potable tap water for 15 minutes. Dehulling of the seeds was done manually by rubbing the soaked seeds in between the palms until every hull was be completely removed.

Preparation of *moi-moi* from pigeon pea and cowpea seeds

Moi-moi was prepared using the recommended standard method described by Enwere (1998).The dehulled beans (500g) were grinded separately using 750ml of water for each. Ingredients ; crayfish (50g), onions (15g), red pepper (15g), maggi star (5g), salt (5g) were added to the paste and mixed manually with the aid of a wooden pestle until homogeneous slurry was obtained. The paste was scooped into aluminum foils and steamed for 60 minutes under moderate heat using a cooking stove.

Chemical analyses

Proximate composition of the sample was determined using standard AOAC (2006) methods. Carbohydrate was obtained by difference, while energy was calculated using the Atwater Conversion factors in KJ and Kcal (17KJ/4Kcal, 17KJ/4Kcal, and 37KJ/9Kcal) for protein, carbohydrate and lipid respectively.

Mineral elements were determined using wet-acid digestion method for multiple nutrients determination as described by the method of AOAC. (2006). The digest was used for the determinations of calcium (Ca) and magnesium (Mg) by the ethylamine ditetra acetic acid (EDTA) Versanate Complexiometric titration method. Potassium (K) and sodium (Na) were evaluated by flame photometry method and phosphorus (P) by the Vanadomolybdate method using the spectrophotometer. The trace metals (Zn, Fe) were determined using the atomic absorption spectrophotometer 969 instrument. The vitamin A, riboflavin, niacin and thiamin of the products were determined spectrophotometrically as described by AOAC (2006), while ascorbic acid was determined as described by AOAC (2006) using titration method.

Statistical analysis

All determinations were done in duplicates. The data generated were analyzed using Statistical Software for Social Sciences (SPSS version 18.0). Means and standard deviation obtained from the chemical analysis were calculated. Studentized T- Test was used to compare the means (P =0.05).

RESULTS AND DISCUSSION

The energy and proximate composition of the products is shown on Table 1. The moisture composition of the products ranged between 23.9-25.1%. *Moi-moi* prepared from cowpea had the highest moisture value (23.9%) while that of pigeon pea had the lowest moisture value (23.9%). The higher moisture obtained in cowpea moi-moi could be attributable to the fact that cowpea may have a greater affinity for absorption/retention of moisture (Eddy *et al*., 2007). Crude protein (23.4%), crude fiber (2.5%), ash ((2.4%) and CHO (44.4%) were significantly ($p<0.05$) higher in moi-moi prepared from cowpea while crude fat (11.0%) and energy value were significantly higher in moi-moi prepared from pigeon pea.Higher values of crude protein and fiber in moi-moi prepared from cowpea confirms with the report of Hall *et al*., (2003)

The result of the mineral composition of the products on Table 2 showed that the Ca (1.6mg/100g), Na (81.2mg/100g) Mg (3.9mg/100g) P(129.6mg/100g), K(181.6mg/100g) and Fe(1.8mg/100g) compositions of cowpea moi-moi were significantly higher than those of pigeon pea. Though pigeon pea moi-moi had lower Ca, Na, Mg K, and Fe compared to cowpea moi-moi, the consumption of pigeon pea moi- moi alongside other food sources will increase intake. The zinc obtained for pigeon pea moi-moi (2.4mg/100g) was significantly ($p<0.05$) higher than that of cowpea moi-moi (1.6mg/100g). Zinc is an important micronutrient in human diet. It is needed for catalysis, stabilization of cell membranes and regulation of gene expression (Black, 2003).

The vitamin A and E obtained for cowpea moi-moi were 16.1µg/100g and 0.34mg/100g respectively while those obtained for pigeon pea moi-moi were 6.6µg/100g and 0.30mg/100g respectively. Vitamin A plays an important role in vision, growth and development of tissue and it enhances immunity (FNB. 2001), while vitamin E is known for its role as an antioxidant (FNB 2000). Vitamin B_2 (0.30mg/100g) B_3 (2.6mg/100g), and vitamin C (20.2mg/100g) composition of pigeon pea moi-moi were significantly higher than those of cowpea moi-moi. The B-vitamins in food or taken as supplements enhances carbohydrate metabolism while vitamin C helps to convert plant iron into absorbable form in-vivo.

CONCLUSION

The study shows that *moi-moi* prepared from cowpea was a richer source of protein, fiber, Magnesium Phosphorus Potassium, vitamin A, and Iron. *Moi-moi* prepared from pigeon pea is a better source of fat, energy, Zinc, vitamins B_2, B_3 and C. The study shows that moi-moi prepared from pigeon pea can serve as an alternative to cowpea.

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EFFECT OF MODIFICATION ON THE PROXIMATE AND FUNCTIONAL PROPERTIES OF TIGER NUT (*Cyperus esculentus* L.) STARCH

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ABSTRACT
The effect of modification on the proximate and functional properties of tiger nut starch was studied. The results obtained from the proximate composition shows that fat and protein were not detected in the 1.0%HCl and 1ml glucoamylase treated starch samples. The native starch sample had fat content of 0.57% with a protein content of 1.92%. The moisture content of the starch samples were within the range of 8.13 – 8.69%. Their carbohydrate values were high as expected being devoid of many other nutrients. Observations on the functional properties showed that the modified tiger nut starches exhibited higher bulk densities than the native starch sample. The bulk density values were in the range of 0.68 – 0.72g/ml while the wettability values had 3.38sec for 1ml glucoamylase treated starch sample and 3.24secs for 1.0%HCl treated sample. There were significant difference in the foaming capacity of the starch samples with the native starch sample having 2.29% higher than the modified starch samples (1.10 -1.50%). The foaming capacity of all the starch samples can be rated as low since they do not contain considerably high amounts of proteins.
Keywords: starch, modification, tiger nut

INTRODUCTION

Tiger nut (*Cyperus esculentus* L.) is an edible perennial grass-like plant native to the Old World, and is a lesser-known vegetable that produces sweet nut-like tubers known as "earth almonds" (Cos¸kuner *et al*., 2002). It is also known as yellow nut sedge, earth or ground almonds, "*souchet*" in French, "*ermandeln*" in German and "*chufa*" in Spanish (TTSL, 2005). Tigernut is found wild and cultivated in Africa, South America, Europe and Asia. Tigernuts grow in the wild, along rivers and are cultivated on a small scale by rural farmers mostly in the northern states of Nigeria. It is locally called "*aya*" in Hausa; "*aki awusa*" in Igbo; "*ofio*" in Yoruba and "*isipaccara*" in Effik. *C. esculentus* had been reported to be a "health" food, since its consumption can help prevent heart disease and thrombosis and is said to activate blood circulation (Chukwuma *et al*., 2010). The tuber is rich in energy content (starch, fat, sugar, and protein), minerals (mainly phosphorus and potassium), and vitamins E and C (Belewu and Belewu 2007).

Wurzburg (1989) gave insight into the physical properties of native starch, which limits its usefulness in many commercial applications and defined a modified starch as a product in which the chemical and (or) the physical properties of the native starch may have been altered. Food consumers are primarily influenced by the sensory properties of the food while the manufacturers are interested in the technological and functional properties of which starchy foods are linked closely to their rheological behavior. This study however tries to investigate the effect of tiger nut starch modification on their nutrient and functional properties.

MATERIALS AND METHODS

Source of material

The tiger nut used for this research work was purchased from Ubani market in Umuahia Abia State. Starch was extracted from tiger nuts by the modified method of Umerie *et al*. (1997). The acid and enzyme modification treatments of tiger nut (*Cyperus esculentus* L.) starch were performed using the method of Asinobi *et al*. (1988).

Nutrient and Functional Properties Analysis - The samples were analyzed for moisture, ash, protein and fat contents according to the method of AOAC (2000). The carbohydrate content was determined by difference.

Functional Properties - The Bulk density, viscosity, wettabiity and solubility index of the tiger nut starch samples were determined using the method described by Onwuka (2005). The swelling index determination was done by the method described by Ukpabi and Ndumele (1990). The method described by Abbey and Ibeh (1998) was used for water absorption capacity determination. The foaming capacity and stability of the starch samples were studied according to the methods described by Abbey and Ibeh (1988). The emulsion capacity was determined according to A.O.A.C (1990).

Statistical Analysis - Data obtained were subjected to statistical analysis using the statistical package for social services (SPSS).

RESULTS AND DISCUSSION

Table 1 shows that there were significant difference in the fat and protein contents of the starch samples. The native starch obtained from tiger nut starch had 0.57% fat and 1.92% protein respectively. The was significant difference in the moisture content of the starch samples. The native starch from tiger nut had higher moisture content of 8.69% compared to the 8.13% and 8.26% obtained by the 1.0% HCl modified starch and 1.0ml glucoamylase modified starch from tiger nut. Salwa *et al*., (2010) in their study of the physicochemical properties of starch extracted from different sources and their application in pudding and white sauce reported moisture content of 9.18% for native starch of tiger nut and 8.36% for corn. The moisture content of the starch samples were relatively low. The samples all had high carbohydrate values. This is to be expected as starch extract is devoid of other nutritional components.

Table 2 shows that bulk density values of the samples were higher for the 1%HCl treated starch (0.72g/ml), closely followed by 1ml glucoamylase treated starch (0.68g/ml) and the native starch (0.68g/ml). Higher bulk density is desirable for greater ease of dispersibility and reduction of paste thickness (Okezie and Bello, 1988). The swelling index of the native and modified starch samples were in the range 2.91 – 3.38%. The swelling power of starch is negatively affected by the presence of fat and protein in the sample (Udensi and Eke,2000). The modified starch samples had lower wettability values of 13.42 and 13.48 secs respectively. The native starch sample had wettability value of 17.82 secs. This could be due to its low protein content. It has been reported that the lower the level of denatured protein present, the slower it takes to get wetted or imbibe water (Oti and Akobundu, 2008). The native starch from the tiger nut had foaming capacity of 2.29% higher than those of the acid and enzyme treated starches. The foaming capacity of all the starch samples can be rated low (1.10 – 2.29%) since they do not contain considerably high amounts of proteins, a good foaming agent (Ayele and Nip, 1994). The native starch also had higher solubility in water index (17.82) compared to those of the treated starches. Bremiller (1993) also reported that modification of starches could bring about increased solubility of the starches.

The gelatinization temperature were in the range of 71.17 – 75.33^{o}C.The least gelation concentration for the starch samples were 9.33% for the native starch sample while the modified starches were 14.67 and 14.00% respectively. Gelatinization affects digestibility and texture of starch containing foods, It is also observed that gel forming capacity increased with increase in concentration of the starch samples (Lawal *et al.*, 2004). It has been reported that acid hydrolysis may make starch to lose its ability to gel (Sester, 1993).

CONCLUSION

It could be concluded from the study that native and modified tiger nut starches using 1% Hydrochloric acid and 1ml glucoamylase could be used in industrial food processing as well as thickening agents in food production.

Table 1: Proximate composition (%) of native and modified tigernut starches

Sample	Crude Fat	Moisture content	Crude Protein	Ash	Crude Fibre	Carbohyd-rate
Native starch	$0.57^{b}\pm0.08$	$8.69^{b}\pm0.03$	$1.92^{b}\pm0.87$	$2.19^{c}\pm0.06$	$0.32^{b}\pm0.03$	$86.30^{a}\pm0.85$
1.0% HCl treated starch	$0.00^{a}\pm0.00$	$8.13^{a}\pm0.15$	$0.00^{a}\pm0.00$	$1.15^{a}\pm0.16$	$0.01^{a}\pm0.01$	$90.65^{b}\pm0.30$
1ml Glucoamylase treated starch	$0.00^{a}\pm0.00$	$8.26^{a}\pm0.02$	$0.00^{a}\pm0.00$	$1.35^{b}\pm0.01$	$0.09^{a}\pm0.02$	$90.26^{b}\pm0.00$

- *Values with different superscripts along the columns are significantly different (P<0.05)*

Table 2: Functional properties of native and modified tigernut starches

Samples	Bulk density (g/ml)	Swelling index (v/v)	Water absorption capacity (g/ml)	Wettability (Secs)	Oil Absorption capacity (g/ml)	Foaming capacity(%)	Emulsion Capacity(%)	Solubility in water
Native starch	0.68^{a}±0.00	2.91^{a}±0.08	1.57^{b}±0.06	28.67^{b}±2.08	1.67 ^{a}±0.23	2.29^{b}±1.23	6.95^{b}±1.32	17.82^{b}±6.03
1% HCl treated starch	0.72^{c}±0.00	3.24^{b}±0.05	1.13^{a}±0.58	48.33^{c}±2.51	1.37^{a}±0,23	1.50^{a}±0.50	3.50^{a}±1.53	13.48^{a}±3.16
1ml glucoamylase treated starch	0.69^{b}±0.00	3.38^{b} 0.09	1.03^{a}±0.58	21.67^{a}±1.15	1.73^{a}±0.29	1.10^{a}±0.56	3.84^{a}±1.37	13.42^{a}±2.92

Values with different superscripts along the columns are significantly different (P<0.05)

Table 3: Gelation and viscosity of native and modified tigernut starch

Samples	Gelatinization Temperature (Tg)	Least Gelation Concentration (%)	Viscocity
Native starch	75.33^{b}±1.15	9.33^{a}±1.15	430.61^{a}±6.96
1% HCl treated starch	71.17^{a}±0.29	14.67^{b}±1.15	435.60^{a}±7.44
1ml glucoamylase treated starch	71.17^{a}±0.58	14.00^{b}±0.00	438.33^{a}±7.33

Values with different superscripts in the same column are significantly different (P<0.05)

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COMPOSITIONAL, FUNCTIONAL AND SENSORY CHARACTERISTICS OF FLAVORED ZOBO DRINK PACKED IN TEA BAGS

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ABSTRACT
Pineapple and banana flavored Instant Zobo Drinks spiced with ginger were produced from local Hibiscus sabdariffa and packaged in tea bags (Thermoplastic packaging material). The drinks were coded as sample (A) pineapple flavored, (B) banana flavored and (C) the control. Proximate, physico-chemical and microbiological analysis of the infusion were carried out on the drinks. Sensory evaluation was conducted to determine the acceptability of the drinks using nine point hedonic scale and 20 panelists who assessed taste, color, flavor, texture and the overall acceptability. The proximate percentage composition of the drinks showed that moisture, protein, fat, ash, crude fiber and carbohydrates ranged between 13.10 - 13.20; 2.70 - 3.11; 3.40 - 3.60; 6.08 - 6.60; 12.30 - 13.40; and 61.12 - 62.60 respectively. In addition, the energy values recorded were between 86.70 - 289.85 Kcal. The physico-chemical analysis of the infusion revealed that pine apple flavored drink had the highest value of vitamin C, total soluble solid, total solid and specific gravity. While the banana flavored drink and the control recorded the highest pH and total titratable acidity respectively. In addition, the results of microbiological analysis revealed low counts of $<1.0x10^2$ CFU/g. The sensory evaluation results indicated no significant (5%) difference for taste, color and overall acceptability but statistically significant (5%) differences were observed for flavor and texture. It was concluded that a well packaged, spiced and flavored instant Zobo drink that is microbiologically safe, nutritious and generally acceptable and is convenient to handle and easy to prepare can be made from Hibiscus sabdariffa calyces.
Keywords: Zobo, drink, functional and sensory, characteristics

INTRODUCTION
Zobo drink (sorrel, Zoborodo) is a non – alcoholic local beverage made from dried petals, acid – succulent calyces of the flower - *Hibiscus sabdariffa* by boiling and filtration of the aqueous extracts of the calyces. The drink is gaining wide acceptance, being consumed by several millions of people from different socio – economic classes and background in the West Africa sub – region, especially amongst the youths, who see Zobo drink as an alternative source of cheap and relaxing non – alcoholic drink in social gathering (Ogiehor and Nwafor, 2004). In addition, Zobo drink is used as a substitute to carbonated drinks in Nigeria and indeed Africa due to its beneficial effect in the prevention of hypertension, urinary tract infection, low sperm count (infertility in men), antidiuretic and diabetes mellitus and lowering of cholesterol in the blood (Adesokan, *et al*., 2013).
Zobo drink is a highly nutritious food drink rich in vitamins, minerals, fibre and other antioxidants in addition to its content of macronutrients such as carbohydrate, protein and fat (Osutogun and Aboaba, 2004). It is believed to help cure ailments such as diarrhoea and pneumonia, and is recommended for people with vitamin C deficiency diseases, hypertension and urinary tract infection (Ojokoh, *et al*., 2002). The flowers of *H. sabdariffa* are rich in vitamins and other antioxidants (Kochlar, 1991).The proximate composition of Zobo drink shows that it has 90% water, 0.7%protein, 8% carbohydrate, 1.4%, fiber and 1.1 fat with iron, niacin, riboflavin, thiamine, Betacarotene, phosphorous and calcium also present in various proportions (Fasoyiro et al., 2005). The medicinal value of the zobo plant has been claimed to include antihypertensive, antiseptic, astringent, diuretic, purgative activities, remedy for cancer, abscesses, cough, debility, scurvy and fever (Ogbo, 2002).
The flavour of food is important to its enjoyment and it is not surprising that flavours are added to food to increase its acceptability. Herbs and spices are used in cooking to improve the taste of food and bring out its natural flavor. Spices (e.g. ginger, glove and black pepper) added to Zobo drink enhance its organoleptic properties, flavour, aroma and taste. Spices have been known and used for ages especially for their aroma and to some extent for their preservative qualities (Dziezak, 1989). Garlic, Cinnamon and cloves have also been shown to inhibit bacterial and mould growth (Paster *et al*., 1995). The use of cheap, readily available and largely underutilized local spices as additive in Zobo drink will have a dual effect of improving the taste as well as prolonging the shelf life. Therefore the objective of this study was to produce and evaluate the production processes of flavoured instant Zobo drink with an improved shelf life.

MATERIALS AND METHODS

Row Material Collection and Preparation

Hibiscus sabdariffa dried calyces, ginger rhizomes, cloves pods, black pepper seeds and flavors (pineapple, banana) were purchased from a local market in Kaduna metropolis. The raw materials were then properly sorted, cleaned, washed in cold water and weighed with a weighing balance. The materials were later dried in the cabinet drier at 50 ^{0}C for 3 hours, milled using harmer mill and sieved to obtain fine powder of about 20um.

Production of Instant Flavored Zobo drink

The materials for the production of the Zobo drinks including, Hibiscus sabdariffa calyces - sorrel flowers processed to Zobo powder - (700g); ginger powder (100g); cloves powder (50g); black pepper powder (50g) and flavors - pineapple or banana - (100g each) were thoroughly mixed and blended together to a homogeneous mixture in a bowl and used to formulate the three different Zobo flavors A (pineapple), B (banana) and C (control). Five grams of each of the product was then packaged in thermoplastic packaging material and sealed using electric impulse sealing machine to protect against moisture uptake and microbial contamination as instant Zobo drink. The flow chats for the processing operations for the production of instant flavored Zobo is shown figure 1.

Proximate Analysis

The proximate composition (moisture, protein, fat, ash, crude fibre, carbohydrate and energy value) of the flavored Zobo drink were determined following the methods described by the Association of Official Analytical Chemists (AOAC, 2000).

Physico-Chemical Analysis

The functional properties of the instant flavored Zobo drink were determined by assessing the total titratable acidity (TTA), vitamin C, total soluble solid, total solid, and specific gravity. Similarly, the pH of the various Zobo samples was determined at 24 h interval as described by Adesokan *et al.*, (2008) using a digital pH meter. The titratable acid (TA) of Zobo samples was also analyzed at the same time interval by titrating 0.1M NaOH solution and phenolphthalein as end point indicator. The titer volume of each homogenate was multiplied by 0.09 to give the percentage TA as lactic acid (Olubamiwa and Kolapo, 2008).

Microbiological Screening

For the microbial analysis the following bacteria's were enumerated:

a. Mesophilic bacteria using standard plate count method (WHO/FAO , 2006).
b. Yeasts and moulds using standard plate count method according to WHO/FAO, (2006).
c. Coliform bacteria using standard plate count method (WHO/FAO, 2006)
d. Gram staining as described by WHO/FAO (2006).

Sensory Evaluation

Sensory evaluation was carried out using 20 panelists who assessed the various drinks for differences in taste, color, flavor, and over all acceptability, using 9 point hedonic scale. A sachet of each flavored Zobo drink was infused into 200ml of hot water in a transparent plastic cup by dipping continuously for a few minutes to complete the extraction. 2 cubes of sugar equivalent to 10g was added and mixed to dissolve complexly to a degree brix of between 10.1 to 10.6%. The samples were then presented to the panelists in the department of food technology sensory evaluation room.

Statistical Analysis

The data collected from the organoleptic assessment were statistically analyzed using ANOVA (Analysis of variance) to determine whether significant differences exist among the samples.

RESULTS

Proximate Analysis

The result of the proximate analysis conducted on the instant Zobo drink mixed with different flavors and spices is presented in Table 1. The data indicated that compared to the pineapple flavored Zobo Drink and the control, the banana flavored Zobo drink re-coded the highest percentage of protein, fat, and ash being 3.11, 3.60 and 6.60 percent respectively. The moisture and crude fiber content of the unflavored Zobo sample was higher than pineapple and banana flavored Zobo products. It was observed from the result that the carbohydrate composition of the pineapple drink (61.60%) was higher than that of the banana flavored instant Zobo and the control with 61.23 and 61.12 percent respectively. In terms of Energy, the highest value of 289.85 Kcal was recorded by the banana flavored instant drink as against the energy contained by the pineapple flavored Zobo (289.44) and the control (286.78).

Physico-chemical Analysis

The physicochemical attributes of the Zobo drinks that include the pH, total titratable acid, vitamin C, total soluble solid, total solid and specific gravity as affected by the addition of flavor and spice is presented in Tale 2. The pH of the instant Zobo drinks ranges from 4.58 to 4.62 with the banana flavored Zobo drink having the highest. The none-flavored Zobo sample recoded the highest total titratable acidity (0.086%) which is comparable to those of the pineapple and banana flavored Zobo products having 0.084 and 0.083 percent respectively. The pineapple flavored Zobo drink was observed to have the highest content of vitamin C, total soluble solids, total solids and specific gravity among the three instant Zobo drinks with 48 mg/100 ml, 10.4%, 17.58% and 1.012 respectively.

Microbiological Analysis

The result of the microbial count of the instant Zobo drink is presented in Table 3. The data indicated a very low microbial growth for all the three samples. The microbial counts results also showed very few growth of mesophilic bacteria **($<1.ox10^2$ CFU/g)** and the Gram staining of the isolated organism reveals bacillus species (a spore former).

Sensory Evaluation

The mean sensory evaluation scores of the instant Zobo drink in terms of taste, color, flavor, texture and overall acceptability as examined by 20 member panelists is presented in Table 4. The organoleptic test data indicated that the flavored drinks (samples A and B) performed significantly better than the control in terms of all the parameters evaluated. The data further demonstrates that the pineapple flavored Zobo drink had the highest acceptability (8.35), followed by the banana flavored instant Zobo with an acceptability rating of 7.70, while the flavor free Zobo Product (control) had the least overall acceptability rating of 7.40 . The panelist showed higher preference for the pineapple flavored Zobo product, followed by the banana flavored instant Zobo with respect to taste, color, flavor and texture. In addition the result showed least preference for control in terms of the variable listed.

DISCUSSION

Beverages, as part of food, are among the important requirements for life sustenance for both plants and animals. These beverages are sometimes referred to as non-alcoholic drinks. They are obtained mainly from local sources such as plant sources. Their methods of preparation and preservation still depend on local technologies and due to microbial contamination their storage and long shelf life is not guaranteed (Osuntogun and Aboabe, 2004).

The proximate composition of Zobo-drink mixed with deferent flavor and spices (Table 1) indicated a moisture content ranging from 13.10% to 13.20%. Adedokun, *et al*., (2015) reported a high moisture content of Zobo-drink ranging from 85.21% to 86.49% that was attributed to a desirable, refreshing and thirst-quenching attribute. The low moisture content observed in this trial was as a result of the dry state of the Zobo product. The protein content of the pineapple (03.10%) and banana (03.11%) flavored Zobo product was higher than that of the control sample without flavor (02.70%). The variation and increase of protein could be due to difference in chemical composition of raw materials used *Hibiscus sabdariffa L*. and spices or other plant flavoring materials. Total carbohydrate composition of the Zobo samples showed a slight variation with the pineapple flavored drink having the highest (61.6%) and the control having the least (61.12%). These values represent the mineral elements present in the drink. The ash content of the banana flavored Zobo product was fairly higher than that of the other two samples indicating the high mineral value. Rao, (1996) recorded that roselle generally contain high amount of ash which indicates that the plant provides appreciable quantity of minerals required by the body.

The data on the physicochemical properties of instant Zobo drink (Table 2) indicates that the products contain some reasonable amount of vitamin C in which pineapple flavored drink had the highest. Duke (1985) had earlier reported that vitamin C in Zobo drink raises human immunity. The pH value of the instant Zobo drink which ranges from 4.58 to 4.62 (Table. 2) imply that it belongs to a class of food referred to as high acid foods (Frazier and Westhoff, 1988). Similarly, Wong *et al*., (2002) has observed Zobo drinks to be a naturally acidic fruit rich in organic acids: Oxalic, tartaric, malic and succinic. An advantage of an acid food is that it does not support the survival of many pathogenic organisms Jay (1996). The total soluble solid described as ^{0}Brix content of instant flavoured Zobo-drink ranged between 09.10 - 3.410 for the three sample with the control having the list. The titrable acidity (%) is a measure of acidity level present in a food. The percentage found was between 0.083 – 0.086 percent. The findings on the properties of Zobo-drink shows that combination of Roselle extract with spice bioactive extract tends to improve the proximate composition and chemical properties of non-alcoholic drink.

The microbial counts of the instant Zobo drinks presented in Table 3 indicated very low microbial growth. The low population of microbes in these products could be attributed to the low moisture content or the preservative effect of the spices added to the drinks. This may have been because the active component of these spices may have interacted synergistically with other factors to increase its preservative effect. The preservative effect of

these spices is due to their chemical composition especially the essential oil fractions which are inhibitory to microbial growth. Furthermore it has been documented that the volatile oil in spices are responsible for their aroma, flavor and taste as well as their antimicrobial properties (Zaika, 1998).
The data generated from the sensory evaluation result in this study indicated that the flavored drinks (samples A and B) performed significantly better than the control in terms of all the parameters evaluated. As was expected superior acceptability of these drinks over the control was due to the addition of flavor (pine apple and banana). Overall acceptability is the product of color, taste and flavor. Conversely, there was least preference for control in terms of taste and overall acceptability. It could be concluded that fortification of Zobo samples with additives to a certain level resulted in organoleptically more acceptable samples than the control as reported by Abulude *et al.,* (2006) who observed that fortification of Kunun Zaki resulted in increased acceptability over the control.

CONCLUSION

It can be concluded from this study that a generally acceptable, microbiologically safe and nutritious flavored instant Zobo drink packaged in tea bags (thermoplastic packaging material) can be produced from *Hibiscus sabdariffa* (Zobo) calyces. The results of this research also show that addition of flavors (pineapple and banana) and local spices (ginger, cloves, black pepper) had significantly improved the taste and acceptability of Zobo drinks. The findings on the properties of Zobo-drink showed that combination of roselle extract, Zobo-drink" with spice bioactive extracts tend to improve the proximate composition and chemical properties of non-alcoholic Zobo-drink and improve its shelf life.

Dry calyx of Roselle (700g)

Inspection, Sorting, Grinding and Weighing

Addition of Spices and Flavor

Homogenous Mixing

Weighing & Filling Into Tea Bags

Sealing With Electrical Sealing Impulse Machine

Packaging and Labeling of Flavored Instant Zobo Drink

Figure 1: Flow Chart for the Production of Instant Flavored Zobo

Table 1: The proximate composition of the control and the two instant flavoured Zobo drinks

Parameters	**Sample**		
	A	**B**	**C**
Moisture (%)	13.10	13.12	13.20
Protein content (%)	3.10	3.11	2.70
Fat (%)	3.40	3.60	3.50
Ash content (%)	6.50	6.60	6.08
Crude fibre (%)	12.30	12.33	13.40
Carbohydrate (%)	61.60	61.23	61.12
Energy value Kcal	289.40	289.85	286.78

Table 2: The physicochemical properties of the instant flavored Zobo drink

Parameters	**Sample**		
	A	**B**	**C**
PH	4.60	4.62	4.58
Total Titratable Acidity (%)	0.084	0.083	0.086
Vitamin C (Ascorbic Acid mg/100 ml)	48.00	46.00	37.00
Total Soluble Solid (TSS) ^{0}Brix (%)	10.40	10.20	09.10
Total Solid (%)	17.58	17.52	16.26
Specific Gravity (S.G)	1.0115	1.0112	1.0108

Table 3: The microbiological properties of the instant flavored Zobo drink

Properties	Sample		
	A	B	C
Enumeration of mesophillic aerobic Bacteria (CFU/g)	<1.0 x 10^2	<1.0 x 10^2	<1.0 x 10^2
Enumeration of yeast and molds (CFU/g)	Nil	Nil	Nil
Enumeration of Coliform Bacteria (CFU/g)	Nil	Nil	Nil
Gram's reaction of isolated Organism (s)	Gram +Rods	Gram + Rods	Gram + Rods
Identification	Bacillus Spp	Bacillus Spp	Bacillus Spp

Table 4: The sensory properties of the instant flavored Zobo drink

Parameters	Sample		
	A	B	C
Taste	8.20	7.75	7.25
Colour	8.05	7.80	7.75
Flavour	8.60	7.70	6.85
Texture	8.00	7.70	7.60
Acceptability	8.35	7.70	7.40

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ECONOMIC DIVERSIFICATION:
THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME XII:

SOIL CONSERVATION, SOIL & WATER MANAGEMENT

MORPHOLOGICAL PROPERTIES OF SOILS OF THREE DIFFERENT TOPOSEQUENCES UNDERLAIN BY DISSIMILAR LITHOLOGIES IN IMO STATE SOUTH-EAST NIGERIA

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ABSTRACT
The morphology of an area determines its land-use suitability. The study was carried out on three toposequences of dissimilar lithologies namely Coastal plain sand, Imo clay shales and Falsebedded sandstone all in Imo State, with the aim of studying the morphological properties of the soils for optimal management and utilization. A transect survey technique was used to align three profile pits on each of the toposequence at an inter-pedal distance of about 100 m. The profile pits were sited on each physiographic position consisting of the summit, midslope and toeslope. Soil samples were described using FAO soil description approach. The textural class of the toposequences generally appears more sandy in composition with a fewer clay and loamy concentration. All the horizons were well drained, except for the horizons that had common boundary with the high water table at the toeslope of coastal plain sand toposequence. The soils varied among the toposequences due to their geological and morphological properties. Therefore, agro-environmental practitioners should consider these soil attributes in order to maintain and sustain soil utilization.
Key words: morphology, horizon, lithology, physiographic position, toposequence

INTRODUCTION
The nature of soil is determined by the material from which it has been developed and the environment to which it has been subjected. Variations in the environment give rise to variations in soils, since the processes responsible for soil development are controlled by the environment. The toposequence concept emanated as slope soil evolutionary processes. Soils along a toposequence can be with or without uniform lithology (Brady and Weil, 1999). The distribution of individual soil series on a toposequence and the spatial distribution of the toposequecne itself have considerable influence on the land use pattern of an area. It also results in morphological changes and horizonation thus relating hydrology to topographic position (Odenerho, 1980). Soil properties along a toposequence vary from summit to toeslope due to micro climate, pathogenesis and geologic processes which result to a considerable influence on the land (Nuga *et al.,* 2008). The variation along a toposequence can be as a result of parent materials and slope aspect which implies that different soil lithologies give rise to different soil formations. It is very important to understand the nature, behaviour and distribution of various soils along a toposequence and the various parent materials that constituted the soils, but this can only be possible if these soils are studied. It is important to study the geomorphology of an area for proper management and precision decision. Hence, this study was aimed to describe the morphological properties of soils of toposequences underlain by dissimilar lithology.

MATERIALS AND METHODS
Study Area
The study was carried out at three (3) different locations namely, Inyishi in Ikeduru Local Government Area (L.G.A), Isiebu in Isiala Mbano L.G.A., and Ihube in Okigwe L.G.A. all in Imo State, South-east Nigeria. The study areas lie between latitude 5° 52' 07.83'' N and 7° 22' 05.03'' E for Ihube site, 5° 45' 02.44'' N and 7°10' 36.33'' E for Isiebu site, while 5° 33' 59.23''N and 7° 10' 30.75'' E for Inyishi site.
The geological (lithology) materials from which the soils of the study areas developed are Coastal Plain Sand (Benin formation) for Ikeduru study site, Falsebedded Sandstone (Ajalli formation) for Okigwe study site and Imo Clay Shales (Imo formation) for Isiala Mbano study site. The study areas are generally denominated by plains and lowlands (Ofomata, 1987).
The area lies under the tropical rainforest zone of the South-east Nigeria with a humid tropical rainfall range of 1500 mm to 2200 mm. The average annual atmospheric temperature above 20 °C creates an annual relative humidity of 75 % while during the rainy season humidity reaches 90 %. The areas have a typical rainforest with sparse vegetation at Okigwe and densely vegetated rainforest at Ikeduru and Isiala Mbano.

Field Sampling
A reconnaissance study was carried out on the study areas. Subsequently, transect survey technique was used to sunk three (3) soil profile pits along each toposequences with respect to physiographic positions namely summit, midslope and toeslope. The profile pits were described following the guideline of FAO, (2006) soil description approach.

RESULTS AND DISCUSSION
The result of the soil morphological properties of the studied sites as indicated in Tables 1, 2, and 3 showed that all the horizons were well drained except for the Bt-horizons that had common boundary with the high water table at the toeslope of Coastal Plain Sand (CPS) toposequence. The surface soils were loose at all physiographic land units except for the summit and midslope of falsebedded sandstone (FBS) toposequence while the subsurface horizons were mostly firm. The loose nature of the soil may be as a result of runoff and downward migration of finer particles. The roots sizes and quantity was as a result of the type and age of plants in the study sites. Also, the land-use types suggest root sizes and quantity. Soil of the CPS recorded more roots in terms of quantity and size over soil of other lithologies.

Soils formed over the coastal plain sand toposequence indicated that across the horizons the soil colour ranged from dark red (10R 3/6) moist, very dark reddish brown (2.5YR 3/3) moist to dull reddish brown (5YR 4/3) moist at the summit and dark red (10R 3/4; 10R 3/6; 2.5YR 3/4) moist, reddish brown (5YR 4/5) moist to dark reddish brown (2.5YR 3/4; 2.5YR 3/2) moist at the midslope while, very dark reddish brown (2.5YK 2/4) moist, dark reddish brown (10R 3/6; 2.5YR 3/4) moist to brown (7.5YR 4/6) moist was recorded at the toeslope. The soils of Falsebedded Sandstone had colour matrix ranged from red (10R 4/8) moist, dark red (10R 3/6) moist to dark reddish brown (2.5YR 3/6; 5YR 3/3) moist at the summit and dark red (10R 3/6; 10R 3/4) moist to dark reddish brown (5YR 3/4) moist at the midslope while, dark reddish brown (10R 3/3; 5YR 3/3) moist to very dark reddish brown (2.5YR 2/4; 5YR 2/3) moist was indicated at the toeslope. However, it was also observed that soil horizons at Imo Clay Shale (ICS) toposequence showed colour matrix ranged from dull reddish brown (2.5YR 3/4; 5YR 5/4; 2.5YR 4/3) moist, bright reddish brown (5Y 5/6) moist to reddish brown (2.5YR 4/6) moist at the summit and dull orange (2.5YR 6/4; 5YR 6/4) moist, bright brown (7.5YR 5/6) moist to dark brown (7.5YR 3/4) moist at the midslope while, the toeslope had bright brown (2.5YR 5/6; 7.5YR 5/6;) moist, bright reddish brown (5YR 3/6) moist to brown (7.5YR 4/6) moist. Generally the surface horizons of each physiographic position has a colour matrix range of dark red (10R 3/6) to very dark reddish brown (5YR 2/3) moist at the coastal plain sand toposequence while, the surface horizons of falsebedded sandstone toposeqence showed colour ranged from red (10R 4/8), dark red (10R 3/6) to dark reddish brown (10R 3/3) moist. However, surface horizons of Imo clay shales toposequence indicated soil colour matrix range of dull reddish brown (2.5YR 4/4), dull orange (2.5YR 6/4) to bright brown (2.5YR 5/6) moist at the surface horizon of each physiographic position respectively. The drainage condition and physiographic position may have influenced the observable change in the soil colour matrix in the horizons which agrees with the works of Gerrard, (1981) and Esu *et al.*, (2008). The parent materials and environmental factors (rainfall, humidity and temperature) may have contributed to the soil colour variation of each horizon. Also, the amount of eluviations and/or illuviations that has occurred within these toposequences may equally contribute to the soil colour matrix on each topographic unit. The red colours are due to the presence of ferrous (Fe^{2+}) compound and indicate that the soils are well aerated. According to Nuhu (1983) the brownish tinges in most of the horizons of the profile were due to the presence of organic matter which is the main colouring agent in surface soil.

Furthermore, the textural class of the toposequence generally appears sandy in composition with fewer clay and loamy concentration. The coastal plain sand toposequence had textural range of loamy sand (LS) at the Ap and A-horizons while sandy clay loam (SCL) was observed at the other horizons for the summit. The midslope had range of sandy loam at the Ap and Bt_3-horizons while other horizons was observed as sandy clay loam (SCL). The toeslope recorded a textural range of loamy sand (LS) at the Ap and Bt_2 horizons while A-horizon had sandy clay loam (SCL) texture. TheBt_1 and Bt_3 horizons were observed to be sandy loam (SL) in texture. Falsebedded sandstone toposequence recorded textural range of sandy loam at A-horizon while other horizons were observed as sandy clay texture at the summit. The midslope had sandy loam at A-horizon and sandy clay loam at E and Bt-horizon. Furthermore, the toeslope had it's A, E and B_t-horizon as sandy loam in texture while Bt_2, was observed as sandy clay loam in texture. However, the textural range of Imo clay shale toposequence showed that at the summit it was sandy clay loam in texture across the horizons. Its midslope showed loamy sand texture at the Ap horizon, sandy clay texture at the Bt_3 horizon while others had sandy clay loam texture. The toeslope of the ICS toposequence was observed to have, sand, loamy sand, sandy clay loam and sandy clay down its horizon. However, the textural classes of the toposequences agrees with the findings of Tomer and Anderson (1995) who attributed difference in soil texture to the variation in parent materials and to the topography. Also, the result is in conformity with the findings of Brady and Weil, (2007) that attributed difference in soil texture to soil formation factors.

The study sites had crumb or granular structure in all the surface horizons of the toposequences and dominating the subsurface horizons are subangular blocky structure. The crumb structure could be as a result of eluviation of mostly clay particles and runoff effect on the soil surface.

CONCLUSION

Significant morphological differences were observed in the horizons of the study sites which varied physiographically and among the toposequences. This is an indication that the soil under different toposequence has possessed different characteristics. However, land users are encouraged to adopt agro friendly practices while exploring the toposequences due to land pressure that is on the increase within the studied areas. The use of conservation tillage, application of organic manure into the soils, adequate ground cover will encourage soil sustainability in the area.

Table 1: Morphological Characteristics of the Pedons in Soils of Coastal Plain Sand Toposequence

Horizon	Depth (cm)	Colour (moist)	Texture	Structure	Consistence (moist)	Drainage	Boundary	Root
				SUMMIT				
Ap	0 – 19	Dark red (10R 3/6)	LS	Crumb	Loose	Well drained	cs	m1rts
A	19 – 30	Dark red (10R 3/4)	LS	Granular	Friable	Well drained	cs	c1rts
Bt_1	30 – 45	Dark red (7.5R 3/4)	SCL	SBK	Firm	Well drained	cw	f1rts
Bt_2	45 – 64	Dark reddish (2.5YR 3/4)	SCL	SBK	Firm	Well drained	cs	vf1rts
Bt_3	64 – 126	Very dark reddish brown (2.5YR 2/4)	SCL	SBK	Firm	Well drained	as	vf1rts
Bt_4	126 – 180	Dull reddish brown (5YR 4/3)	SCL	SBK	Firm	Well drained	-	vf1rts
				MIDSLOPE				
Ap	0 – 20	Dark red (10R 3/6)	SL	Crumb	Loose	Well drained	cs	m1rts
A	20 – 34	Dark red (2.5YR 3/4)	SCL	SBK	Firm	Well drained	cw	m12rts
Bt_1	34 – 70	Reddish brown (5YR 4/5)	SCL	SBK	Firm	Well drained	cw	m2rts
Bt_2	70 – 105	Dark reddish brown (2.5YR 3/4)	SCL	SBK	Firm	Well drained	cw	f2rts
Bt_3	105 – 135	Dark red (10R 3/4)	SL	SBK	Firm	Well drained	cw	vf1rts
Bt_4	135 – 200	Dark reddish brown (2.5YR 3/2)	SCL	SBK	Firm	Well drained	-	vf1rts
				TOESLOPE				
Ap	0 – 30	Very dark reddish brown (5YR 2/3)	LS	Crumb	Loose	Well drained	cs	m12rts
A	30 – 40	Dark red (10R 3/6)	SCL	Granular	Firm	Well drained	cw	c12rts
Bt_1	40 – 70	Dark reddish brown (2.5YR 3/6)	SL	SBK	Friable	Well drained	cs	c1rts
Bt_2	70 – 95	Dark reddish brown (2.5YR ¾)	LS	SBK	Friable	Poorly drained	cs	f1rts
Bt_3	95 – 110	Brown (7.5YR 4/6)	SL	SBK	Firm	Poorly drained	-	vf1rts

SL= Sandy Loam, SCL = Sandy Clay Loam, LS = Loamy Sand, SC = Sandy Clay, SBK= Subangular Blocky, m= many, c= common, f= few, vf= very few, 1= fine, 2= medium, rts= roots, c= clear, abrupt, s= smooth, w= wavy

Table 2: Morphological Characteristics of the Pedons in Soils of Falsebedded Sandstone Toposequence

Horizon	Depth (cm)	Colour (moist)	Texture	Structure	Consistence (moist)	Drainage	Boundary	Root
				SUMMIT				
A	0 – 9	Red (10R 4/8)	SL	Granular	Friable	Well drained	cs	m1rts
E	9 – 28	Dark red (10R 3/6)	SC	SBK	Firm	Well drained	cs	f1rts
Bt_1	28 –50	Dark reddish brown (2.5YR3/6)	SC	SBK	Firm	Well drained	cs	vf1rts
Bt_2	50 – 120	Dark reddish brown (5YR3/3)	SC	SBK	Very firm	Well drained	-	vf1rts
				MIDSLOPE				
A	0 – 13	Dark red (10R 3/6)	SL	Granular	Very friable	Well drained	cs	f1rts
E	13 – 27	Dark red (10R 3/4)	SCL	SBK	Firm	Well drained	cw	vf1rts
Bt_1	27 – 63	Dark reddish brown (5YR¾)	SCL	SBK	Firm	Well drained	-	vf1rts
				TOESLOPE				
A	0 – 21	Dark reddish brown (10R 3/3)	SL	Crumb	Loose	Well drained	cs	c1rts
E	21 – 43	Dark reddish brown (5YR 3/3)	SL	Granular	Very friable	Well drained	cw	f1rts
Bt_1	43 – 80	Very dark reddish brown (2.5YR 2/4)	SL	SBK	Friable	Well drained	cw	vf1rts
Bt_2	90 – 138	Very dark reddish brown (5YR 2/3)	SCL	SBK	Very firm	Well drained	-	vf1rts

SL= sandy loam, SCL= sandy clay loam, LS= loamy sand, SC= sandy clay, SBK= subangular blocky, m= many, c= common, f= few, vf= very few, 1= fine, 2= medium, rts= roots, c= clear, abrupt, s= smooth, w= wavy

Table 3: Morphological Characteristics of the Pedons in Soils of Imo Clay Shales Toposequence

Horizon	Depth (cm)	Colour (moist)	Texture	Structure	Consistence (moist)	Drainage	Boundary	Root
				SUMMIT				
Ap	0 – 15	Dull reddish brown (2.5YR 4/4)	SCL	Granular	Loose	Well drained	cs	f12rts
AB	15 – 34	Bright reddish brown (5YR 5/6)	SCL	SBK	Friable	Well drained	cs	f2rts
Bt_1	34 – 60	Reddish brown (2.5YR 4/6)	SCL	SBK	Firm	Well drained	cw	vf1rts
Bt_2	60 – 94	Dull reddish brown (5YR 5/4)	SCL	SBK	Firm	Well drained	cs	vf1rts
Bt_3	94 – 180	Dull reddish brown (2.5YR 4/3)	SCL	SBK	Firm	Well drained	-	vf1rts
				MIDSLOPE				
Ap	0 – 20	Dull orange (2.5YR 6/4)	LS	Crumb	Loose	Well drained	cs	f12rts
AB	20 – 34	Dull orange (5YR 6/4)	SCL	SBK	Firm	Well drained	cs	f2rts
Bt_1	34 – 70	Bright brown (7.5YR 5/6)	SCL	SBK	Firm	Well drained	cs	vf1rts
Bt_2	70 – 110	Dull reddish brown (2.5YR 4/3)	SCL	SBK	Firm	Well drained	cw	vf1rts
Bt_3	110 – 180	Dark brown (7.5YR 3/4)	SC	SBK	Very Firm	Well drained	-	vf1rts
				TOESLOPE				
Ap	0 – 23	Bright brown (2.5YR 5/6)	S	Crumb	Loose	Well drained	cs	m12rts
AB	23 – 48	Bright reddish brown (5YR 5/6)	LS	Granular	Friable	Well drained	cw	m1rts
Bt_1	48 – 63	Brown (7.5YR 4/6)	SCL	SBK	Firm	Well drained	cs	f1rts
Bt_2	63 – 150	Bright brown (7.5YR 5/6)	SC	SBK	Very firm	Well drained	-	vf1rts

S = sand, SL= sandy loam, SCL = sandy clay loam, LS = loamy sand, SC = sandy clay, SBK= subangular blocky, m= many, c= common, f= few, vf= very few, 1= fine, 2= medium, rts= roots, c= clear, abrupt, s= smooth, w= wavy

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EFFECTS OF NITROGEN SOURCES ON SOME SOIL PHYSICAL PROPERTIES UNDER MAIZE–COWPEA ROTATION SYSTEM IN UMUDIKE, SOUTHEASTERN NIGERIA

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ABSTRACT
The effects of organic and inorganic nitrogen fertilizer applications on soil physical properties are important to agricultural sustainability and increased crop yield. A trial was carried out in rainforest area of Umudike to investigate the physical properties of the soil under maize-cowpea rotation system as affected by nitrogen sources in 2009 and 2010 using urea (UR), sawdust (SD), poultry dropping (PD), Cow dung (CD), brewers' spent grains (BS), pig manure (PM) and combination of the organic N sources (CB), each applied at the rate 120 kg ha^{-1}. It was observed that there were significant variations in the soil physical conditions of the location of the study area during the two years of the study. However, observed values of bulk density, soil porosity and volumetric moisture contents for the whole profile at 0 – 40 cm depth ranges from 1.42 Mg m^{-3} for SD to 1.51 Mg m^{-3} for CT and 1.41 Mg m^{-3} for SD to 1.48 Mg m^{-3} for CT respectively, from 43.4 % for CT to 63.7% for SD and 44.3% for CT to 47.0 % for SD and from 26.8 v/v, % for CT to 28.8 v/v, % for CD and 29.3 v/v,% for CT to 31.2 v/v,% for CD, PM and CB after maize and cowpea harvest respectively. Across the two cropping seasons and among the organic N sources, the sawdust treatment maintained the lowest bulk density and highest porosity values for the entire soil profile depth. The results indicated that soil physical properties with the organic nitrogen sources maintained more favorable content than fertilizer urea and control.

Key words: Nitrogen sources, soil physical properties and maize–cowpea rotation.

INTRODUCTION
The maintenance of optimum soil physical fertility is an important component of soil management that has only recently been accepted. If well managed, organic waste material can provide significant source of plant nutrient as well as improves the physical properties of the soil (Janzen, 1993; Opara – Nadi and LaI, 1987; Nottidge *et al*, 2005).

Several studies (Eghball, 2002; Whalen and Chang, 2002; Fares et al., 2008) reported that N sources might improve soil physical property by improving soil tilt, decreasing soil bulk density, increasing total porosity and saturated hydraulic conductivity. Zhong and Shangguan (2014) reported that N-applied treatments increased water consumption in different layer of soil and evapor-transpiration that were significantly higher in N-applied than in non-N treatments.

Application of nitrogenous (N) fertilizers alone adversely affected physical quality of the soil and significantly declined the system productive capacity. Hati *et al.*, (2006) studied the effects of farmyard manure on soil physical properties and reported that the combined application of inorganic fertilizer and farmyard manure resulted in the lowest bulk density and total porosity in the top soil layer compared with total porosity and bulk density of control treatment and had little effect on bulk density and saturated hydraulic conductivity in subsurface soil layer. They attributed the change to better soil structure, pore size distribution and soil water transmission in the manure amended soil. However, no study has been done on the effects of nitrogen sources on soil physical properties under maize–cowpea rotation system in Umudike. The objective of this study therefore, was to determine the effects of nitrogen sources involving organic and inorganic fertilizer on soil physical properties in Umudike, Southeastern Nigeria.

MATERIALS AND METHODS
The experiment was conducted in 2009 and 2010 cropping seasons to determine effects of nitrogen sources on soil physical properties under maize–cowpea rotation system in Umudike. The experimental design was a randomized complete block (RCBD) with three replications. The treatments were eight as follows, control (CT), urea (UR), sawdust (SD), poultry dropping (PD), cow dung (CD), brewers' spent grain (BS), Pig manure (PM) and combination of all the organic manure (CB) applied at 120 kg ha^{-1} recommended rate for maize in the area.

Undisturbed core soil samples were collected from the experimental site before establishing the experiment from 0 – 10, 10 – 20 and 20 – 40 cm depths. Another soil sample was collected from each replicate plot after maize and cowpea harvest respectively using soil cores (5 cm and 5 cm internal diameter) were used to determine the physical properties of the soil.

Bulk density was determined by using Blake and Hartge, (1986) core method:

$$Bd = \frac{Ms}{Us}$$

Where Bd is the bulk density (g cm^3), Ms is the mass of soil (g) and Us is the volume of soil (cm^3). Total porosity was determined by calculating particle density (Pd) and bulk density (Bd) values.

$$Pt = 100\left(1 - {}^{Bd}/_{Pd}\right) = 100\left(Pd - {}^{Bd}/_{Pd}\right)$$

Where Bd is the bulk density (g cm-^{3}) and Pd is the particle density (g cm-^{3}). Volumetric moisture content was determined by oven dry method:

$$Wv = Wd * {}^{Pb}/_{Pw}$$

Where Pb is the soil bulk density (g dry soil /cm3 soil) and Pw = density of water (1g water/cm3 water)
The data collected were subjected to standard statistical analysis of variance (ANOVA). Treatment means were separated using least significance difference (LSD) at 5% level of probability test.

RESULTS AND DISCUSSION

Some soil physical properties of the experimental site are shown in the Table1. Bulk density increased with depth, with values of 1.36, 1.49 and 1.59 Mg m^{-3} in the 0 – 10, 10 – 20 and 20 – 40 cm depths respectively. The lower bulk density values in the 0 – 10 cm depth for the experimental site showed that the value may be attributed to the influence of the organic matter, root and faunal activities, while the higher value in the 20 – 40 cm depth may be due to the higher clay content and reduced root and faunal activities Table1.

Effects of N sources on soil bulk density measured after maize harvest in 2009 and 2010 are shown in Table 2, while after cowpea harvest in 2009 and 2010 is in Table 3. Bulk density values averaged two years of study (for both maize and cowpea) showed that SD treatment produced the lowest value of 1.41 Mg m^{-3}, while CT treatment has the highest value of 1.51 Mg m^{-3} for the three depths. Generally, the variation in bulk density among the different N sources with the exception of the SD treatment was minimal especially in the 0 – 10 and 10 – 20 cm depths. However, the CT treatment produced significantly higher bulk density when compared with the different N sources, while the SD treatment also produced significantly lower bulk density values when compared with the other N sources and this could be due to the improved soil structure caused by the SD treatment.

Effects of addition of different N sources on mean soil total porosity after maize and cowpea harvest in 2009 and 2010 are shown in Tables 4 and 5 respectively. After the two years cropping, significant differences in total porosity were observed for the three depths among the different N sources. Data on total porosity showed that the higher porosity measured for the SD treatment indicated the lower bulk density resulting from the adjustment in soil structure form the SD materials. On the other hand, the CT treatment resulted in lowest total porosity as a result of high bulk density.

Effects of nitrogen sources on volumetric moisture content measured after maize harvest in 2009 and 2010 and also after cowpea harvest in 2009 and 2010 are shown in Tables 10 and 11 respectively. Generally, differences in volumetric moisture content measured for the three depths for the different N sources were significant. For both after maize and cowpea harvest measurements, volumetric moisture content for the N sources increased with depth. Data in Table 10 showed that mean volumetric moisture content for the three depths (average for 0 – 40 cm depth) was of the order CD > PM = CB > PD > SD > BS > UR > CT. Similarly, mean volumetric moisture content for all three depths sampled after cowpea harvest (Table 11) was of the order CD = PM = CB > BS > SD > PD > UR > CT. The high moisture content under the N sources in comparism with the control seem to indicate the improved moisture storage capacity under the nitrogen sources as a result of improved soil physical properties such as bulk density. On the other hand, the CT treatment, which gave the lowest volumetric moisture content, seems to indicate the reduced moisture storage capacity in the crop-rooting zone (0 - 40 cm depth) as a result of increased bulk density and reduced total porosity. Data in Tables 10 and 11 shows that moisture storage under cowpea was better than under maize which showed that cowpea produced greater vegetative cover than maize for the soil surface which in turn reduced evaporation from the soil

CONCLUSIONS

After two cropping season, data on bulk density, total porosity and volumetric moisture content showed that the organic nitrogen sources maintained more favourable soil physical properties than fertilizer urea and control. Among the organic N sources, the sawdust treatment maintained the lowest bulk density and highest porosity values.

Table 1: Some soil physical properties of the experimental plot before treatment application in 2009 and 2010.

Parameter	Depths		
	0-10cm	10-20cm	20-40cm
Bulk density (Mgm^{-3})	1.36	1.49	1.55
Total Porosity (%)	48.7	43.8	41.1
Moisture content (v/v,%)	18.3	16.5	16.0

Table 2: Effect of nitrogen sources on mean soil bulk density measured after maize harvest in 2009 and 2010.

Nitrogen source	Soil bulk density ($Mg\ m^{-3}$) Soil depth (cm)			
	0 – 10	**10 – 20**	**20 – 40**	**Mean**
CT	1.37	1.53	1.62	1.51
UR	1.39	1.47	1.57	1.48
SD	1.31	1.42	1.54	1.42
PD	1.35	1.48	1.53	1.45
CD	1.37	1.47	1.56	1.47
BS	1.38	1.46	1.53	1.46
PM	1.36	1.46	1.53	1.45
CB	1.35	1.46	1.54	1.45
Mean	1.37	1.47	1.55	
LSD (0.05)	0.04	0.04	0.04	

Table3: Effect of nitrogen sources on soil bulk density of measured after cowpea harvest in 2009 and 2010

Nitrogen source	Soil bulk density ($Mg\ m^{-3}$) Soil depth (cm)			
	0 – 10	**10 – 20**	**20 – 40**	**Mean**
CT	1.38	1.48	1.58	1.48
UR	1.37	1.45	1.55	1.46
SD	1.31	1.40	1.51	1.41
PD	1.33	1.43	1.52	1.43
CD	1.34	1.42	1.50	1.42
BS	1.32	1.44	1.53	1.43
PM	1.34	1.42	1.52	1.43
CB	1.33	1.43	1.54	1.43
Mean	1.34	1.43	1.53	
LSD (0.05)	0.02	0.02	0.03	

Table 4: Effect of nitrogen sources on mean total porosity of 0 – 10, 10 – 20 and 20 – 40 cm depths measured after maize harvest in 2009 and 2010.

Nitrogen Source	**Total porosity (%)**			
	Soil depth (cm)			
	0-10	**10-20**	**20-40**	**Mean**
CT	48.01	42.30	39.75	43.4
UR	47.85	44.15	40.95	44.2
SD	50.09	46.60	42.10	46.3
PD	49.25	44.15	42.30	45.2
CD	48.50	44.75	41.35	44.9
BS	48.15	45.25	42.25	44.3
PM	48.65	45.10	42.95	45.6
CB	49.3	45.45	43.35	46.0
Mean	48.9	44.70	41.7	
LSD(0.05)	1.0	1.4	1.5	

Table 5: Effect of nitrogen sources on mean total porosity of 0 – 10, 10 – 20 and 20 – 40 cm depths measured after cowpea harvest in 2009 and 2010.

Nitrogen Source	**Total porosity (%)**			
	Soil depth (cm)			
	0-10	**10-20**	**20-40**	**Mean**
CT	48.4	44.2	40.4	44.3
UR	48.4	45.3	41.6	45.1
SD	50.6	47.2	43.1	47.0
PD	49.9	46.1	42.7	46.2
CD	49.5	46.5	43.4	46.5
BS	50.2	45.7	42.3	46.1
PM	49.5	46.5	42.7	46.2
CB	49.9	46.1	41.9	46.0
Mean	49.6	45.9	42.3	
LSD(0.05)	0.8	1.2	1.3	

Table 6: Effect of nitrogen sources on mean volumetric moisture content for the 0 – 10, 10 – 20 and 20 – 40 cm depths measured after maize harvest in 2009 and 2010.

Nitrogen source	**Volumetric moisture (v/v, %)**			
	Soil depth (cm)			
	0-10	**10-20**	**20-40**	**Mean**
CT	28.8	26.5	25.1	26.8
UR	30.1	27.3	25.2	27.5
SD	31.5	28.5	25.4	28.5
PD	31.8	28.4	25.5	28.6
CD	32.0	28.9	25.5	28.8
BS	31.7	28.3	25.3	28.4
PM	31.9	28.7	25.6	28.7
CB	32.0	28.7	25.4	28.7
Mean	31.2	28.2	25.4	
LSD (0.05)	2.2	2.0	1.1	

Table7: Effect of nitrogen sources on mean volumetric moisture content for the 0 – 10, 10 – 20 and 20 – 40 cm depths measured after cowpea harvest in 2009 and 2010.

Nitrogen source	Volumetric moisture (v/v, %) Soil depth (cm)			
	0 – 10	**10 – 20**	**20 – 40**	**Mean**
CT	33.1	28.9	25.9	29.3
UR	33.7	29.5	25.6	29.6
SD	33.4	30.7	26.2	30.1
PD	34.2	31.3	27.5	30.0
CD	34.6	31.6	27.3	31.2
BS	34.0	31.9	27.1	31.0
PM	34.5	31.5	27.5	31.2
CB	34.2	31.9	27.5	31.2
Mean	34.0	30.9	26.8	
LSD (0.05)	0.8	0.9	0.5	

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SOIL NUTRIENTS AND OKRA PERFORMANCE IN INTEGRATED APPLICATION OF INORGANIC FERTILIZERS AND OIL PALM BUNCH ASH IN EDO STATE, NIGERIA

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ABSTRACT
The effect of oil palm bunch ash (OPBA) as source of nutrients in okra production when used alone or combined with urea (U) or NPK fertilizer was investigated in two years on Ultisol at Ewatto in Edo State of Nigeria. There were thirteen treatments replicated three times on okra (Abelmoschus esculentus moench), in Randomized Complete Block Design. The treatments were Control, 100% U (160kg/ha), 100% OPBA (4t/ha), 75% U + 25% OPBA, 50% U + 50% OPBA, 25% U + 75% OPBA, 100% NPK (240kg/ha), 75% NPK + 25% OPBA, 50% NPK + 50% OPBA, 25% NPK + 75% OPBA, 75% OPBA, 50% OPBA and 25% OPBA. Each plot was 13.5m^2 with okra seeds planted at 60cm by 90cm at one plant per stand after thinning. Treatments were applied three weeks after planting by ring method with NPK or urea and OPBA mixed. Soil samples were collected at 0-15cm depth with soil auger before planting and ten weeks after treatment applications and analysed for pH, OM, N, P, K, Ca and Mg. Statistical analyses were performed using Statistical Analysis System (SAS) software version 9.0. Duncan multiple range test (p=0.05) was used to compare means. The soil is sandy, acidic and low in OM, P, K, Ca and CEC. OPBA increased soil OM, N, P, K, Ca and Mg, and the nutrients increased with level of OPBA. OPBA alone or combined with Urea or NPK fertilizer increased soil pH, had liming effect. The pH increased with OPBA rate. Addition of OPBA to inorganic fertilizers (Urea and NPK) increased soil and plant growth and yield components of okra. Combinations of reduced rates of OPBA and NPK or Urea fertilizer most increased okra pod weight, although the combinations with NPK had highest pod weight.
Keywords: soil nutrients, okra, performance, oil palm, inorganic fertilizers

INTRODUCTION

Okra (*Abelmoschus esculentus)* is an important vegetable that is popularly cultivated and consumed in Nigeria and other tropical countries of the world. The fresh fruits and young leaves are used in preparing soups as they are rich in vitamins and other minerals. The mature pods contain a mucilaginous substance that can be used in the pharmaceutical industry and manufacture of papers. Because of its importance in human diet and local economy, there is the need to improve the production and quality of okra plant through application of organic and inorganic fertilizers. Moyin-Jesu (2007) asserted that okra plays important role in human diet by supplying carbohydrate, protein, fats, minerals and vitamins that are usually deficient in the staple food. Despite the nutritional value of okra, its optimum yields (2-3 t/ha) and quality has not been attained in tropical countries partly because of a continued decline in soil fertility (Fatokun and Chedda, 1983; Muoneke and Aliyu, 1997). Hence research is needed on using organic and inorganic fertilizers to enhance growth and pod yield. Oil palm bunch ash is an organic waste derived from burning of empty oil palm bunch refuse. Ojeniyi and Folorunso (2005) reported that oil palm bunch ash contains P, K, Ca and Mg. It is almost impossible to meet the crop demand with inorganic fertilizers alone, hence the need for combined application of OPBA with Urea and OPBA with NPK.
With a combination of organic and inorganic fertilizers, the organic fertilizer can exhibit its long residual effect and add organic matter to the soil (Palm and Nariduwa, 1997). Sustainable crop production in the tropics is possible only with combination of organic and inorganic fertilizers. This study is to provide research information that is scarce on integrated nutrient supply, to investigate the effect of combined application of OPBA with NPK and OPBA with Urea on soil chemical composition, growth and yield, and also to determine the rate suitable for okra production.

MATERIALS AND METHODS

The work was done at Abhuru farm settlement in Ewatto, Edo State located in the southern zone of Nigeria. The site was manually cleared, heap packed and planted with Dwarf Long-45 variety of okra. The plot is 13.5m^2 and okra seeds were planted 60cm by 90cm with one plant per stand after thinning. There were thirteen treatments replicated three times using randomized complete block design. Treatments were Control, 100% U, (160kg/ha), 100% OPBA (4t/ha), 75% U + 25% OPBA, 50% U + 50% OPBA, 25% U + 75% OPBA, 100% $NPK_{15\ 15\ 15}$

(240kg/ha), 75% NPK + 25% OPBA, 50% NPK + 50% OPBA, 25% NPK + 75% OPBA, 75% OPBA, 50% OPBA and 25% OPBA. Treatments were applied three weeks after planting by ring method with NPK or Urea and OPBA mixed. Thorough weeding was done before the application and it was weeded twice after the application of treatments. Harvesting of pods was done at 4 days interval from 50 days of planting to 90 days. The experiment was repeated in the following year.

Soil Analysis

Auger soil samples collected at the site were bulked for analysis. Surface soil (0 – 15cm depth) samples collected below treatment plants in each plot 10 weeks after treatment applications were also bulked. The samples were air dried, sieved with 2mm mesh and analysed chemically. Organic matter was determined using dichromate oxidation method, total N was determined by microkjedhal method, available P was extracted using Bray-1 extract followed by molybdenum blue colorimetry, exchangeable cations were extracted using ammonium acetate, K was determined on flame photometer, while Ca and Mg were determined using EDTA titration. The pH in soil-water 1:2 medium was determined.

Data Collection

Ten plants were randomly selected and tagged for data collection which included plant height, number of leaves and weight of pods.

Statistical Analysis

Statistical analyses were performed using statistical analysis system (S.A.S) software version 9.0. Duncan multiple range test (p=0.05) was used to compare means.

RESULTS AND DISCUSSION

The soil at the site is sandy, acidic, low in OM, total N, available P, exchangeable K, Ca and Mg (table 1). In both years, Urea did not influence soil pH. It reduced it in subsequent year. Application of OPBA alone or combined with Urea or NPK increased soil pH in both years. Generally, combined application of OPBA with either urea or NPK increased soil OM, P, K, Ca and Mg compared with sole use of chemical fertilizers (tables 2 and 3). Urea alone applied at 100% gave highest value of N in both years but has low values in soil pH, OM, P, K, Ca and Mg. Its combination with OPBA increased the values. Also, NPK had higher values of soil pH, OM, N, P, K, Ca and Mg when compared with control but its combination with OPBA gave higher values in both years. However, 75% NPK + 25% OPBA and 50% NPK + 50% OPBA gave relatively high values in all the parameters. The combination of OPBA with NPK or urea increased number of leaves of okra in both years. Sole OPBA, NPK, urea and their combinations increased and had similar values of number of leaves in both years when compared with control (tables 4 and 5). Urea, OPBA, NPK and their combinations at reduced rates increased plant height. Sole OPBA gave the least plant height relative to sole NPK and urea. It indicated that urea and NPK more enhanced okra growth. Combinations of reduced rates of fertilizers with OPBA at 75% U + 25% OPBA, 50% NPK + 50% OPBA and 50% U + 50% OPBA gave highest and similar values of pod weight, although, the combinations that involved NPK gave highest pod yield. OPBA and NPK combination gave highest values of mean pod weight with 75% NPK + 25% OPBA having the highest value (table 6). The highest mean value for number of leaves for the two years was recorded at 75% U + 25% OPBA. Also, the highest mean values for pod weight in the two years were derived from 75% NPK +25% OPBA and 50% NPK + 50% OPBA (table 6). Generally, it was found that OPBA as an organic material increased soil nutrient concentration of K, Ca, Mg and pH. It was reported that plant derived ash has some base elements which could be used to supply these nutrients and lime (Adetunji, 1997). The use of mineral fertilizer alone has not been helpful under intensive agriculture because it is often associated with reduced yield, increase in soil acidity and nutrient imbalance. However, nutrients are readily released from inorganic fertilizers because organic manures undergo mineralization before nutrients are made available for crop use. To achieve meaningful increase in crop production, adequate combination of organic and inorganic fertilizers is essential (Lombin *et al*, 1991).

CONCLUSION

Yield of okra as a major stable crop in Nigeria is limited by low soil fertility and soil acidity. It responds to application of organic and inorganic fertilizers. OPBA used alone or combined at different and lower rates with urea and NPK fertilizers increased soil OM, pH, N, P, K, Ca and Mg. The combinations also increased plant number of leaves, plant height and pod weight. 75% NPK fertilizer with 25% OPBA and 50% NPK fertilizer plus 50% OPBA generally had highest soil nutrient contents and growth and yield parameters. Therefore 75% NPK + 25% OPBA or 50% NPK + 50% OPBA is recommended for okra production.

Table 1: Pre-experiment Soil chemical Composition

Properties	Ewatto site
Sand (%)	90.10
Silt (%)	4.60
Clay (%)	5.30
pH (water)	5.20
Organic matter (%)	1.55
Total N (%)	0.11
Available P (mg/kg)	7.24
Exchangeable Ca (cmol/kg)	0.10
Exchangeable Ca (cmol/kg)	0.14
Exchangeable Mg (cmol/kg)	0.79
CEC	2.55

Table 2: Effect of OPBA and its combined use with Urea and NPK Fertilizer on Soil Nutrient Composition (Year1)

Experiment	pH	OM	N	P	K	Ca	Mg
		%	%	mg / kg	---------cmol / kg---------		
Control	5.38e	1.59i	0.11h	14.20i	0.17i	1.00g	0.67g
100% U	5.37e	1.67h	0.50a	17.70hi	0.19hi	1.60f	0.13f
75%U + 25%OPBA	5.85abc	2.10f	0.49ab	21.90gh	0.20hi	3.20d	1.33e
50%U + 50% OPBA	5.91ab	2.16ef	0.46bc	29 .3def	0.23h	4.33a	1.97d
25%U + 75% OPBA	5.94ab	2.63ab	0.44cde	33.60cd	0.28g	4.20ab	2.17abcd
100% OPBA	6.00a	2.63ab	0.41ef	33.60cd	0.49d	4.05b	2.37a
100% NPK	5.58d	1.62hi	0.46bc	38.20bc	0.65c	2.00e	2.00cd
75%NPK + 25%OPBA	5.82abc	2.20e	0.45cd	40.80b	0.71b	3.00d	2.30ab
50%NPK + 50% OPBA	5.90ab	2.69a	0.44cde	40.00b	0.81a	4.41a	2.25ab
25%NPK + 75% OPBA	5.96abc	2.30d	0.41ef	48.30a	0.80a	4.20ab	2.10bcd
75% OPBA	5.89abc	2.60b	0.41ef	30.30ef	0.47d	4.00b	2.33a
50% OPBA	5.80cd	2.57bc	0.40fg	23.50fg	0.41e	3.65c	2.20abc
25% OPBA	5.71cd	2.52c	0.37g	20.60h	0.35f	3.58c	2.18abc

Means in the same columns not followed by same letters are significantly different at 5% level of significance by Duncan's Multiple Range Test (DMRT). U = urea, $NPK_{15-15-15}$ fertilizer, OPBA = Oil Palm Bunch Ash and NS = Not significant.

Table 3: Effect of OPBA and its combined use with Urea and NPK Fertilizer on Soil Nutrient Composition (Year2)

Experiment	pH	OM	N	P	K	Ca	Mg
		%	%	mg / kg	-------- cmol / kg-------		
Control	5.64de	1.46b	0.16f	11.00h	0.15ij	0.99m	0.87i
100% U	5.62e	1.64ab	0.50a	20.80fg	0.17i	1.10I	1.05h
75%U + 25%OPBA	5.76c	1.83ab	0.52a	21.40fg	0.22h	3.50j	1.27f
50%U + 50% OPBA	5.85ab	1.80ab	0.45b	22.00f	0.24h	4.60c	2.02e
25%U + 75% OPBA	5.83b	1.84ab	0.36d	24.70e	0.23h	4.80b	2.00e
100% OPBA	5.92a	2.30a	0.38cd	28.40d	0.50r	4.50e	2.63a
100% NPK	5.70cd	1.57ab	0.54b	38.40a	0.75d	1.98k	1.00h
75%NPK + 25%OPBA	5.90ab	1.89ab	0.42bc	35.20b	0.85c	3.60i	1.23g
50%NPK + 50% OPBA	5.89ab	1.81ab	0.40bcd	32.50c	0.96a	4.95a	2.06d
25%NPK + 75% OPBA	5.89ab	1.77ab	0.40bcd	28.20d	0.92b	4.82b	2.03d
75% OPBA	5.90ac	2.27a	0.29e	23.20e	0.48ef	4.43f	2.60ab
50% OPBA	5.88ab	2.00ab	0.29e	21.20fg	0.7f	4.30g	2.58ab
25% OPBA	5.83b	1.88ab	0.20f	20.00g	0.33g	4.10h	2.20b

Means in the same columns not followed by same letters are significantly different at 5% level of significance by Duncan's Multiple Range Test (DMRT). U = urea, $NPK_{15-15-15}$ fertilizer, OPBA = Oil Palm Bunch Ash and NS = Not significant.

Table 4: Effect of OPBA and its combined use with Urea and NPK Fertilizer on Number of Leaves, Plant Height and Weight of Pod (3months) Year 1

Experiment	No. of Leaves	Plant Height (cm)	Weight of Pod (kg/36 plants)
Control	8.30g	57.00hi	1.84e
100% U	11.00b	81.00a	2.34bc
75%U + 25%OPBA	11.20a	70.00b	2.39bc
50%U + 50% OPBA	11.10ab	66.00c	2.39bc
25%U + 75% OPBA	10.60c	63.00d	2.35bc
100% OPBA	10.50c	62.00ef	2.29c
100% NPK	10.20d	66.00c	2.47b
75%NPK + 25%OPBA	10.10d	63.00d	2.66a
50%NPK + 50% OPBA	10.00d	64.00d	2.62a
25%NPK + 75% OPBA	10.40c	63.00d	2.54ab
75% OPBA	10.00d	58.00g	2.28c
50% OPBA	9.50d	58.00h	2.25cd
25% OPBA	9.20e	58.00h	2.07d

Means in the same columns not followed by same letters are significantly different at 5% level of significance by Duncan's Multiple Range Test (DMRT). U = urea, $NPK_{15-15-15}$ fertilizer, OPBA = Oil Palm Bunch Ash and NS = Not significant.

Table 5: Effect of OPBA and its combined use with Urea and NPK Fertilizer on Number of Leaves, Plant Height and Weight of Pod (3months) Year 2

Experiment	No. of Leaves	Plant Height (cm)	Weight of pod (kg/36 plants)
Control	8.10d	57.00i	1.80b
100%U	11.50a	83.00a	3.00a
75%U + 25%OPBA	11.60a	74.00b	3.17a
50%U + 50% OPBA	11.20ab	72.00c	3.14a
25%U + 75% OPBA	10.80ab	67.00de	3.10a
100% OPBA	10.50abc	65.00ef	3.10a
100% NPK	11.00abc	68.00d	3.21a
75%NPK + 25%OPBA	10.20abc	65.00ef	3.27a
50%NPK + 50% OPBA	11.00abc	65.80ef	3.28a
25%NPK + 75% OPBA	10.80ab	64.80f	3.14a
75% OPBA	10.30bc	60.00gh	3.10a
50% OPBA	10.10bc	61.00g	3.00a
25% OPBA	10.00c	56.00hi	2.85a

Means in the same columns not followed by same letters are significantly different at 5% level of significance by Duncan's Multiple Range Test (DMRT). U = urea, $NPK_{15-15-15}$ fertilizer, OPBA = Oil Palm Bunch Ash and NS = Not significant.

Table 6: Treatment Interaction in Years of Okra Planted on Number of Leaves, Plant Height and Weight of pod

Treatment	Number of Leaves			Pod weight (kg/36plants)			Plant height (cm)		
	Year1	Year2	Mean	Year 1	Year 2	Mean	Year 1	Year 2	Mean
Control	8.30	8.10	8.20e	1.84	1.80	1.82e	57.00	57.00	57.00j
100%U	11.00	11.50	11.25a	2.34	3.00	2.67ab	81.00	83.00	82.00a
75%U + 25%OPBA	11.20	11.60	11.40a	2.39	3.17	2.78bc	70.00	74.00	72.00b
50%U + 50% OPBA	11.10	11.20	11.15ab	2.39	3.14	2.77bcd	66.00	72.00	69.00c
25%U + 75% OPBA	10.60	10.80	10.70bc	2.35	3.10	2.73cd	63.00	67.00	65.00e
100% OPBA	10.50	10.50	10.50c	2.29	3.10	2.70cd	62.00	65.00	63.50f
100% NPK	10.20	11.00	10.60c	2.47	3.21	2.84ab	66.00	68.00	67.00d
75%NPK + 25%OPBA	10.10	11.20	10.65c	2.66	3.27	2.97a	63.00	65.00	64.00ef
50%NPK + 50%	10.00	11.00	10.50c	2.62	3.28	2.95a	64.00	65.80	64.90e
OPBA	10.40	10.80	10.60c	2.54	3.14	2.84ab	63.00	64.80	63.90ef
25%NPK + 75%	10.00	10.30	10.15cd	2.28	3.10	2.69cd	60.00	60.00	60.00h
OPBA	9.50	10.10	9.80d	2.25	3.00	2.63cd	58.00	61.00	59.50h
75% OPBA	9.20	10.80	9.60d	2.07	2.85	2.46d	58.00	56.00	57.000i
50% OPBA									
25% OPBA									

Means in the same columns not followed by same letters are significantly different at 5% level of significance by Duncan's Multiple Range Test (DMRT). U = urea, $NPK_{15-15-15}$ fertilizer, OPBA = Oil Palm Bunch Ash and NS = Not significant.

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CLAY MINERALOGY OF SELECTED SOILS FORMED UNDER DIFFERENT LITHOLOGIES IN SOUTH-EASTERN NIGERIA

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ABSTRACT
This study investigated the mineralogy of soils formed on olivine basalt (Ikom), coastal plain sands (Ekparakwa) and shale (Abakaliki) in selected areas in South-eastern Nigeria using X-ray diffraction techniques. Two profile pits each of about 150cm deep were sunk in these locations. Profile pits were delineated according to natural horizonation. Soils derived from these parent materials were randomly collected, air-dried, sieved and analysed in the laboratory. Clay mineralogical analysis was carried out using clay fractions less than two microns in size from selected B- horizons of the various profiles. Two series of specimens namely Mg- saturated and K – saturated samples were prepared. Results showed that the dominant minerals in the clay fractions were kaolinite and quartz, while vermiculite, montmorrillonite and illite occurred in Abakaliki soil. Gibbsite occurred in Ikom and Abakaliki in moderate amounts. Soil properties that are related to soil fertility status particularly organic matter concentration, exchangeable (available) potassium and pH were higher in Abakaliki soil.
Keywords: clays, Mineralogy, Parent materials, Pedogenesis

INTRODUCTION
To assess inherent soil fertility for appropriate large – scale management, it is important to understand how clay mineralogy relates to geological and weathering conditions (Tetsuhiro et al., 2006). The knowledge of mineralogy is useful for an understanding of many important characteristics related to soil nutrient status (Unamba- Oparah et al., 1989). Consideration of the characteristics of minerals found in soils, and their transformation from one form to another, is essential in understanding both the nature of soils chemical properties and the origin of its fertility (Foth, 1984). The nutrient supply by a soil, and the type of problems one is likely to encounter, often differ greatly, depending on the parent material from which the soil was formed (Asher et al.,2002). Important processes in the formation of clay minerals are the neoformation of gibbsite, kaolin minerals and smectite, and the transformation of mica. Neoformation is mainly controlled by H_4SIO_4 activity. Gibbsite forms under conditions of strong desilication, where H_4SIO_4 activity is low (Huang et al., 2002). Kaolin minerals forms under moderate H_4SIO_4 activity conditions and smectite under high activity (Reid –Soukup and Ulery, 2002). Mica which is commonly present in felsic and sedimentary rocks, weathers to vermiculite and smectite, with a decrease in the layer charge and release of alkaline metals. The increased resistance to weathering of dioctahedral mica means that dioctahedral vermiculite is more common in soils than trioctahedral vermiculite (Malla ,2002). Kaolinite formation is favoured in acidic soils low in base and montmorillonite is favoured by high magnesium in the weathering environment. Montmorillonite originates from weathering of basalt where magnesium remains in the soil (Foth, 1984).
The goal of the study was to investigate mineralogical properties of soils of the selected sites (Ikom, Abakaliki, and Ekparakwa) in south-eastern Nigeria.

MATERIALS AND METHODS
The study was conducted in Ebonyi, Cross River and Akwa Ibom States, all in South-Eastern, Nigeria.The area lies between latitudes 4^0 15^I and 7^0 20^I North, and longitudes 5^0 05^I and 9^0 30^I East. The study area covered about 75,488 km^2 and lies within the rainforest agroecology. The geology of the sampled locations namely Ikom, Abakaliki, and Ekparakwa were olivine basalt, shale and coastal plain sands, respectively. The soils were of a flat topography (0 – 1 % slope). Profile pits of about 150 cm deep were sunk in soils of these areas. The profile pits were described according to FAO (1990) soil description guidelines. Soil samples from the subsoil were collected, air dried and sieved using 2- mm aperture. The pH was determined in 0.1 mol L^{-1} KCl, and the values were read off electrometrically using the pH meter. Cation exchange capacity was determined by the method described by Rhoades (1982). Organic carbon was analysed by Walkley and Black wet digestion method as described by Nelson and Sommers (1982).
Clay mineralogical analysis was carried out using clay fractions of less than two microns (< 2 um) in size collected from the B horizon. Clay fractions were obtained by sedimentation method after decomposing the organic matter with hydrogen peroxide (H_2O_2). Two series of specimens, namely Mg-saturated and K- saturated samples were prepared. For Mg and K saturation, one mole of chloride salt each of Mg and K samples was added to the clay

suspension and centrifuged. The excess salt was washed with distilled water once, and with ethanol for three times. Further treatments were as follows: Mg – saturated and glycerol solvated; K – saturated heated at 550 ^{0}c in an electric oven for two hours. Scanning was done from 2 –34 degrees (2 theta) for all specimen (Rich and Kunze 1964).

RESULTS AND DISCUSSION

The results of the physico-chemical properties of the soils are presented in Table 1. The clay content ranged from 22.8 to 250.7 g/kg. The highest amount of clay occurred in Abakaliki. The silt content ranged from 29.2 to 185.3 g/kg. The highest amount of silt occurred in Ikom. The sand fraction dominated in the soils with a range of 599.0 to 946.5 g/kg. The highest amount of sand occurred in Ekparakwa. The pH of the soils varied from 4.41 to 6.30 indicating strongly acidic to slightly acidic reaction. Soils of Abakaliki were slightly acidic, while Ikom and Ekparakwa were strongly acidic. Organic carbon varied from 5.8 to12.1 g/kg. The highest amount of organic carbon occurred in Abakaliki and the lowest occurred in Ekparakwa. Potassium content varied from 0.03 to 0.81cmol/kg. The highest amount occurred in Abakaliki and the lowest in Ekparakwa .The diffractograms for the clay fraction (Figure 1) of the three selected soils show that the most common clay minerals identified in all the soils were kaolinite and quartz. Kaolinite was characterized by strong diffraction peaks at 7.2 A^0 and 3.5 A^0 (first and second order peak respectively) under Mg – saturated air dried treatment. The peaks however disappeared after heating for 2 hours at 550 ^{o}C confirming the presence of kaolinite (Rich and Kunze, 1964). Quartz was characterized by strong diffraction peaks at 3.34 A^0 and 4.26 A^0 in all the soils studied. Soils derived from shale in Abakaliki (pedon 02) and olivine basalt in Ikom (pedon 07) contained some amount of montmorillonite which was identified by the presence of 15 A^o peak under Mg – saturated air – dried sample which increased to 17 A^o under ethylene glycol treatment and further collapsed to 10.57 A^o when the samples were subjected to heating at 550 ^{o}C. Other clay minerals found in the samples included vermiculite in Abakaliki soil characterized by a peak at 4.76 A^o under K – saturated treatment heated at 550 ^{o}C, illite in Abakaliki soil, characterized by a peak at 5.03 A^o in Mg – saturated sample. Gibbsite in Ikom and Abakaliki, , characterized by a peak at 4.37 A^o under Mg – saturated, glycerol solvated sample in Ikom and by a peak at 2.39 A^o under Mg – saturated, glycerol solvated sample in Abakaliki. Hematite (2.68 A^o and goethite (4.19 A^o) occurred in the samples. Soils were collected from site 0 -1 % slope to homogenize the topographic factors. Again climate, time factor, vegetation were considered to be the same for all sample points hence main source of dissimilarity was the parent material. For the purpose of recognizing or mapping different types of soils, the properties of the B horizons are often paramount. Not only is this the zone of major accumulations of minerals and clays, but the layers nearer the soil surface are too quickly altered by management and soil erosion to be reliable source of information for the classification of soils.

The presence of kaolinite was corroborated by the generally low pH and ECEC of the soils studied. The dominance of quartz has the implication of bringing about low pH, low ECEC and generally low fertility status of the soils. The presence of montmorillonite in soils derived from Abakaliki and Ikom brought about higher pH and ECEC on the soils. The presence of Iron and Aluminium oxides is justified by the fact that the soils are highly weathered and the minerals generally form the last stage of weathering of tropical soils. They give rise to the typical reddish or dark reddish brown colour of such soils.

It can be deduced from the results that the mineralogy of the clay fraction of the well drained upland soils typified by Ekparkwa were generally dominated by kaolinite, quartz, and the sesquoxides whereas the mineralogy of the lowland soils typified by Abakaliki were dominated by montmorrillonite and other 2:1 lattice clay minerals. This implies that the soils of Abakaliki are consequently less leached and have the ability to retain water for long period of time thereby making it possible for dry season cultivation to be practiced on them. They can attract, retain and fix a lot of nutrients without their being washed away. They have negative charges for binding nutrients to themselves and when fertilizer is applied, they are able to retain the nutrients and will not allow them to be washed away easily.. They therefore have high agricultural potentials. Their agricultural potential is in this order Abakaliki > Ikom > Ekparakwa. Secondly, Abakaliki soils are possible sink for contaminants like divalent lead in the environment because of the presence and dominance of montmorillonite that have high cation exchange capacities (Nagy et al. 2003). They can hold or adsorb low molecular mass organic acids, which increase their adsorptive capacity for pollutants such as Cadmium and Lead by forming bridging bonds (Huang et al. 2010). Clay mineral studies carried out by Asadu et al. (1990) and Eshett et al. (1990) on soils of south-eastern Nigeria identified kaolinite as the most abundant mineral in clay fraction. An investigation of the mineralogy of the soils suggested that properties of the soil are largely dependent on the parent materials. This agrees with Allen (2001); Radoslovich (2006) and Atkinson and Waugh (2007) that parent material influenced mineralogy of the weathering products in soils.

CONCLUSION

The variations in clay mineralogy of these soils appear to depend mainly on the parent materials from which the soils are formed. Those soils developed on coastal plain sands and olivine basalts contain more kaolinite, quartz, Iron and Aluminium oxide. Those soil developed on shale contain more montmorrillonite, vermiculite and illite. It is recommended that the mineralogical properties of these soils be considered in their management for the production of crops and trees. There is need for scanning electron microscopy of soils studied for the purposes of corroboration.

Table 1 : Average values of soil properties of the soil studied

Soil property	Ikom Olivine basalt	Abakaliki shale	Ekparakwa coastal plain sands
Sand mg/kg	599	641.8	946.5
silt mg/kg	185.3	117.5	29.2
clay mg/kg	215.7	250.7	22.8
organic carbon mg/kg	10.6	12.1	5.8
pH	4.83	6.30	4.41
ECEC cmol/kg	4.85	4.58	2.88
Base saturation %	80.52	50.25	60.42
Ca cmol/kg	2.18	0.36	0.66
Mg cmol/kg	1.18	0.07	0.23
K cmol/kg	0.17	0.81	0.03
Na cmol/kg	0.96	1.05	0.81

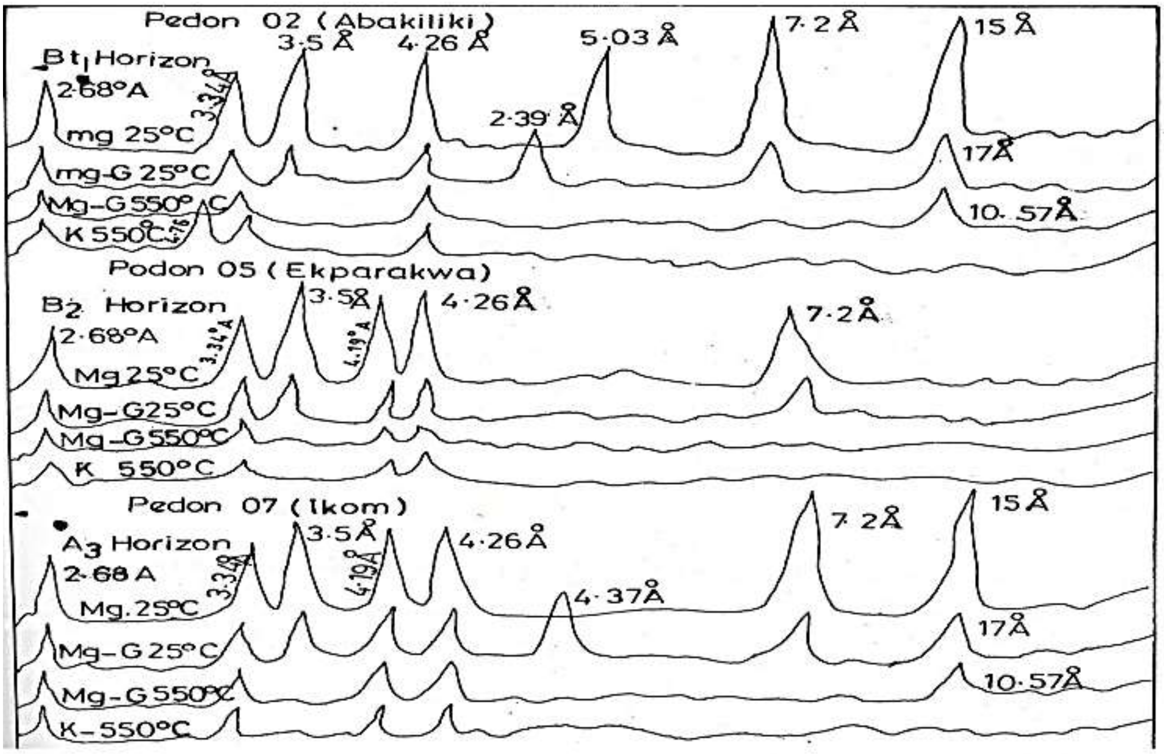

Fig 1: X-ray difractograms of clay fraction(undeferrated) of selected soil horizons of the studied soils

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EFFECT OF TILLAGE, CROPPING SYSTEMS AND NITROGEN FERTILIZER APPLICATION ON ORGANIC CARBON AND NITROGEN STATUS OF A SAVANNA ALFISOL, NIGERIA

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ABSTRACT
Soil organic carbon and nitrogen status under tillage, cropping systems and nitrogen fertilizer in a Savanna Alfisol were investigated at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Nigeria, for two years (2011 and 2012). This study was set up in a split-split plot design with three replications using improved soybean variety (TGX-1448-2E) and maize (SAMMAZ 14) as the test crops. The treatments consisted of two tillage practices (reduced and conventional tillage) as main plot, four cropping systems (inoculated soybean-maize intercrop, uninoculated soybean-maize intercrop, inoculated soybean-maize rotation and uninoculated soybean-maize rotation) as sub plot and four nitrogen fertilizer rates (0, 40, 80 and 120 kg N ha^{-1}) as sub-sub plot. At harvest the second year of trial (2012) only, soil samples were taken from each of the experimental plots and used for laboratory analysis. The organic carbon and nitrogen content of the soil were consistently higher in reduced tillage (RT) (6.59 and 1.11 g/kg) than under conventional tillage (CT) (6.32 and 1.06 g/kg) respectively. With respect to the cropping systems, soil organic carbon and nitrogen content were significantly higher under inoculated soybean-maize rotation compared to other cropping systems. A significant difference was found among the effects of N rates on soil organic carbon and total nitrogen content which was consistently lower in control plots. The study demonstrated that the integration of inoculated soybean inoculated in the cropping systems under tillage practices, especially reduced tillage in combination of meaningful N fertilizer management, would improve the productivity of the soil.
Keywords: Tillage, Cropping Systems, Nitrogen fertilizer, organic carbon and nitrogen status

INTRODUCTION
Soil organic C (SOC) and total N (TN) contents play a crucial role in sustaining productivity of the soil and environmental quality (Bauer and Black, 1994; Doran and Parkin, 1994; Robinson *et al.*, 1994) due to their effects on soil physical, chemical, and biological properties, such as soil water retention, nutrient cycling, gas flux, and plant root growth (Sainju and Kalisz, 1990; Sainju and Good, 1993). Soil, as an open system, can be a net source of CO_2 released to the atmosphere due to elevated SOC mineralization as a result of disruptive agricultural practices especially during tillage operation. On the other hand, soil can function as a net sink for sequestering atmospheric CO_2 under appropriate soil tillage and crop management, and thus reducing atmospheric CO_2 (Paustian et al., 1992; Lal *et al.*, 1995). This would subsequently enhance SOC and TN status of the soil which virtually promotes the productivity of the Savanna soil.
The SOC and TN status of a soil often influences soil fertility and productivity, depending also on their forms, sources, concentration, and cultivation practices. Tillage enhances the mineralization of soil organic C and nitrogen (N) by incorporating crop residues, disrupting soil aggregates, and increasing aeration (Tangyuan *et al*. 2009). But conservation tillage is a complex, fairly flexible agricultural system that can be widely adapted to local conditions (Wall 2007) which promote slow mineralization of SOC and TN. Nitrogen fertilization improved crop production and some soil quality attributes but also increased the potential for NO3-N leaching and N2O-N emissions, especially when it was applied in excess of the crop requirements (Malhi and Lemke 2007). Also, N is one of the major reasons to support the food for increasing human population (Robertson and Vitousek 2009). However, frequent tillage and excessive nitrogen fertilizer not only reduces the crop productivity but also exacerbates soil erosion, air and water pollution (Hundera *et al.* 2001, Godfray *et al.* 2010).
Declining of SOC and TN contents in Nigerian Savanna soils due to continuous cropping under conventional tillage and total removal of plant residues after harvest is posing a threat to the sustainability of maize-based cropping systems.

MATERIALS AND METHODS
***Study Area*:** A field study was conducted at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University (IAR/ABU), Samaru, Zaria during the 2011 and 2012 cropping seasons. The research field was located within longitudes11^{o} 11' N and latitudes 007^{o} 37' E. Samaru has an average of 686m above sea level and is located in the Northern Guinea savanna of Nigeria, having a total rainfall of 1207mm2011 and 1333mm in

2012, distributed between April and October with a mono-modal rainfall pattern. The temperature data was 21.05ºC (minimum) and 33.47ºC (maximum) of the cropping season (Oluwasemire and Alabi, 2004).The mainsoil sub-group is Typic Haplustalf (Awujoola, 1979) or Chromic cambisols according to the FAO system of soil classification (FAO, 2001). The study area was dominated by fire tender and fire tolerant trees, with an understory of shrub and grasses.

Treatments and Experimental Design:

The experiment was a split-split plot arrangement in a randomized complete block design with three replicates. The treatments were two tillage practice as main plots (reduced and conventional tillage), four cropping systems as sub-plots (inoculated soybean-maize intercrop, uninoculated soybean-maize intercrop, inoculated soybean-maize rotation and uninoculated soybean-maize rotation) and four nitrogen fertilizer rates as sub-sub plots (0, 40, 80 and 120 kg N ha^{-1}). The conventional tillage (CT) was manual ridging at 0.75 m apart using hoe and remoulded at 8 weeks after sowing, while reduced tillage (RT) was planted directly without ridging at 0.75 m interval between the lines after the field was demarcated into plots. Each plot measured 6 m by 5 m (eight ridges; 5 m long) and a total of 96 plots were used for the research. The intercropping system was maize/soybean intercrop in the order of 2 rows maize to 2 rows soybean (2:2); this was maintained for both seasons. The crop rotation system was soybean–maize rotation, with soybean planted in 2011 (1:0), followed by maize in 2012 (0:1). Soybean (TGx 1448-2E) and maize (SAMMAZ 14) were used as test crops.

Soybean seed inoculation and planting:

The soybean seeds were surface sterilized, as reported by Vicent (1970), and inoculated with commercial rhizobium inoculants, Legume-fix, as directed by the producer (See 3.1.2). Both maize and soybean seeds were sown on 1st July 2011 and 16th July 2012. The maize seeds were sown manually, two seeds per hole at an intra-line or intra-row spacing of 25 cm. The seedlings were thinned to one plant per stand at two weeks after sowing to give a plant population of approximately 53,333 plants ha^{-1}. Soybean seeds were drilled on the lines or ridges and covered lightly with soil. The uninoculated soybean treatment rows were sown first in order to avoid cross contamination. The seedlings were thinned to one plant per hill at a spacing of 5cm to achieve a population of approximately 266,667 plants ha^{-1}.

Fertilizer application:

Phosphorus and potassium fertilizers were applied to all the plots planted with maize at the rate of 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}, whereas those of soybean received 40 kg P_2O_5 ha^{-1} and 20 kg K_2O ha^{-1} at planting in both seasons, respectively. The sub plots were divided into four; only maize plots in both cropping seasons received urea fertilizer application at the rates of 0 kg N/ha, 40 kg N/ha, 80 kg N/ha and 120 kg N/ha. Nitrogen fertilizer rate was applied in two splits; first application was done at four weeks after sowing, while the remaining part was done as second application at eight weeks after sowing in the ratio of 1:2.

Soil Sampling:

Soil samples were collected systematically by dividing the field into eight sections. A total of 16 points two points per division within the field were sampled using the soil auger at 0-15 cm depth before trial establishment. The samples were bulked and thoroughly mixed and a composite sample was taken for analysis. At the end of the field experiments in 2012, four disturbed surface soil samples (0-15cm depth) were taken at alternate points from four inner ridges per plot using a soil auger. The samples were bulked to form a composite sample per plot. The composite samples taken were bagged, properly labelled, air-dried, crushed lightly and sieved through 2 mm sieves in readiness for analysis.

Laboratory Analysis:

Particle size distribution was determined by the hydrometer method, as described by Gee and Bauder (1986), using sodium hexametaphosphate as a dispersing agent. The textural classes were obtained from the USDA textural triangle. The bulk density was measured using core method (Grossman and Reinsch, 2002). The moist core soil sample was oven-dried at 105°C for 24 h, until a constant dried weight was obtained.

$$\text{Bulk density (BD Mg cm}^{-3}\text{)} = \frac{\text{Oven dry soil sample}}{\text{Volume of core cylinder}} \quad (1)$$

Bulk density (BD Mgm^{-3}) = Oven dry soil sample Volume of core cylinder (1) Soil porosity was calculated using a mathematical relationship between bulk density and particle density (Foth, 1984). Porosity (P) was computed as follows:

$$P (\%) = 1\text{-}BD/PD \times 100 \quad (2)$$

Where P= Porosity, BD=Bulk density (Mg m3) and PD=Particle density (2.65 g/cm3).

Soil pH was determined electrometrically in duplicates both in distilled water and 0.01M calcium chloride solution. A soil-solution ratio of 1:2.5 was used and read on pH meter (Hendershot*et al.*, 1993). The total nitrogen in soil was determined by micro-kjeldahl digestion method as described by Bremner and Mulvaney (1982). Organic carbon was measured using the method described by Nelson and Sommers (1982).

***Statistical analysis*:**

Data collected were subjected to analysis of variance (ANOVA) using the mixed linear model MIXED Procedure of SAS, Institute Inc., (2009). Effects of the various factors and their interactions were compared by computing least square means and standard errors of difference (SED) at 5% level of probability. Coefficient of correlation (r) analysis among some soil properties was also performed.

RESULTS AND DISCUSSION

Soil organic carbon

Data on the effect of tillage systems on soil organic carbon are presented in Table 1. Soil organic carbon (OC) was not significantly different among the tillage systems. The higher value of organic carbon found in reduced tillage could be attributed to reduced mineralization rate of soil organic matter due to less soil disturbance and less exposure of SOC fractions within soil aggregate (Al-Kaisi*et al*., 2005). However, the initial value of OC of the soil was lower than that obtained under both tillage systems, with a difference of 14.91 % for CT and 19.82 % for RT. The differences found in soil organic carbon content in response to tillage systems at surface soil of 0-15 cm depth, compared to initial value, were most likely due to the short-term implementation of the tillage, and the quantity of plant residues returned to the soil. The soil organic carbon impacted by tillage in the short-term are small, relative to the pool of soil organic carbon already present in the soil (Ellert*et al*., 2001). This implies that RT enhances redistribution of SOC closer to the soil surface than CT.

Cropping system had a significant effect on soil organic carbon (Table 1). The four cropping systems evaluated in this study revealed substantially greater OC contents than initial OC contents obtained at the same 0-15 cm depth before the commencement of the experiment. The soil under inoculated soybean-maize rotation had the highest OC content, which was significantly different from other cropping systems. The soil under uninoculated soybean-maize intercropping had the lowest OC content, and was not significantly ($P>0.05$) different from that of uninoculated soybean-maize rotation. The significantly higher OC content found under rhizobium inoculated soybean-maize rotation could be due to high maize-soybean biomass production with low C/N ratio, compared to sole maize. Other factors that can increase OC content in the cropping system are crop residues accruing from nodule mass, root and in-season fall-off leaves, as well as leftover shoot system after harvest. Plant root system may be more important than above-ground crop residues in sustaining soil organic matter (Al-Kaisi*et al*., 2005).

Data on the effect of nitrogen fertilizer rate on soil organic carbon content indicated a significant difference (Table 1). The result revealed a value greater than the initial value of 5.50 g kg^{-1} obtained from the experimental field. The plots treated with 120 kg N ha^{-1}resulted in higher OC content, followed by 80 kg N ha^{-1}. The least was found in soil under 0 kg N ha^{-1} application, which increased with increase in N fertilizer rate (Table 1).The effects of cropping system on soil C under 0 kg N ha^{-1} treatment are limited due to poor performance, which contributed to low plant residues returned to the soil in-season and after harvest. This could explain the non-significant difference observed among the plots treated with N fertilizer. However, little or no changes in SOC observed in control plots reaffirmed the low N status of the soil, which may intensify N immobilization by soil microbs (Karborzova-Saljnikov, 2004).

Soil total nitrogen (TN):

Soil tillage systems had a significant effect on TN (Table 1). The values of soil TN were low in soil under CT plots, compared to that under RT plots. The percentage contrast between RT and CT was 4.72 %, whereas the value increase in both tillage practices when compared with the initial TN of the soils before the experiment.The result suggested that CT produces more soil disturbances and exposes the soil to biotic and abiotic which result in reduction in soil N than RT. The effects of conventional tillage practices on SOC and TN dynamics depend, in part, on soil properties and environmental factors, such as soil texture, clay mineralogy, topography, and climate (Campbell *et al.,* 1999). These environmental factors may have contributed to the significant difference observed in soil total N contents in response to tillage systems at 0–15cm depth. However, greater total N contents in soil under RT may have accrued from more ground cover and slow decomposition rate due to settlement of crop residues on the soil surface and the decreased contact of crop residues with soil microorganisms (Salinas-Garcia *et al*., 1997; Schomberg and Steiner, 1999). This can also be attributed to the reduced mineralization rate of soil organic matter due to decreased soil aeration and less exposure of SOC fractions within soil aggregates with no-tillage (Al-Kaisi*et al.*, 2005). The statistically non-significant C/N ratio observed in response to tillage systems was most likely due to the short-term implementation of the tillage treatment. It implies that the quantities and quality of SOC impacted by tillage are small relative to the pool of SOC already present in the soil (Ellert*et al*., 2001).

Data on the effects of various cropping systems on total soil N at 0 to 15cm depth are presented in Table 2 The total N in inoculated soybean-maize rotation and inoculated soybean/maize intercrop was higher than those in the other two cropping systems involving soybean without inoculation. Total N in the plots previously cropped with inoculated soybean (rotation) or maize/inoculated soybean (intercrop) was 20% and 28% higher than those in rotation plots with uninoculated soybean, and intercrop with uninoculated soybean, respectively. The results showed significant differences between the cropping systems with inoculated soybean, as well as those without inoculation. Cropping systems with inoculated soybean in rotation contributed the highest amounts of N to the soil, followed by inoculated soybean intercropped with maize;thelowest amount was recorded for uninoculated soybean intercropped with maize, considering the initial TN in soil. This could be attributed to additional N_2 fixed (residual effect of rotation) due to effectiveness of rhizobium strain used in the inoculants and possibly supported by low nitrogen content and C/N ratio of the soil. Thus, a low C/N ratio suggests the release of soil nitrogen in available form to plants due to high microbial activity, while the reverse is the case for high C/N ratio. The increases in N supply in previous soybean treatments and yield of subsequent maize was probably due to additional N fixed and left in the soil for the subsequent maize crop. Study conducted by Yusuf *et al*., (2006) showed that cowpea fixed 16-34 kg N ha^{-1} and soybean fixed between 41-50 kg N ha^{-1} in the same Nigeria savannaAlfisol. Sanginga*et al.*, (2002) reported a nodulating soybean improve soil total N with an estimated net N balance input from fixation following grain harvest of 43 kg N ha^{-1}. This would be more enhanced under inoculated soybean cropping systems, suggesting higher soil productivity improvement, compared to cropping systems without inoculated soybean.

Furthermore, data on the effects of nitrogen fertilizer application on soil TN content are presented in Table 1. Total N in soil was significantly affected by N fertilizer rates at probability level of 5 %. The value was higher in soil with 120 kg N ha^{-1}, followed by 80 kg N ha^{-1}. The least was obtained for plots without N fertilizer. The result revealed that TN in soil increases with an increase in N fertilizer rate. The values of TN ranged from 1.04 to 1.14 g kg^{-1} across the N fertilizer rates. Thus, soil TN content indicated a consistent increase with corresponding N fertilizer application rate, with a significant difference between 120 kg N $ha^{-1}$and other treatments, but at par with 80 kg N ha^{-1}. The same trend was observed at 40 kg N ha^{-1} and 0 kg N ha^{-1} application rates as well as C/N ratio. The implication is that N fertilizer application improves N status of the soil. This can partly be explained by the changes in composition of SOM; suggesting that addition of inorganic N reversed immobilization of mineral N by microorganisms (Karborzova-Saljnikov, 2004) due to a reduction in C/N ratio. It is an indication that the N mineralization process exceeded immobilization process, which raises N in the study soil. This may be supported by low C/N ratio obtained in soil under N treatments that reflected the increase in microbes (bacteria) activity due to N application, which invariably enhanced decomposition and mineralization.

CONCLUSION

The study revealed that reduced tillage promotes carbon and nitrogen content in the soil than conventional tillage. Results also showed that values of OC and TN content of the soil were improved under inoculated soybean-maize rotation by 49.48 % for OC, 57.97 % for TN, higher than under uninoculated soybean-maize rotation. This implies that integration of inoculated soybean with rhizobium in the maize-based cropping systems would improve the productivity of the soil.

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Table 1 Selected chemical properties of soil productivity indicators

Treatment	OC (g/kg)	TN (g/kg)	C/N Ratio
		Tillage (TS)	
Conventional tillage	6.02[b]	1.02[b]	5.90[a]
Reduced tillage	6.89[a]	1.11[a]	6.21[a]
SE±	0.09	0.03	0.20
		Cropping system (CS)	
Rotation inoculated	8.05[a]	1.49[a]	5.40[b]
Rotation uninoculated	5.84[c]	0.99[c]	5.90[b]
Intercrop inoculated	6.75[b]	1.09[b]	6.19[a]
Intercrop uninoculated	5.18[c]	0.78[d]	6.56[a]
SE±	0.30	0.02	0.14
		N Rate (kg ha^{-1})	
0	5.36[c]	1.04[b]	5.15[c]
40	6.39[b]	1.06[b]	6.03[ab]
80	6.57[b]	1.10[ab]	5.97 [b]
120	7.51[a]	1.14[a]	6.59 [a]
SE±	0.27	0.01	0.1
		Interaction	
TS*CS	NS	*	*
TS*Nrate	NS	NS	NS
CS*Nrate	NS	NS	NS
TS*CS*Nrate	NS	NS	NS

OC = Organic carbon, TN = Total nitrogen, C:N = Carbon : nitrogen ratio, SOCs = Soil organic carbon stock, NS = Not significant at P<0.05, * = significant at P<0.05

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INFLUENCE OF VARIED RATIOS OF CASSAVA PEELS AND PIG MANURE - BASED COMPOST ON SOIL PROPERTIES AND YIELD OF OKRA (*ABELMOSCHUS ESCULENTUS (L) MOENCH*)

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ABSTRACT
Pot trial was conducted in the screen-house of University of Calabar Teaching and Research Farm, Calabar, Cross River State, Nigeria to determine the influence of varied ratios of cassava peels and pig manure based compost on soil properties, growth and yield of okra. The eight (8) treatments comprised of the absolute control, cassava peels alone (CP), pig manure alone (PM), three parts of cassava peels to one part of pig manure (3 CP + 1 PM, 3:1 ratio), two parts of cassava peels to one part of pig manure (2 CP + 1 PM, 2:1 ratio), one part of cassava peels to one part of pig manure (1 CP + 1 PM,1:1 ratio), one part of cassava peels to two parts of pig manure (1 CP + 2 PM, 1:2 ratio) and one part of cassava peels to three parts of pig manure (1 CP + 3 PM, 1:3 ratio) each applied at the rate of 20 t/ha The experiment was laid out in a completely randomized design (CRD) with three replications. The results obtained showed that the treatments applied brought about significant (P < 0.05) improvement in soil properties relative to control. The growth parameters of okra were significantly increased in all treated soil, especially the 2:1 and 1:1 ratios, relative to control. The highest fruit weight of okra (5200 kg/ha) was obtained from the 2: 1 ratio and is therefore recommended for sustainable production of okra as well as in promoting environmental safety.
Keywords: cassava peels, okra, pig manure, soil

INTRODUCTION

Okra (*Abelmoschus esculentus (L) Moench*), is a widely cultivated vegetable crop and very important in the diet of Africans (Omotoso and Shittu, 2008). Okra thrives naturally in the low land rainforest soils, high in moisture and temperature. However, owing to continuous cultivation devoid of adequate soil management practices, soil nutrient depletion, soil structure degradation, reduced water infiltration and run off erosion, non-profitability of okra production is on the increase. Researches into organic wastes that are cheap, readily available and environmentally friendly that could be used as fertilizers is of great necessity. This is due to the capability of organic waste in conserving soil physical, chemical and biological properties with implications on nutrient cycling, reducing erodibility, enhancing water storage, boosting plant vigor and the overall soil productivity (John *et al.*, 2013 and Iren *et al*., 2015).

Cassava peels are commonly found in farm locations and processing sites as heaps that are generally perceived as hazard to the environment. These materials, however, could be utilized more effectively and sustainably through recycling. Cassava peels like many organic waste materials are potential source of organic matter and plant nutrients. Management of cassava peels includes direct incorporation into the soil, feeding them to livestock, burning or processing them into a more stable organic fertilizer called compost. Composting cassava peels eliminate the problem of waste disposal and increase the manurial value of the materials (Akanbi e*t al.*, 2007; Iren *et al*., 2015). The abundance, as well as cheapness of cassava peels and pig manure had necessitated a research into their use by composting either solely or in combination for soil fertility trials and for okra production.

MATERIALS AND METHODS

Description of experimental site: The experiment was conducted at the screen house of the Teaching and Research Farm of the University of Calabar, Calabar (latitude 5º 32' and 4º 27' N and longitude 7º 15' and 9º 28' E). The total rainfall ranges from 2000- 3500 mm annually while the mean temperature ranges from 23 -33 ºC. The mean relative humidity is 60- 90%.

Collection and preparation of materials: Plastic buckets (10 Litre capacity) were perforated at the bottom to allow for easy drainage and facilitate aeration. Cassava peels and pig manure were composted on dry weight basis based on specified ratio for 12 weeks using the heap method. Top soil (0-15cm) used for the experiment was collected from the Teaching and Research Farm of the University of Calabar.

Experimental design and treatments/ Rate of manure application: Eight (8) treatments, including the control were laid down in a completely randomized design (CRD) and replicated three times. To each experimental bucket containing 10 kg of soil, the various treatments were applied, based on the calculated rate of application of 20 t/ha with each bucket receiving 100 g of specified manure. The treatments were thoroughly mixed with the soil except the absolute control pots, watered to field capacity for a period of seven days before planting.

Planting and crop management/ Data collection: Four (4) okra seeds were planted in each pot and were later thinned down to two plants per pot two weeks after planting (WAP). Watering was done every other day after planting using one litre of water per bucket. The growth parameters measured after one month of planting were number of leaves per plant, stem girth, plant height, number of fruits and fruits weight and these continued at a monthly interval.

Soil sampling/Laboratory analyses: One composite soil sample was taken before experiment and at the end of the experiment; soil in each pot was sampled for analysis. The soil samples were air dried, ground and sieved with 2 mm size sieve and physicochemical properties analyzed following standard procedures as outlined by Udo *et al*. (2009). The properties analyzed include particle size distribution, Soil pH (H_2O), organic carbon, total nitrogen, available phosphorus, exchangeable bases and exchangeable acidity. Effective cation exchange capacity and base saturation were calculated.

RESULTS AND DISCUSSION

Soil properties before experiment and nutrient contents of pig manure and cassava peels before composting: The physicochemical analysis of the soil at the onset of the experiment is presented in Table 1. The soil texture was sandy loam and strongly acid (pH = 5.5) in reaction, low in organic carbon, total nitrogen but high in available P. Results of the analysis of pig manure and cassava peels are also presented in Table 1.

Influence of cassava peels and pig manure based compost on soil properties: Table 2 presents the influence of cassava peels and pig manure based compost on soil properties. Soil pH was significantly ($P < 0.05$) increased across the various treatments when compared with the initial pH of 5.5 and the absolute control (5.2). The highest pH value of 7.2 was obtained from the 1:1 ratio (1CP + 1PM). Generally, it was observed that the cassava peels and pig manure based compost buffered the soil pH, increase organic carbon, available P, calcium and potassium contents in the soil when compared to the initial status of the soil and control. The results agree with previous reports which asserted that organic compost helps in maintaining the nutrient content of the soil while improving other soil condition (Alarisi and Ogunkeyede 1999; John *et al.*, 2013; Iren *et al*.,2014; Iren *et al*., 2015)

Influence of cassava peels and pig manure based compost on growth parameters of okra plant: The number of leaves per okra plant at one month after planting (MAP) and at 2 MAP was significantly increased by all the treatments with the highest number obtained from soil treated with 1:1ratio (1CP + 1PM) (Table 3) whereas at 3 MAP the highest number of leaves was obtained from soil treated with 2:1 ratio (2CP + 1PM) compost. Generally, the cassava peels and poultry manure based compost improved the number okra leaf more than when either of them was applied singly. Increase in the number of okra leaves as a result of organic based fertilizer application has been reported by Olatunji and Oboh (2012).The same trend was observed for the leaf area of okra plant. This is in agreement with the findings of Iren *et al*. (2015) who observed higher increase in leaf area of waterleaf from cassava and poultry manure based compost treatments than their sole application.

The influence of cassava peels and pig manure based compost on stem girth and height of okra plant are shown in Table 4. Generally, all the treatments significantly ($P < 0.05$) increased the stem girth of okra plant across all the growth stages when compared with the control. There was significant increase in plant height of okra at different growth stages as shown in Table 4. At 1 and 2 MAP, tallest plants were obtained from 1: 2 ratio (1CP + 2PM) treatment followed by 1: 1 ratio (1CP + 1PM) treatment while the shortest plants were from control. At 3 MAP, the 1: 1 ratio (1CP + 1PM) treated plants were taller than the other treated plants. Generally, the untreated plants were shorter than the treated plants at all the growth stages. This agrees with the findings of Odiete *et al*. (1999) who reported increase in okra plant height by the application of goat manure.

Influence of cassava peels and pig manure based compost on the number of fruits and weight of okra: The influence of cassava peels and pig manure based compost on number of fruits and weight of okra was significant (Table 5) with the highest number of fruits (12.6) and fruit weight (5200 kg/ha) of okra obtained from the application of 2:1 ratio (2CP + 1CP), followed by cassava peels. All the treatments differ significantly from one another. This is similar to the findings of Olatunji and Oboh (2012) who reported response of okra plant to applied manures. The increase in fruit weight of okra was in the order 2CP + 1PM > CP > 3CP + 1PM = 1CP + 3PM > 1CP + 2PM > 1CP + 1PM > PM > control. Similar trend was obtained for number of okra fruits.

Conclusion: The addition of pig manure and cassava peels solely or in combination improved soil chemical properties as well as growth performance of okra when compared with control. Growth parameters were increased mostly by the combined application of cassava peels and pig manure treatments than the single applications. The cassava peels and pig manure based compost when used effectively will help reduce the hazard caused by indiscriminate dumping of these materials for a safer environment.

Table 1: The properties of the soil before experiment and nutrient content of amendments used

Soil property		Nutrient content of amendments (%)		
Parameter	Value	Parameter	Pig manure	Cassava peels
pH (H_20)	5.5	Organic carbon	27.9	12.57
Organic carbon (%)	1.67	Total N	3.72	1.47
Total Nitrogen (%)	0.14	C:N ratio	7.50	8.60
Available P (mg/kg)	13.50			
		Total P	1.46	0.79
Mg	0.80			
Ca	8.0	Total K	0.62	0.11
Na	0.07			
K	0.09	Calcium (Ca)	1.04	1.89
Exch. Acidity (cmol/kg)	0.12			
ECEC	9.08	Magnesium (Mg)	0.54	0.81
Base saturation (%)	95.0			
Clay	3.0			
Silt	17.0			
Sand	80.0			
Textural class	Sandy loam			

Table 2: Chemical properties of the Soil after Experiment

Treatment	pH (H_2O)	Org. C (%)	Total N (%)	Av. P (mg/kg)	Exchangeable cations (cmol/kg)				EA (cmol/kg)	ECEC (cmol/kg)	BS (%)
					Ca	Mg	K	Na			
Control (no manure)	5.2e	0.8g	0.06g	57.3h	11.4a	1.9d	0.12a	0.10a	0.15f	9.7cd	98.7a
Cassava peel (CP)	6.7bcd	1.4e	0.11e	99.0g	7.9c	0.9e	0.11b	0.08c	0.2e	9.3cd	97.7ab
Pig manure (PM)	6.9ab	2.8a	0.24a	189.9b	8.7b	2.7ab	0.12a	0.09b	0.4b	12.00a	96d
3CP + 1PM	6.7bcd	1.3f	0.10f	162.0d	6.1e	3.4a	0.10c	0.08c	0.28dc	10.9b	97c
2CP + 1PM	6.8bc	1.5cd	0.11e	144.2e	6.4e	2.4ab	0.09d	0.07d	0.2e	9.2d	97.3c
1CP + 1PM	7.2a	1.8c	0.15c	173.4c	7.3cd	1.7d	0.10c	0.08c	0.24d	6.4e	97.3c
1 CP + 2 PM	6.2cd	1.6cd	0.13d	124.5f	7.5c	2.1c	0.11b	0.09b	0.30c	10.1c	97c
1 CP + 3 PM	6.5bcd	2.4b	0.20ab	214.25a	6.7de	3.1a	0.11b	0.08c	0.5a	10.5bc	94.7e

Means followed by the same letter(s) within the same column are not significantly different (DNMRT at 5% level)

Table 3: Influence of cassava peels and pig manure based compost on the number of leaves and leaf area of okra plant

	Number of leaves per plant			**Leaf area (cm²)**		
Treatments	**1 MAP**	**2 MAP**	**3 MAP**	**1 MAP**	**2 MAP**	**3 MAP**
Control	3.3g	6.3g	6.3e	17.49g	96.30h	167.31g
Cassava Peels alone	3.9f	6.5f	8.0cd	90.64c	243.10f	393.30d
Pig manure alone	7.0e	7.7e	8.3cd	83.00c	107.80g	111.51h
3CP + 1PM (3:1)	9.3b	9.6bc	9.4b	116.40b	442.70d	447.19b
2CP + 1PM (2:1)	8.0c	8.7c	11.5a	117.00b	472.99c	486.59a
1CP + 1PM (1:1)	10.3a	10.0a	11.2a	143.00a	557.50a	366.39e
1CP + 2PM (1:2)	8.0c	9.7b	6.6f	60.30f	426.39e	397.11c
1CP + 3PM (1:3)	7.3d	8.0d	6.6f	73.00d	511.20b	358.11f

Means followed by the same letter(s) within the same column are not significantly different.

TABLE 4: Influence of cassava peels and pig manure based compost on okra stem girth and height.

	Stem girth			Plant height		
Treatments	1 **MAP**	2 **MAP**	3 **MAP**	1 **MAP**	2 **MAP**	3 **MAP**
Control	1.2e	1.3f	1.7e	28.3g	36.7f	42.0g
Cassava Peels alone	1.5d	2.0e	2.6c	34.7bcd	45.0cd	63.3c
Pig manure alone	1.7b	2.5c	2.6c	34.7bcd	45.0cd	48.7f
3CP + 1PM (3:1)	1.6c	2.3d	2.5c	31.3f	45.3cd	59.3d
2CP + 1PM (2:1)	2.1a	2.5c	2.7b	35.0bc	48.3c	62.3c
1CP + 1PM (1:1)	1.8c	2.6b	2.8b	35.3b	52.0ab	71.3a
1CP + 2PM (1:2)	2.0a	2.7a	3.4a	37.7a	54.7a	64.3b
1CP + 3PM (1:3)	2.1a	2.7a	3.3a	34.3bcd	42.0e	51.7e

Means followed by the same letter(s) within the same column are not significantly different.

TABLE 5: Influence of cassava peels and pig manure based compost on the number and weight of okra fruits.

Treatment	**Number of fruits**	**Fruit weight (kg/ha)**
Control	10.3f	600g
Cassava peels alone	12.3b	4600b
Pig manure alone	11.3d	1400f
3CP + 1PM (3:1)	11.7c	3400c
2CP + 1PM (2:1)	12.6a	5200a
1CP + 1PM (1:1)	11.0e	2000e
1CP + 2PM (1:2)	11.3d	2600d
1CP + 3PM (1:3)	11.7c	3400c

Means followed by the same letter(s) within the same column are not significantly different.
3CP + 1PM= 3:1 ratio (3 parts of cassava peels to 1 part of pig manure), 2CP + 1PM =2:1 ratio (2 parts of cassava peels to 1 part of pig manure), 1CP + 1PM = 1:1 ratio (1 part of cassava peels to 1 part of pig manure), 1 CP + 3 PM = 1:3 ratio (1 part of cassava peels to 3 parts of pig manure), 1CP + 2PM =1:2 ratio (1 part of cassava peels to 2 parts of pig manure).

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BIO-FERTILIZERS AS AN INNOVATIVE TOOL FOR SOIL FERTILITY AND CROP PRODUCTIVITY: A REVIEW

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ABSTRACT
The continuous application of synthetic fertilizers enhance proper growth and crop yield but these fertilizers endanger ecosystem, soils, plants, human and animal lives. Alternative to chemical fertilizers is required to reduce environmental pollution, depletion of soil health status and d risk to human lives. Bio-fertilizers are one such technique, which can be used in a scientific way to avoid environmental pollution, and to increase soil fertility and crop productivity. Bio-fertilizers not only keep the crops healthy, will change micro environment of the soil and increase beneficiary microbial fauna.
Keywords: bio-fertilizers, soil, crop productivity, innovative

INTRODUCTION
With the introduction of green revolution technologies, the modern agriculture is getting more and more dependent upon the steady supply of synthetic inputs. Intensive agriculture with the use of chemical fertilizers in large quantity has resulted in manifold increase in the productivity of farm commodities but the adverse effect of these chemicals are clearly visible on soil properties leading to depletion of water holding capacity of the soil, soil fertility, micro flora, quality of water, and disparity in soil nutrients (Mohapatra et al,2013). Hence, the need to develop some low cost effective and eco-friendly fertilizers which would work without disturbing the nature arise. At this critical juncture, bio-fertilizers as an alternative become useful supplement to chemical fertilizers.
Bio-fertilizers are natural and organic fertilizer that helps to keep in the soil with all the nutrients and live microorganisms required for the benefits of the plants. It is used in organic farming, sustainable agriculture, green farming and non pollution farming. It is also one of the important components of integrated nutrient management, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers for sustainable agriculture.(Mishra et. al,2013). Scientists have developed the way of organic farming by use of "Bio-fertilizers" to prevent chemical pollution in farm lands. Bio-fertilizer contains microorganisms which promote the adequate supply of nutrients to the host plants and ensure their proper development of growth and regulation in their physiology. Living microorganisms are used in the preparation of Bio-fertilizers which have specific functions to enhance plant growth and reproduction. Bio-fertilizers being essential components of organic farming play vital role in maintaining long term soil fertility, crop productivity and sustainability (Venkatashwarlu, 2008). The aim of bio-fertilizers is to complement and, where appropriate, replace conventional chemical fertilizers so that their use can be reduced with the resulting economic and environmental benefits.

What are Bio-fertilizers?
A **Bio-fertilizer** is a substance which contains living microorganisms(bacteria, fungi, and algae) which, when applied to seeds, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Vessey,2003).In addition, a live formulation of micro-organisms are used for fertilization of farm lands in the aspect of fixation of N2, solubilisation and mobilization of phosphorus, increasing organic carbon content, balanced C/N ratio, plant growth promotion by increasing nutrient absorption, antagonistic activity against plant pathogens, production of hormones etc that are beneficial for agriculture. Bio-fertilizers were promoted through integrated plant nutrient systems (IPNS) that involved combining fertilizers, organic/green manures and bio-fertilizers to sustain crop production, maintaining soil productivity, health and diversity.(Mohaptra, et. al 2013).

Why Biofertilizers?
Since a bio-fertilizer is technically living, it can symbiotically associate with plant roots. Involved microorganisms could readily and safely convert complex organic material in simple compounds, so that plants can easily take it up. Microorganism function is in long duration, causing improvement of the soil fertility. It maintains the natural habitat of the soil(Chen,2016). It can also provide protection against drought and some soil-borne diseases are sufficient for growth and multiplication of organisms in subsequent years. They improve soil texture, pH, water holding capacity and other properties of soil. They have lower manufacturing costs. As a safe alternative to chemical fertilizer, it minimizes the ecological disturbance and are cost effective, eco-friendly and when they are required in bulk can be generated at the farm itself. They increase crop yield up to 10-40% and fix nitrogen up to 40-50 Kg and parental inoculums especially regarding nitrogen and phosphorus use. They produce

plant growth promoting substances IAA, amino acids, vitamins etc. Bio-fertilizers contained 3.5% - 4% nitrogen, 2% - 2.5% phosphorus and 1.5% potassium. In terms of N: P: K, it was found to be superior to farmyard manure and other type of manure (Mishra,et al.,2014).

Types of Bio-fertilizers

The various types of bio-fertilizers which help the plant to grow at different levels of its growth are:

1. **Nitrogen fixing bio-fertilizers** (Azotobacter, Nostoc, Rhizobium, Azospirillum) increase soil nitrogen level (ii). Fixes the atmospheric nitrogen in the soil and make it available to the plants.

2.**Phosphate bio-fertilizers** (a). Phosphorous solubilizing bio-fertilizers (Species of Bacillus, Pseudomonas, Penicillium, Aspergillus) solubilize the insoluble phosphate from organic and inorganic phosphate sources, releases insoluble phosphorus in soil and fix in clay minerals, secrete organic acids and lower the pH to dissolve bound phosphates in soil. (b). Phosphorus mobilizing biofertilizers (Arbuscular Mycorrhiza, AM fungi) fungus penetrates the cortical cells of the roots, increase surface area of roots, displace of absorption equilibrium of phosphate ions which increases the transfer of P ions, stimulate metabolic processes, Arbuscles absorb these nutrients into the root system

3.**Bio-fertilizers for micro-nutrients** (Bacillus sp.) bacterial species are Silicate and Zinc solubilizers, degrade silicates and aluminum silicates in soil, help in silicate weathering

4**. Plant growth promoting Rhizobacteria** (Pseudomonas sp., Bacillus sp.) act as both bio-fertilizer and bio-pesticides, promote growth by improved nutrient availability (bio-fertilizers), suppression of plant disease (bioprotectants), phytohormones production (biostimulants)

5. **Compost** (Cellulolytic fungi, Azotobacter) utilize animal dung to enrich soil with microorganisms, eco-friendly organic fertilizer, consists of nitrogen, phosphate solubilizing bacteria and various decomposing fungi, microorganisms breaks down organic matter (dead plants, farm yard waste, cattle waste).

These microbes (Table. 1) are effective in inducing plant growth, enhance seed germination and root and shoot growth, decomposition of organic materials and enrichment of compost.(Mishra,et al.,2014)

Biofertilizers for Different crop plants

Bio-fertilizers provide eco-friendly organic agro-input and are more cost-effective than chemical fertilizers. Bio-fertilizers such as Rhizobium, Azotobacter, Azospirilium and blue green algae (BGA) have been in use a long time. Rhizobiuminoculant is used for leguminous crops. Azotobacter can be used with crops like wheat, maize, mustard, cotton, potato and other vegetable crops. Azospirillum inoculations are recommended mainly for sorghum, millets, maize, sugarcane and wheat. Blue green algae belonging to a general cyanobacteria genus, *Nostoc* or *Anabaena* or *Tolypothrix* or *Aulosira*, fix atmospheric nitrogen and are used as inoculations for paddy crop grown both under upland and low-land conditions. *Anabaena* in association with water fern Azolla contributes nitrogen up to 60 kg/ha/season and also enriches soils with organic matter.

Other types of bacteria, so-called phosphate-solubilizing bacteria, such as Pantoea agglomerans strain P5 or Pseudomonas putida strain P13, are able to solubilize the insoluble phosphate from organic and inorganic phosphate sources. In fact, due to immobilization of phosphate by mineral ions such as Fe, Al and Ca or organic acids, the rate of available phosphate (P_i) in soil is well below plant needs. In addition, chemical P_i fertilizers are also immobilized in the soil, immediately, so that less than 20 percent of added fertilizer is absorbed by plants. Therefore, reduction in P_i resources, on one hand, and environmental pollutions resulting from both production and applications of chemical P_i fertilizer, on the other hand, have already demanded the use of new generation of phosphate fertilizers globally known as phosphate-solubilizing bacteria or phosphate bio-fertilizers.

Role of Bio-fertilizers in soil fertility and Agriculture

Some of the important functions or roles of Bio-fertilizers in agriculture are:

1.They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops.

2. They can add 20-200 kg N/ha year *(eg. Rhizobium sp* 50-100 kg N/ha year ; *Azospirillum , Azotobacter* : 20-40 kg N/ha /yr; Azolla : 40-80 kg N/ha; BGA :20-30 kg N/ha) under optimum soil conditions and thereby increases 15-25 percent of total crop yield.

3.They can at best minimize the use of chemical fertilizers not exceeding 40-50 kg N/ha under ideal agronomic and pest-free conditions.

4. Application of Biofertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation.

5. Some Biofertilizers *(eg, Rhizobium, BGA, Azotobacter* sp) stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc.

6. Phosphate mobilizing or phosphorus solubilizing Biofertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.) converts insoluble soil phosphate into soluble forms by secreting several organic acids and under optimum conditions they can solubilize / mobilize about 30-50 kg P2O5/ha due to which crop yield may increase by 10 to 20%.

7. Mycorrhiza or VA-mycorrhiza (VAM fungi) when used as Biofertilizers enhance uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also enhance resistance to root diseases and improve hardiness of transplant stock.

Application of Bio -fertilizers

Seed treatment : One packet of the inoculants (200 g) is mixed with 200 ml of rice kanji to make slurry. The seeds required for an acre are mixed in the slurry so as to have a uniform coating of the inoculant over the seeds and then shade dried for 30 minutes. The shade dried seeds should be sown within 24 hours. One packet of the inoculant (200 g) is sufficient to treat 10 kg of seeds**.**

Seedling root Dip: It has better application for transplanted crops. Two packets of the inoculant is mixed in 40 liters of water. The root portion of the seedlings required for an acre is dipped in the mixture for 5 to 10 minutes and then transplanted.

Main field application: 1kg of the inoculant is mixed with 20 kg of dried and powdered farm yard manure and then broadcasted in one acre of main field just before transplanting.

Mass Production of Bio-fertilizers :

The mass production of Bio-fertilizers involves three stages:

1 : Culturing of microorganisms

2: Processing of carrier material

3: Mixing the carrier and the broth culture and packing

Bio-fertilizers are carrier based preparations containing efficient strain of nitrogen fixing or phosphate solubilising microorganism prepared in suitable medium and mass produced in fermentor with proper aeration, temperature, growth conditions and without any undesired microbial contaminations. Bio-fertilizers are formulated usually as carrier based inoculants. The organic carrier materials are more effective for the preparation of bacterial inoculants. Peat soil, lignite, vermiculite, charcoal, press mud, farmyard manure and soil mixture can be used as carrier materials. The neutralized peat soil/lignite are found to be better carrier materials for bio- fertilizer production which is cheaper, locally available, inert, having high WHC and organic content. The bacterial culture drawn from the fermentor is added to the sterilized carrier and mixed well by manual (by wearing sterile gloves) or by mechanical mixer then sealed at room temperature (Mohapatra et al,2013**).**

CONCLUSION

Bio-fertilizers being essential components of organic farming play vital role in maintaining long term soil fertility and sustainability by fixing atmospheric di-nitrogen (N=N), mobilizing fixed macro and micro nutrients or convert insoluble P in the soil into forms available to plants, there by increases their efficiency and availability. Currently there is a gap of ten million tonnes of plant nutrients between removal of crops and supply through chemical fertilizers. In context of both the cost and environmental impact of chemical fertilizers, excessive reliance on the chemical fertilizers is not viable strategy in long run because of the cost, both in domestic resources and foreign exchange, involved in setting up of fertilizer plants and sustaining the production. In this context, organic manures (bio- fertilizers) would be the viable option for farmers to increase productivity per unit area.

Table. 1. Microbes used as Biofertilizers

Groups	Examples
1. N2 Fixing Biofertilizers	
❖ Free Living	Berijerinkia,Azotobacter,Anabaena, Nostoc
	Rhizobium,Frankia,Anabaena,Azolla
	Azospirillum
❖ Symbiotic	
	Bacillus Megaterium,B.subtilis,
❖ Associative Symbiotic	B.Circulans,Pseudomonas Striata
2. P Solubilizing Biofertilizers	
❖ Bacteria	Penicillium spp, Aspergillusawamori
❖ Fungi	Glomus spp.,Gigaspora spp., Acaulospora spp.
	Laccaria spp.,Pislithus sp.,Boletus sp.,Amanita spp.,
3. P Mobilizing Biofertilizers	Pezizellaericae
❖ Arbuscular Mycorrhiza	
	Rhizoctonia solani
❖ Ectomycorrhiza	
❖ Ericoid mycorrhizae	Bacillus spp.
❖ Orchid Mycorrhiza	
4. Biofertilizers for Micronutrients	Pseudomonas fluorescens
❖ Silicate and Zinc solubilizers	
5. Plant Growth Promoting Rhizobacteria	
❖ Pseudomonas	

Source:http://www.agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology

Table 2. Micro organisms as Biofertilizers for different Crops

Micro organisms	Nutrient fixed (kg/ha/year)	Host crops for which used
Actinorrhizae (frankia spp)	150 kg N/ha	For certaain non-legumes mainly trees and shrubs
Algae	25kg N/ha	Rice
Azolla	900kg N/ha	Rice
Azospirilllum	50 to 300kg N/ha	Non-legumes like Maizee, barley, oats, sorghum, Millets, rice, Sugarcane
Rhizobium	0.026 to 20kg N/ha	Legumes like pulses, peas, Groundnut, soyabeans, beans and clover
Azotobacter	10-20kg N/ha	Cereals, millets, cotton, vegetables
Mycorrhizae (VAM)	Solubilize food phosphorus (60%)	Many trees species, wheat, sorghum, ornamentals
Phosphate Solubilizing Bacteria and fungi	Solubilize about 50%-60% of them fixed phosphorus in the soil	Soil application for all crops

Sources: Mall et al., 2013

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DISTRIBUTION OF SELECTED SOIL PROPERTIES IN AGGREGATE SIZES UNDER DIFFERENT GEOLOGIC FORMATIONS IN SOUTH EASTERN NIGERIA

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ABSTRACT
The study investigated distribution of selected soil properties in aggregate sizes under different geologic formations in south eastern Nigeria. The experiment was analysed using ANOVA suitable for RCBD. ***.*** *Bulk density ranged from 1.2 gcm-^{3} in Obinze to 1.4gcm-^{3} in Umuna. Soil organic matter content ranged from 1.13 % in Obinze to 2.49 % in Umuna respectively. The stability of aggregates using percentage water stable aggregates greater 0.25 mm (WSA > 0.25) was significantly higher in soils under Umuna (59.18%) and least at soils of Obinze (26.27 %) under coastal plain sand. Soil properties significantly p(< 0.05) varied with sieve sizes. Soil organic matter ranged from 2.12 % in aggregate diameter of 2 mm to 2.74% in 0.3mm, 1.39 % in 0.3mm diameter to 3.21% in < 0.3mm in Obinze, 2.03% in 2mm sieve to 3.02% in < 0.3mm and from 1.45% in sieve of 0.3mm to 2.73% in < 0.3mm sieve size in Uzoakoli. In all cases however, organic matter were low and occurred majorly in less than 3 mm aggregates sizes.*
Keywords: Geologic formation, aggregate sizes, soil properties, southeast Nigeria, organic matter

INTRODUCTION

Soil aggregation is a soil quality indicator that provides information on the soil's ability to function as a basic component of the ecosystem and influences the transportation of liquids , gases and heat as well as physical process such as infiltration and aeration (Nimmo 1997).

Land forms (lithology and morphology) permits an understanding of differences in soil formation, evolution, soil analysis and soil aggregate depends on site-specific characteristics of the morpho-edaphological unit. The growing population leading to land use increase, the non adoption of modern technologies amidst inappropriate management practices such as continuous cropping, burning, deforestation, tillage (Mbagwu and Obi 2003) has led to soil disintegration of soil aggregates thus leading to soil erosion, which according to Brady and Weil (1999). There is a death of information on the relationship between aggregate sizes and properties of soils of the south eastern Nigeria. Scantiness of such information could be responsible for the increasing spate of soil structural breakdown and development of a variety of rills and gullies on a once beautiful landscape, leading to soil loss, displacement of homes, loss of farmlands, poor nutrient reserve and declining yield of crops Osuji and Onweremadu (2007). Based on the above, the major objective of the study was to determine the distribution of selected soil properties in aggregate sizes under different geologic formations in south eastern Nigeria. Specifically the studies determined the soil physical and chemical properties, the distribution of selected soil properties in soil aggregate sizes.

MATERIALS AND METHODS

The study was conducted at Ishiagu in Ebonyi State located on latitude 5^{0} 27'11"N and longitude 7^{0} 31'50.04' E, Umunah in Okigwe, Imo state on Latitude 5^{0}42'N, Longitude 7^{0}10'E, Uzoakoli in Abia State on latitude 5^{0}38'10.2" E and longitude 7^{0}33'32.1" N and Obinze in Owerri Imo State on Latitude 5^{0} 22'23.3"N and longitude 7^{0} 9'34"E, representing four parent materials namely Asu River group, false bedded sand, Bende Ameki and coastal plain sand respectively (FEDLAR 1990). The study areas belong to the humid tropical climate which is warm all the year round (Anyadike 2002). Mean annual rainfall ranged from 1205 mm in Ebonyi - 2700 mm in Imo State, NIMET (Nigerian Meteorological Agency), Nigeria, (2012) while annual temperatures and humidity range from 26-29^{o}C and 80 %- 90 % respectively (NIMET, 2012). The major vegetation is tropical forest (Anyadike 2002), which has been tampered by anthropogenic activities. There also exists forest savanna vegetations and fresh water swamp around Afikpo, Akeze, Abakiliki, and Okigwe and within the Riverine areas. Farming is a major socio-economic activity of the area.

Soil samples were collected randomly at a depth of 0-15 cm from the four locations in three replicates. Samples were air dried, crushed and sieved using 2 mm mesh, properly labelled and was taken to laboratory for analysis. Samples for aggregate stability were not crushed after air drying. Core samplers were also used to collect samples for bulk density determination.

Experimental design. The experiment was arranged in randomized complete block design (RCBD). The parent material and the aggregate sizes constitute the treatments.

Laboratory analyses. Particle size determination was determined in calgon and water by bouyoucos hydrometer method (Gee and Or 2002).Bulk density was measured by core method (Grossman and Reinsch 2002). Soil aggregate stability (WSA) was estimated by wet-sieving techniques (Kemper and Rosenau 1986). Aggregates sizes were separated with nest of sieves having diameters of 4.75mm, 2.0mm, 1.mm, 0.5mm, 0.25mm stacked together and shaken. Soil pH was determined potentiometrically in soil-water ratio of 1:2.5 as described by Hendershot *et al.* (1993). Soil organic carbon was measured by wet digestion (Nelson and Sommers, 1996). Available phosphorus was measured by Olsen method (Emteryd, 1989). Effective cation exchange capacity will be determined by summation method.

Data Analyses. Data were analysed using analysis of variance ANOVA. Significant means were separated using least significant difference (LSD) at 5% probability.

RESULTS AND DISCUSSION

The results of the physical and chemical properties of the studied soils are presented in Table 1. Sand fraction ranged from 552.90 to 840.00 gkg^{-1} and is significantly higher ($p<0.05$) in Uzoakoli. Clay fraction ranged from 110.00gkg^{-1} to 323.30gkg^{-1}, while silt ranged from 40.00gkg^{-1} to 123.80 kg^{-1}.These values were typical of soils of south eastern Nigeria (Igwe, 1995). Texturally, soils of Ishiagu was sandy clay loam, Obinze, sandy, Umuna and Uzoakoli were sandy loam and loamy sand respectively. The classification was in line with Esheth (1995), Akamigbo and Asadu (1993) who documented similar textures for surface horizon soils of humid tropics. Bulk density ranged from 1.2 $gcm\text{-}^{3}$ in Obinze to 1.4$gcm\text{-}^{3}$ in Umuna. Soils whose bulk densities were low related to high porosity, lesser compaction and easier penetration of roots and movement of micro fauna in them. Soil pH in water though not significantly differed ($p<0.05$) among parent materials ranged from 5.37 to 5.75. Moderate acidic condition of the soils was attributed to constant leaching by rainfall in the area which leaves the soil saturated with more aluminium and hydrogen (Landon 1991). Soil organic matter content ranged from 1.13% in Obinze to 2.49% in Umuna respectively Table 1. These values have been rated as low and are typical of tropical soils a factor that predisposes the soils to dispersion making it prone to erosion menace. The stability of aggregates using percentage water stable aggregates greater 0.25 mm (WSA > 0.25) was significantly higher in soils under Umuna (59.18%) and least at soils of Obinze (26.27 %) under coastal plain sand. The trend of the stability with respect to studied parent material was FBS > ARG>BAG> CPS. This trend is attributed to texture, type of clay (USDA 1996), organic matter which acts as a bonding agent between mineral soil particles (Tisdall and Oades 1982; Hayness and Swift 1990; USDA 1996) and their interactions (Le-Bissonnaise 1996), exchangeable sodium percentage (Kazman *et al.* 1983), soil management (Iraj 2009). Kay and Angers (1999) stated that aggregate stability declines rapidly as organic carbon decreases from 1.5- 1.2%. Among the list of other factors that affect structural stability include sesquioxides (Le-Bissonnaise and Singer 1993).

The result of soil organic carbon presented in Table 1 significantly differed ($p<0.05$) with parent material and followed similar trend with that of aggregate stability (FBS > ARG>BAG> CPS). SOC ranged from ranged from 9.60 in Obinze soil - 14.80 gkg^{-1} in soils under Umunna. Generally, the result of soil organic matter are rated low (Landon 1991; Igwe and Stahr 2004, Opara - Nadi (1988).

The distribution of selected soil properties in aggregate sizes of studied soil

The distribution of selected soil properties in aggregate sizes of studied soils are presented in Table 2. Soil organic carbon ranged from 12.3 % in aggregate diameter of 2 mm to 15.9 % in 0.3mm, 8.10 % in 0.5 mm diameter to 18.60 % in < 0.25mm in Obinze, 11.80 % in 2mm sieve to 17.50 % in 0.25 mm and from 8.40 % in sieve of 0.50 mm to 15.80 % in 0.25 mm sieve size in Uzoakoli respectively. In all cases however organic matter were low and occurred majorly in 0.25 mm aggregates sizes. The high values of soil organic matter at this level of aggregation is attributed to slaking which occurs when higher aggregates are not able or strong enough to withstand internal stresses caused by rapid water uptake or tillage thus releasing heat which makes the aggregate to collapse. Igwe (2003) observed that soils whose aggregates occur more on the < 0.25 mm sizes correlates with inter rill and rill erosion in the field. Le Bissoinnaise (1996) posited that aggregates at these sizes are very unstable and undesirable. This implies that the organic matter contained in the above soils are very much prone to erosion loses. The relationship between micro aggregate stability and organic matter concentration in tropical soils has been reported to be positively significant (Mbagwu *et al.*1993, Obi 1982). Effective cation exchange capacity ECEC ranged from 5.77 to 9.03 $cmolkg^{-1}$ in sieves of 2mm and 1mm in Ishiagu, from 2.20 to 2.93$cmol^{-1}$ in sieves of 0.25 mm and 1mm, Obinze ; from 5.22 to 12.13 $cmolkg^{-1}$ in sieves of 2mm and 0.5 mm in Umuna and from 3.04 to 3.44 $cmolkg^{-1}$ in sieves of 0.25 mm and 2 mm in Uzoakoli respectively. ECEC like soil organic carbon in all soils are low. These values are below the critical limits for soils of Southeasthern Nigeria (Enwezor *et al.* 1990), suggesting poor fertility status of the soil (Igwe 2000). Ojanuga and Awojuola (1981) attributed low ECEC to the nature of clay minerals dominant in the study area. Available phosphorus was significantly ($p<0.05$) higher in aggregates size of 1mm in all studied soils. It ranged from 2.90 – 5.70 in sieve size 2 and 1mm in Ishiagu, 3.84 -6.64 in 0.5 and 2 mm sieves in Obinze, 6.60 -9.60 in sieve size of 0.25 and 2mm in Umuna and 0.10 to 9.40 mgkg^{-1} in aggregates sizes of 0.5 and 0.25mm in Uzoakoli respectively. The values were low (Landon 1991) and typical of soils of the area. Uzoho and Oti (2005) recorded similar trend in similar soil. Low phosphorus availability in tropical soil is attributed to intense weathering and partly due to the low availability of phosphorus in the aluminum and iron combination which were the dominant sources in these soils (Brady and Weil 1999). It has also been documented that low phosphorus values inhibit effective nodulation and leads to biological nitrogen fixation process of leguminous plants (Brady and Weil 1999).

CONCLUSION AND RECOMMENDATIONS

The study investigated distribution of selected soil properties in aggregate sizes under different geologic formations in south eastern Nigeria. Standard methods were used in soil sampling and analyses. The experiment was analysed using ANOVA suitable for RCBD**.** Results showed that soils of Ishiagu was sandy clay loam, Obinze, sandy Umuna and Uzoakoli were sandy loam and loamy sand respectively. Bulk density ranged from 1.2 gcm-^{3} in Obinze to 1.4gcm-^{3} in Umuna. Soil organic matter content ranged from 1.13 % in Obinze to 2.49 % in Umuna respectively. The stability of aggregates using percentage water stable aggregates greater 0.25 mm (WSA > 0.25) was significantly higher in soils under Umuna (59.18%) and least at soils of Obinze (26.27 %) under coastal plain sand. Soil properties varied with sieve sizes. Soil organic matter ranged from 2.12 % in aggregate diameter of 2 mm to 2.74% in 0.3mm, 1.39 % in 0.3mm diameter to 3.21% in < 0.3mm in Obinze, 2.03% in 2mm sieve to 3.02% in < 0.3mm and from 1.45% in sieve of 0.3mm to 2.73% in < 0.3mm sieve size in Uzoakoli. In all cases however, organic matter were low and occurred majorly in less than 3 mm aggregates sizes.

Based on the findings of the study, it is recommended that practices including cover cropping, mulching application of organic amendment etc that improve organic matter content of the soil should be adopted. Since soil erosion is a function of rainfall, measures such as afforestation mulching etc that will dissipate the kinetic energy of falling rain drops before it strikes the soil surface are recommended.

Table1. Physical and chemical properties of studied soils.

Parent material	Location	sand	Silt gkg^{-1}	Clay	Textural class	WSA %	pH(H_20)	SOC gkg^{-1}	ECEC cmolkg^{-1}
ARG	Ishiagu	552.90	123.80	323.30	SCL	47.16	5.37	12.40	7.41
CPS	Obinze	809.60	80.40	110.00	S	26.27	5.75	10.90	3.97
FBS	Umuna	622.90	90.40	286.70	SL	59.18	5.75	9.60	4.73
BAG	Uzoakoli	840.00	40.00	120.00	LS	31.15	5.42	14.80	3.21
LSD (P < 0.05)		22.10*	7.31*	10.42*		2.23*	NS	**0.39****	0.95*

ARG=Asu River Group, CPS=Coastal plain sand, FBS=False bedded sand, BAG=Bende Ameki group, WSA=water stable aggregates.

Table 2 Distribution of selected properties in different aggregate sizes

Parent material	Location	Sieve sizes	pH (H_2O)	SOC	Available..P	ECEC
		Mm		gkg^{-1}	$mgkg^{-1}$	$cmolkg^{-1}$
Asu River group	Ishiagu	2	5.49	12.30	2.90	5.77
		1	5.67	13.39	5.70	9.03
		0.3	5.56	15.90	5.20	7.37
		<0.3	5.51	14.00	4.50	5.79
LSD ($P < _{0.05}$)			NS	0.30*	0.21*	1.18*
Coastal plain sand	Obinze	2	5.63	20.30	6.64	2.55
		1	5.83	22.60	4.06	2.93
		0.3	5.58	25.70	3.84	2.43
		<0.3	5.85	30.20	4.01	2.20
LSD ($P_{0.05}$)			0.23*	0.32*	1.00*	0.32*
Falsebeded sand	Umuna	2	5.41	11.80	8.60	5.22
		1	5.26	13.10	9.60	8.59
		0.3	5.32	14.90	9.00	12.13
		<0.3	5.48	17.50	6.60	9.18
LSD ($P_{0.05}$)			0.27*	NS	0.03*	2.14*
Bende Ameki group	Uzoakoli	2	5.54	14.40	0.20	3.44
		1	5.71	9.80	3.90	3.15
		0.3	5.09	8.40	0.10	3.16
		<0.3	5.04	15.80	9.40	3.04
LSD ($P_{0.05}$)			1.32*	0.17*	0.31*	2.32*
LXB			1.20*	1.76*	1.77*	6.78*

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DETERMINATION OF OPTIMUM RATE OF AGROYZER AND NPK FERTILIZER FOR SEED YAM PRODUCTION IN SOUTHEASTERN NIGERIA

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ABSTRACT
The study was conducted at the eastern farm land of NRCRI, Umudike in 2014 and 2015. Land preparations: slashing, ploughing, harrowing and ridging were carried out. 0.2 ha area of land was marked for the study at 20m² per plot, after which pre-planting soil sample was collected. The experiment was laid out in 5x4 factorial arrangements in a randomized complete block design with three replications. 30g minisett size of land race white yam (Dioscorea rotundata) (Ame) was planted at a space of 0.25x1m. The treatment combinations comprise of four rates of NPK 20:10:10 fertilizer at 0kg/ha, 200kg/ha, 300kg/ha and 400kg/ha and five rates of agrolyzer at 0kg/ha, 10kg/ha, 15kg/ha, 20kg/ha and 25kg/ha were applied on 7th week after planting. Data were collected on following growth parameters: Vine length, number of secondary tillaries, canopy cover, leaf area and stem girth at 4, 5 and 6 months after planting(MAP), yield parameters such as: stand count, number of seed and ware yams, net gross tuber yield, tuber shape index(TSI) and percentage available yield (PAY) were determined at harvest. Application of NPK fertilizer and Agrolyzer at the rate of 400kgNPK/ha+20kgAg/ha led to yield increase of 5.98t/ha when compared to zero application (control) and 3.28t/ha relative to standard check (400kgNPK/ha + 0kgAg/ha). F3A3 when compared to F0A0 (control) and F3A0 (recommended NPK fertilizer rate) showed 9.31% and 8.05% higher percentage available yield respectively.
Keywords: optimum rate, seed yam, NPK, agroyzer

INTRODUCTION

The intensive cropping system under reduced fallow period has led to decline in crop yield and soil fertility, such that a state of over exploitation of the soil natural fertility has been reached in many parts of the Nigeria, thus application of recommended rate of macro inorganic fertilizer has not been giving expected yield output (Ano, *et al.*, 2005; Asiedu, 2007). In addition to over exploitation of soil natural fertility due to reduced fallow period, is the low emphasis on the importance of micro nutrients fertilizer by Nigeria soil fertilization policy frame work, which lays all emphasis on the replenishment of soil with macro nutrients fertilizer to total exclusion of micro nutrients fertilizer. This leaves the attainment of optimum agricultural productivity at a nutritional disadvantage. Eke Okoro *et al*., (2005) and Mortvedr (1985) reported micro nutrients increased root crops yield. Amanze *et al*., (2010) also report that combination of agrolyzer and gibberelic acid induced flowering and fruiting in non-flowering yam variety (Nwopoko) and increased yield of both ware and seed yam.

Agrolyzer belongs to a group of essential elements that are classified as micro nutrients fertilizer, because they are required in smaller quantity compare to those classified as macro elements fertilizer (Akoroda and Okechukwu, 2007). May be the fact that they are required in small quantity has been mistaken to be that they are less important. But on the contrary, these essential elements which include; boron (B), copper(Cu) iron (Fe) chloride (Cl), Manganese (Mn), Molybdenum (Mo) and zinc (Zn) play important roles in plants physiological and reproductive developmental processes; such as root metabolism and protein utilization by copper, whole plant metabolism by Chloride, chlorophyll formation by iron, carbohydrates breakdown and nitrogen metabolic enzymes synthesis by Manganese, nitrogen utilization by Molybdenum and carbohydrate transformation and growth regulation by Zinc. Therefore considering the delicate sett size used in seed yam production by minisett technique, it is very important that these important fertilizer elements are made available in right proportion for maximum yield output.

It is well established that one of the greatest challenges in yam production is the scarcity of planting material (seed yam) (Ikeorgu and Nwokocha 2001). This is because yam is not like most of other root and tuber food crops that are propagated either by botanical seed or non-edible portion such as stem, instead yam is propagated through its edible tuber and so most of what is produced is consumed due to high demand for yam food. It has become a difficult challenge to combat the perennial problem of scarcity of planting material. Although, considerable progress has been made towards development of rapid seed yam production techniques such as; mini tuber, minisett, peel sett and vine cutting (Mazza, *et al.*, 2012; Ikeorgu, *et al.*, 2010). Optimum nutrient requirement for these noble innovations has not been determined. FAO stat.(2006) reported that in Nigeria average yields of yam have been steadily declining over the last 8-10 years as result of declining in soil fertility due to shorter fallow periods and more use of marginal lands for yam production. Therefore it has become imperative that a robust and sustainable fertilization technique that plays emphasis on right combination of micro and macro nutrients fertilizers is developed in order to reverse the declining trend of the average yields of yam in Nigeria. Hence the objective is to determine the optimum rate of agrolyzer and NPK combination for seed yam production using minisett technique in Southeastern Nigeria.

MATRIALS AND METHODS

The study was conducted in rainforest agro ecological zone of Nigeria at the eastern farm land of NRCRI, Umudike in 2014 and 2015. Land preparations: slashing, ploughing, harrowing and ridging were carried out. 0.2 ha area of land was marked for the study at 20m^2 per plot, after which pre-planting soil sample was collected. The experiment was laid out in 5x4 factorial arrangements in a randomized complete block design with three replications. 30g minisett size of land race white yam (*Dioscorea rotundata)* (Ame) was planted at a space of 0.25x1m. The treatment combinations comprise of four rates of NPK 20:10:10 fertilizer at 0kg/ha, 200kg/ha, 300kg/ha and 400kg/ha and five rates of agrolyzer which contains Zn, CU, B, Mn and Fe at 0kg/ha, 10kg/ha, 15kg/ha, 20kg/ha and 25kg/ha were applied on 7th week after planting. Data were collected on following growth parameters: Vine length, number of secondary tillaries, canopy cover, leaf area and stem girth at 4, 5 and 6 months after planting(MAP), yield parameters such as: stand count, number of seed and ware yams, net gross tuber yield, tuber shape index(TSI) and percentage available yield (PAY) were determined at harvest. Postharvest soil samples were collected from each plot. The soil samples were analysed for macro and micro nutrient elements and other soil fertility factors.

Data generated were subjected statistical analysis using Excel and SPSS software, while Dunca multiple ratio test (DMRT) was used to separate the means.

Treatments were combined in the following order with the corresponding codes:

[F0A0= control, F0A1= 0 kg NPK + 10 kg Ag, F0A2 = 0 kg NPK + 15 kg Ag, F0A3= 0 kg NPK + 20 kg Ag, F0A4= 0 kg NPk + 25 kg Ag, F1A0= 200 kg NPK + 0 kg Ag, F1A1 = 200 kg NPK + 10 kg Ag, F1A2 = 200 kg NPK + 15 kg Ag, F1A3 = 200 kg NPK + 20 kg Ag, F1A4 = 200 kg NPK + 25 kg Ag, F2A0 = 300 kg NPK + 0 kg Ag, F2A1 = 300 kg NPK + 10 kg Ag, F2A2 = 300 kg NPK + 15 kg Ag, F2A3 = 300 kg NPK + 20 kg Ag, F2A4 = 300 kg NPK + 25 kg Ag, F3A0 = 400 kg NPK + 0kg Ag, F3A1 = 400 kg NPK + 10 kg Ag, F3A2 = 400 kg NPK + 15 kg Ag, F3A3 = 400 kg NPK + 20 kg Ag and F3A4 = 400 kg NPK + 25 kg Ag.]

RESULTS AND DISCUSSION

Parameters presented are only those that significant differences were observed among the treatments combinations.

Treatments combinations showed significant (P=0.05) difference with regard to vine length at four months after planting (4MAP) (figure 1). The vine length ranges from 56.33 to 63.45cm. F1A4 which recorded the longest vine length of 63.45cm, and was significantly higher than the vine length of F0A0 (control) which has the shortest vine length of 56.33cm, F1A2, F2A2 and F3A1, but it was not significantly higher than F3A0 which is the recommended NPK fertilizer rate. It appears that combination of 200kg/ha of NPK and 25kg/ha encouraged vine enlongation more than other combination rates. There were significant (P=0.05) differences among some of the treatment combinations for leaf area at six after planting (6MAP) (figure 2). The leaf area ranges from 45.57cm^2 to 82cm^2. F2A4 recorded largest leaf area, while F2A1 had the smallest leaf area. F2A4 equally showed significantly higher leaf area than F3A0 (recommended NPK fertilizer rate), but it was not significantly higher than F0A0 (control). Again 300kg/ha NPK and 25kg/ha Agrolyzer produced high leave area which indicates that 25kg/ha Agrolzer could be responsible increased vegetative development and not NPK fertilizer rate. Figure 3 shows that there were significant (P=0.05) among the treatment combinations for yield in t/ha equivalent. The yield in t/ha ranges from 12.08 to 18.06 t/ha. F3A3 recorded the highest yield of 18.06 t/ha, while F0A3 had the lowest yield of 12.08t/ha. F3A3 also showed significantly higher yield than F0A0 (control) and F3A0 (recommended NPK fertilizer rate). Figure 4 indicates that there were differences among the treatment combinations for percentage available yield (PAY). The percentage available yield for the treatment combinations ranges from 64.75 to 74.87%. F3A3 recorded highest percentage available yield, while F0A3 had lowest percentage available yield. F3A3 when compared to F0A0 (control) and F3A0 (recommended NPK fertilizer rate) showed 9.31% and 8.05% higher percentage available yield respectively. It does appear that while 100kg/ha, 200kg/ha NPK fertilizer and 25kg/ha Agrolyzer increased vegetative development, it does translate to yield output, instead, 400kg/ha NPK fertilizer and 20kg/ha Agrolyzer led to increased yield output and subsequently increased also the percentage available yield (PAY), which is the profitability of applying the treatments more than other treatment combinations. May be the vigorous vegetative growth at 100kg/ha NPK, 200kg/ha NPK and 25kg/ha Agrolyzer combinations reduced the bulking rate of tuber and hence could translate to complementary yield output.

CONCLUSION

Application of NPK fertilizer and Agrolyzer at the rate of 400kgNPK/ha+20kgAg/ha gave the highest seed yam yield in t/ha and percentage available yield from minisett technique. Application of this rate of combination of NPK and Agrolyzer led to yield increase of 5.98t/ha when compared to zero application (control) and 3.28t/ha relative to standard check (400kgNPK/ha + 0kgAg/ha). F3A3 when compared to F0A0 (control) and F3A0 (recommended NPK fertilizer rate) showed 9.31% and 8.05% higher percentage available yield respectively. Therefore, it could be recommended that farmers should apply combination of NPK and Agrolyzer at this rate for increased seed yam production through minisett technique.

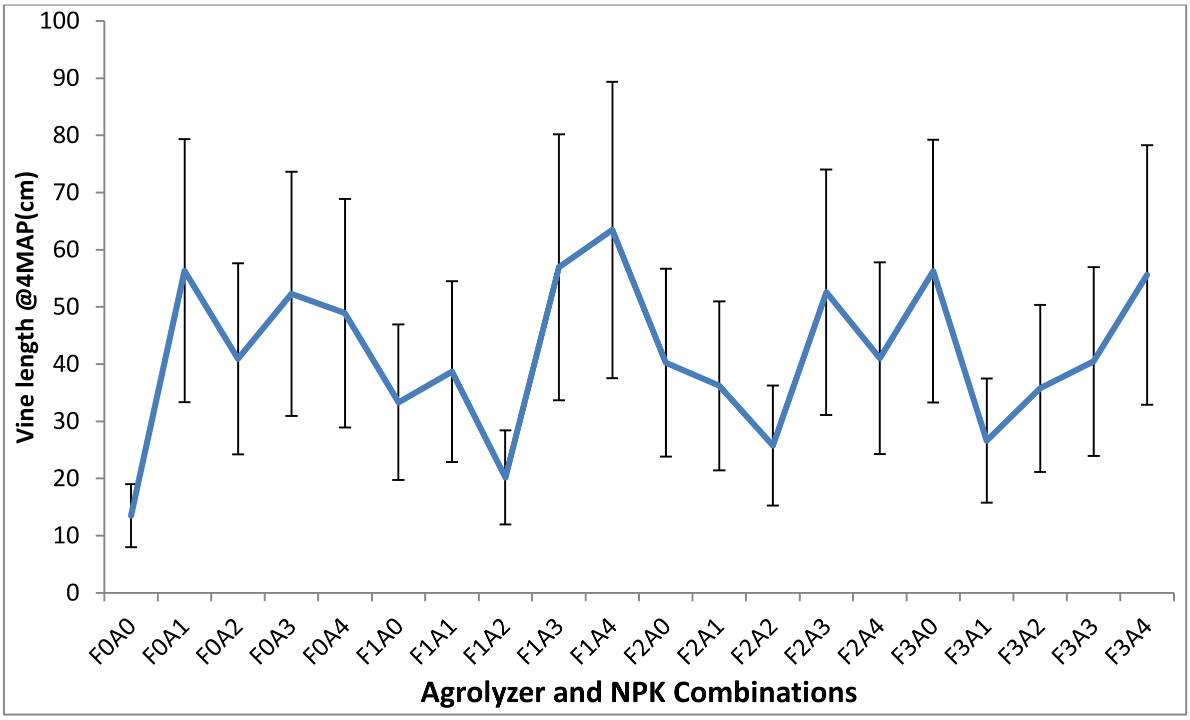

Figure 1: Vine length (cm) of white yam (Ame) minisett at 4 (MAP) as affected by different rates of NPK and Agrolyzer application in 2013/2014-2014/2015 cropping seasons

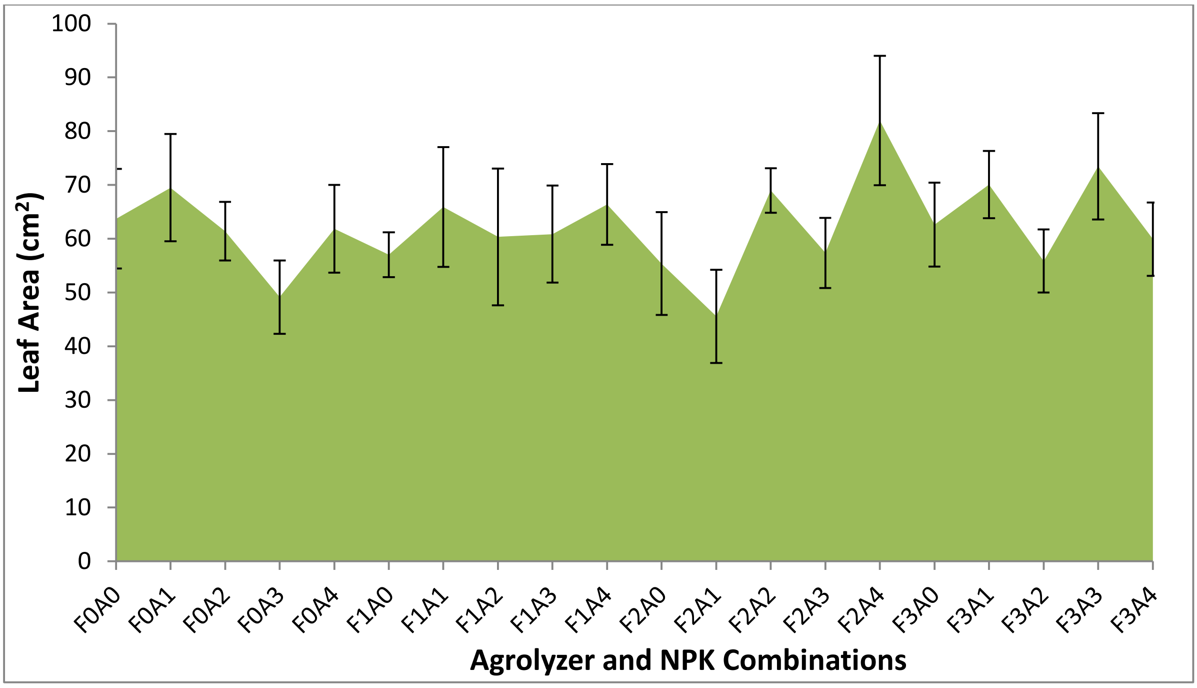

Figure 2: Leaf area (cm^2) of white yam (Ame) minisett at 4 (MAP) as affected by different rates of NPK and Agrolyzer application in 2013/2014-2014/2015 cropping seasons

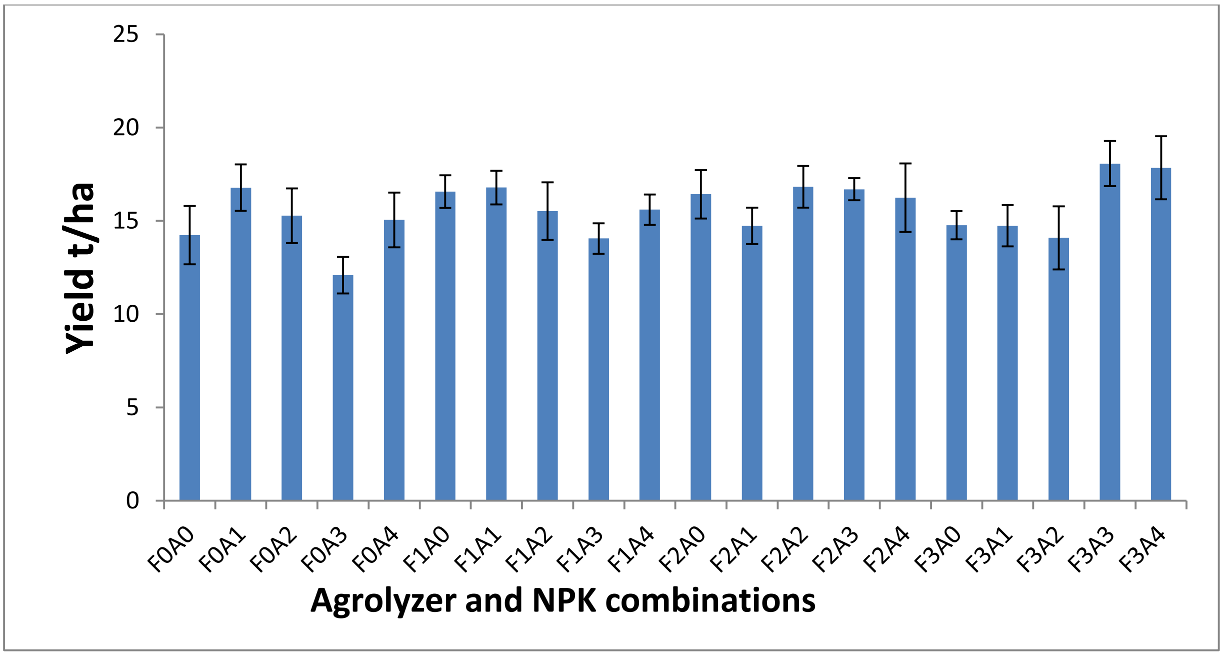

Figure 3: Yield in t/ha of white yam (Ame) minisett at 4 (MAP) as affected by different rates of NPK and Agrolyzer application in 2013/2014-2014/2015 cropping seasons

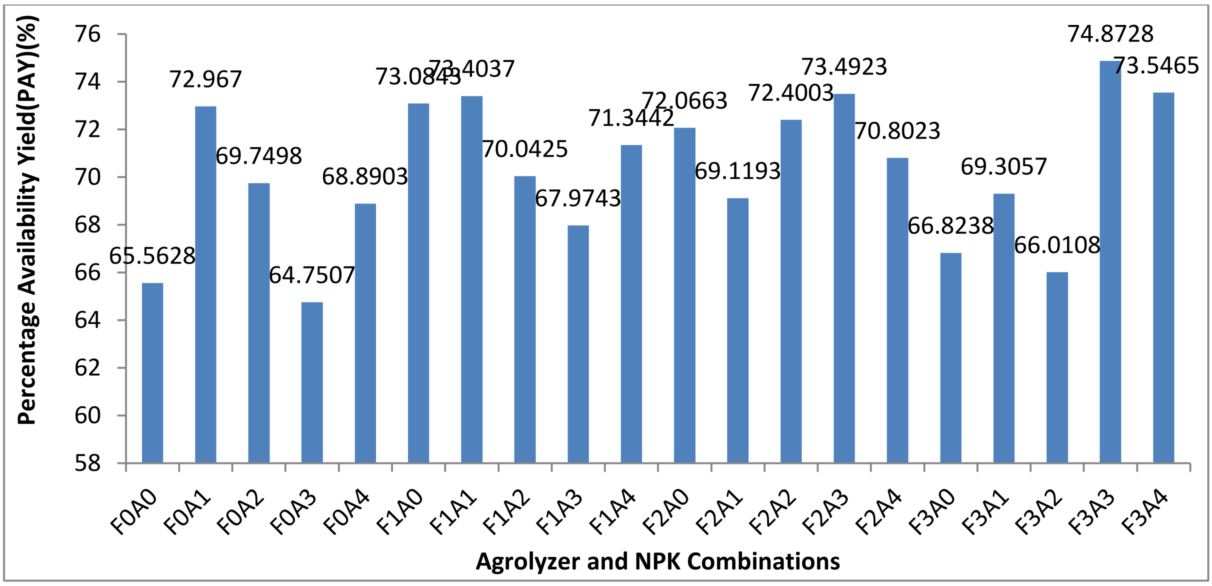

Figure 4: Percentage available yield (%) of white yam (Ame) minisett at 4 (MAP) as affected by different rates of NPK and Agrolyzer application in 2013/2014-2014/2015 cropping seasons

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RECAPITALIZATION OF SOIL FERTILITY: A PANACEA FOR SUSTAINABLE FOOD SECURITY IN NIGERIA

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ABSTRACT
Soil recapitalization is the replenishment of soil fertility as nutrients are added to the soil (inflows) to replace nutrients removed from the soil (outflows) by harvests, erosion, runoff, leaching, N volatilization, and de-nitrification. The reverse of recapitalization is soil mining, which occurs when nutrient outflows exceed in flows the study explores the recapitalization of soil fertility as away to sustain food security in Nigeria.
Keywords: recapitalization, soil fertility, food security

INTRODUCTION
Human population pressure has a major impact on land utilization and land degradation. Population pressure leads to the exhaustion of fertile agricultural lands and the progressive utilization of environmentally fragile marginal areas. In the Nigerian context, environmental degradation as a result of deforestation, overgrazing and cultivation of marginal lands is already a serious problem closely associated with population growth. In an effort to meet the food needs of the growing population of Nigeria, one major challenge is how to increase food production on lands already under cultivation without bringing marginal land into production. Among other things, such a challenge requires making sure that the soil is able to adequately provide the nutrients required to sustain the needed increased crop yields. Current agricultural practices in Nigeria are extractive in nature, taking out more than what is put back into the soil. In addition, since all productive agriculture results in removal of nutrients at harvest, careful management of soil resources is considered imperative in order to prevent unnecessary wastage and improve the efficiency of nutrient recycling. In this regard, soil nutrient levels must, nonetheless, be maintained above a critical threshold through replacement of the nutrients removed at harvest in order to sustain production. This critical threshold will vary for nutrients, yield goals and soil types. The objectives of this review paper are: (1) To highlight the causes and main effects of soil degradation; (2) To review some available technologies for soil fertility recapitalization in Nigeria with a view to highlighting major obstacles associated with their implementation and to suggest cost-effective ways of overcoming these obstacles.

The Nigerian Environment
Nigeria is located within latitude 4^0 – 14^0 N and longitude 2^0 -14^0 E. The country has an estimated land surface area of 923,768 km^2 equivalent to 924 million ha. Out of this figure, only 79 million ha are cultivable while 32 million ha are actually cultivated (Akoroda, 2010). Nigeria is the most populous country in Africa with an estimated population of 131,859,731 inhabitants (July 2006 estimate, World Factbook). The average annual growth rate according to the 2006 estimate was 2.38 %.

The Nigerian Soils
The soils of Nigeria are generally mostly light-textured and low in CEC with clay content ranging from 9 – 43 % in more than 60 % of the area (Agboola, 1986). Average clay content is less than 15 %. Organic matter ranges from 1.0 – 2.55 % while CEC ranges from 2.40 – 9.55 meq/100 g soil, the value being less than 5.0 meq/100g soil in 75 % of the area (Agboola, 1986). In terms of classification using the productivity rating index, Agboola (1986) reported that 94.51 % of the Nigerian soils fall within medium, low and very low productivity classes (Table 1)

Continuous cultivation of soils with such fertility credentials as indicated above without proper management and conservation measures has resulted in accelerated rate of degradation of the natural soil resources culminating in continuous low crop yields and poverty and hence, the need for re-capitalization.

Soil Fertility Re-capitalization: What is it?
Soil recapitalization is the replenishment of soil fertility as nutrients are added to the soil (inflows) to replace nutrients removed from the soil (outflows) by harvests, erosion, runoff, leaching, N volatilization, and de-nitrification. The reverse of recapitalization is soil mining, which occurs when nutrient outflows exceed inflows. The concept of recapitalization views Soil fertility as a form of renewable natural capital with service flows (crop production, food security) that increase when proper technical nutrient-saving measures aimed at protecting soil resource base from future degradation are put in place. The objective of recapitalization is not to build up maximum stocks of nutrient capital, but appropriate stocks of nutrient capital which can provide sustainable levels of nutrients to crops.

What is Food Security?

Food and nutrition security is said to exist when "all people at all times have physical, social and economic access to food, which is consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life" (FAO, 2002). In this context, Recapitalization of soil fertility for sustainable food security therefore means "replacement of soil resources (either used by crop for physiological functions or removed out of the soil system through crop harvest, erosion, leaching, de-nitrification etc.) in a manner that guarantees adequate quantity and quality for future food production and environmental protection.

The alternative route to food security in Nigeria is to ensure that the economic means to purchase food exist, and that the food can be purchased at affordable prices. One important prerequisite is access to land, as more people need to produce their food supplies and make a living from the land. Traditional land management systems are dependent on the availability of sufficient land to allow long fallow periods to maintain soil fertility. When there is no more access to new land, the fallow land has to be used and soil fertility falls. The expansion of agriculture over the past three decades involved the cultivation of marginal areas, or clearance of important natural habitats such as forests and wetlands. Such conversion is a major driving force behind land degradation. More intensive use of land also implies that it becomes more prone to soil erosion. To maintain and raise its productivity, new sustainable management measures have to be introduced and policies changed.

Why Recapitalize Soil Fertility in Nigeria?

As populations continue to grow, competition for use of agricultural land increases, and arable land reserves become increasingly marginal as they are put into continuous cultivation (often times without nutrient-saving measures) resulting in over exploitation of available soil resources. The consequences of over exploitation of soil resources include but not limited to:

(i) Degradation of soil structure and loss of other soil physical qualities.
(ii) Decline in organic matter and soil biological activity.
(iii) Reduction in availability of major nutrients (N, P, K) and micro-nutrients.
(iv) Increase in toxicity, due to acidification or pollution.
(v) Continuous Soil fertility decline resulting in low crop yield and food insecurity and increasing level of unemployment.
(vi) Increased rural poverty.

Soil Fertility Parameters for Recapitalization

Soil fertility is not a static feature. On the contrary, it changes constantly and its direction (accumulation or depletion) is determined by the interplay between physical, chemical, biological, and anthropogenic processes.

Consequently, all soil properties which are amenable to change through investment and which affect long term crop productivity may be regarded as **assets which can be recapitalized.** In this regard, soil properties such as **organic matter, total N, available P, exchangeable K and pH,** are critical soil fertility indices requiring recapitalization.

However, particular properties may be more limiting than others and returns on investment may differ between strategies aimed at different soil properties. Based on this, soil organic matter has an over bearing influence on other fertility parameters and its proper management is important for sustainable food production.

Functions of Soil Organic Matter

Soil organic matter is known to play a wide number of roles in agricultural crop production through its effects on soils. These roles were summarized by Mbagwu (2000) to include:

Nutrient Cycling

(i) Organic matter increases nutrient holding capacity of soils
(ii) It serves as a pool of nutrients for plants.
(iii) It binds nutrients, preventing them from becoming unavailable.

Water Dynamics:

(i) Organic matter improves water infiltration
(ii) It decreases evapotranspiration
(iii) It also increases water Holding Capacity of soils

Soil structure modification:

(i) Improves aggregation, preventing erosion
(ii) Prevents compaction
(iii) Encourages root development.

Review of Various Strategies Adopted by Farmers for Soil Fertility Recapitalization in Nigeria
A number of strategies are potentially available for soil fertility recapitalization in Nigeria. These technologies, some of which are already adopted by small scale farmers in Nigeria, are summarized in Table 4

Recapitalizing Soil for Organic Matter
This refers to those strategies/technologies which are specific for increasing the level of soil organic matter in agricultural crop production. Examples of such technologies include:

(i) Use of animal Manures (poultry manure, cow dung, pig waste, cattle dung etc).
(ii) Residue mulching (using crop residues).
(iii) Kitchen waste
(iv) Legume cropping
(v) Zero tillage
(vi) Organic mulching

Such technologies, their setbacks and suggestions on how to circumvent their setbacks are summarized in the Table 1

Soil Recapitalization for P
Soil P recapitalization takes advantage of the comparative immobility of P in soil. Losses of P through leaching are small, except on sandy textured soils with limited P sorption capacity. However, the immobility of P in soil may render added P susceptible to loss through erosion and surface run-off. Incorporation of P within the rooting depth of the crops reduces losses by erosion and increases reactions with the soil, which is of particular benefit for rock P sources.The available technologies for soil P recapitalization include use of inorganic fertilizers such as urea, NPK fertilizers, rock phosphate, and organic manures.
K and Mg are not good candidates for recapitalization of acid upland soils as their chemical and physical properties may result in large losses by leaching and erosion due to poor retention. However, there must be balanced additions of these and other nutrients so they do not become major limiting factors as productivity increases with soil recapitalization.

Obstacles in Soil Fertility Recapitalization in Nigeria
Number of obstacles are involved in soil fertility recapitalization in Nigeria. These obstacles may be classified as technical, economic or political.

Technical Obstacles in Soil Fertility Recapitalization
Organic matter is vulnerable to high rates of decomposition in marginal soils. Since the rate of decomposition is a major factor in determining the rate at which nutrients are released to the soil, a better understanding of the dynamics of organic matter in a soil is important to significantly enhance its ability to increase yields and improve soil quality simultaneously.
There is not enough organic matter in Nigeria to recapitalize all the degraded soils under cultivation. This poses a big problem in the effort to recapitalize soil fertility in Nigeria.
Sole application of inorganic or organic fertilizers cannot make much fertility impact for sustainable crop production.
Fertilizer makes very little (if any) direct contribution to soil macrostructure, increased water-holding capacity, improved infiltration and erosion control, prevention of soil hardening or improved nutrient holding capacity.
Use of inorganic fertilizers acidifies the soil thereby distorting eco-balance.

Economic Obstacles in Soil Fertility Recapitalization
Inorganic fertilizers are costly and unavailable and much cost is involved transporting huge amounts of organic manures. The high rate of poverty amongst smallholder farmers in Nigeria makes it very difficult for them to be able to afford the cost of fertilizers resulting in their sub-optimal application. In addition, many small scale farmers do not have enough technical knowledge about the working and dynamics of fertilizer usage.
The decision to recapitalize soils is generally a private one made by individual farmers on the basis of perceived accruable financial returns. Farmers tend to focus more on short-run benefits of recommended technologies (e.g., the immediate returns to fertilizer) than on the long-term benefit technologies. This disposition affects the rate at which developed fertility recapitalization technologies are adopted by farmers.
Lack of Government Incentives There is lack of well-adapted technologies and also lack of economic incentives for farmers to adopt soil fertility management technologies developed. This is in addition to poor agricultural credit system which does not encourage farmers to obtain loan for implementation of certain fertility recapitalization strategies.

RECOMMENDATIONS ON THE WAY FORWARD

Government should reduce direct and indirect taxes on fertilizer imports to reduce the cost and encourage efficient use of fertilizers by smallholder farmers in Nigeria. Government should develop, implement and enforce policies intended to:

(i) Minimize land degradation due to erosion and/or organic matter depletion.

(ii) Promote integrated soil fertility management (ISFM) interventions to prevent nutrient depletion through erosion. The strategy is to minimize soil erosion, create positive SOC and N budgets, enhance activity and species diversity of soil biota (micro, meso, and macro), and improve structural stability and pore geometry

(iii) Promote fertilizer use-efficiency by fine-tuning recommendations aimed at strengthening the capacity of the extension systems for better service delivery.

Table 1. Classification of Nigerian Soils Using their Productivity Rating Indices.

S/N	Productivity Classification	Area Covered (Km^2)	Percentage of Total Area
1.	Very High Productivity	Nil	0
2.	High Productivity	8,802.82	5.49
3.	Medium Productivity	50,741.45	31.75
4.	Low Productivity	73,318.00	46.45
5.	Very Low Productivity	28,098.55	16.31

Source: Agboola (1986)

Table 2. Classification of Some African Countries Based on their Rate of Nutrient Depletion.

Nutrient Depletion Classification Rate			
Very High	**High**	**Moderate**	**Low**
Kenya	Nigeria	Liberia	Angola
Ethiopia	Ghana	Cameroon	Mali
Malawi	Uganda	Senegal	Chad
Rwanda	Zimbabwe	Niger	Zambia

Source: Stoorvogel and Smaling (1990).

Table 3. Over view of Different Technologies Available for Soil Fertility Recapitalization in Nigeria.

S/N	Technology	Limitation for Use	References
1.	Bush Fallow	Practiced where land is not limiting	Van Reuler and Prins (1993)
2.	Crop Rotation/Intercropping	(i) Crop combinations and planting arrangements are variable; (ii) Extracts more nutrients from the soil than sole crops and may cause more rapid decline in soil fertility	Eke-Okoro et al., 1998; Ijoyah et al., 2012a
3.	Green Manuring	Adoption by farmers is low due to tedium of land preparation and economics of the practice	Liu et al 2006;Nilza et al., 2015.
4.	Organic Manuring	Large quantity of material needed to give equal crop yield response with mineral fertilizers; Long time is needed for mineralization to occur.	FAO, (2000)
5.	Soil Amendment with Rock Phosphate	Lack of immediate agronomic response on non-acid soils; Handling and transportation challenge	World bank, (1994)
6.	Use of mineral fertilizers	High cost and sporadic availability coupled with acidulation tendencies	Abdul-Galil et al., (2003).
7.	Integrated nutrient management (combined use of organic and inorganic fertilizers	Ideal combination does not exist. Optimum combinations depends on target and farm perculiarity.	Gruhn et al., (2003); Tarfa et al., (2001).
8.	Legume-based cropping	Variability in N-fixing capacity of legumes	Nwaogu et al., (2013)

Table 5. Available Technologies for Soil Organic Matter Recapitalization, their Setbacks and Suggested ways of overcoming their Constraints.

S/N	Technology	Setback	Suggestion on the Way Forward
1.	Use of organic Manures such as cow dung, poultry manure, rice mill waste, kitchen waste, etc.	Large amount of material needed to give equal crop yield response with mineral fertilizers due to low nutrient content; Nutrient mineralization depends on rate of organic matter	Complement with inorganic fertilizers.
2.	Use of mineral fertilizers	Acidulation tendency	Apply with cautious lime use
3.	Legume cropping	Variability in N-fixing capacity of legumes	Use legumes with high N-fixing capacity

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STUDIES ON EFFECT OF NEEM BASED FERTILIZER ON PERFORMANCE OF CASSAVA ON SOILS DERIVED FROM SHALE PARENT MATERIAL IN SOUTHEASTERN NIGERIA

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ABSTRACT
A study was conducted to investigate the effect of neem based fertilizer on the performance of cassava grown on soils derived from Shale parent material at the National Root Crops Research Institute Igbariam Substation Anambra State experimental field, during the 2012/2013 and 2013/2014 cropping seasons. Prior to trial establishment soil samples from the experimental sites were collected at 0 to 20 cm depth and analyzed in Soil Science Laboratory alongside the neem based fertilizer. Result revealed that the soil was moderately acidic (pH 5.5), had moderate total N (0.16 %), moderate available P (10.50 mgkg^{-1}), low exchangeable K (0.18 cmolkg^{-1}), moderate organic Carbon (2.50 %) and Sandy clay loam texture. The neem fertilizer contains 3 % N, 6 % P, 3 % K and 20 to 30% organic Carbon by composition. Based on the nutrient requirement of cassava and the analytical result, 6 treatment combinations were made and applied 8 weeks after planting of cassava (TME 419) and the experimental design was randomized complete block design replicated three times. The yield result showed that neem based fertilizer and N P K fertilizer mixture at the rate of 2,250 kg neem and 187.5 kg N P K 12: 12: 17 + 2 gave significantly ($P < 0.05$) higher fresh root yield in both years than any other treatment, and is therefore recommended for sustainable cassava production in the soils studied.
Keywords: neem based fertilizers, soil, cassava, shale

INTRODUCTION
Most Nigeria soils are highly susceptible to degradation as a result of leaching, low soil reaction (pH), low organic matter content and exchange cations. Ojeniyi and Adejobi (2002).
Consequently, for productivity to be improved in these soils the use of organic fertilizer is essential. According to Agboola and Omueti (1982), the inherently poor fertility characteristics of tropical soils have fertility and nutrient availability in them to be largely controlled by soil organic matter content. Therefore, neem based fertilizer a new organic fertilizer may go a long way for this purpose, but its effectiveness for cassava production is not yet known. The objective of this study was to determine the effectiveness and the optimum rate of neem based fertilizer for performance and fresh root yield of cassava grown on soils derived from shale parent material in southeastern Nigeria.

MATERIALS AND METHODS
The experiment was conducted at the Igbariam substation, Anambra State of National Root Crops Research Institute (NRCRI) Umudike, south east agro ecological zone of Nigeria, during the 2012/2013 and 2013/2014 cropping seasons. The geology of the location is Shale. Pre planting soil samples were collected, prepared and analyzed in the Soil Science Laboratory using the methods outlined by Udo *et al*, (2010). The fields were fallowed for two years in each season, after which they were slashed ploughed harrowed and ridged and planted cassava stakes on the crest of the ridges, laid out in 6 m x 6 m plot size with a planting space of 1m x 1m, and variety of cassava planted was TME 419. The experimental design was Randomized Complete Block Design (RCBD) replicated three times, with six treatments that were applied 8 WAP. The plots were weeded 6 and 20 WAP then under brushed 32 WAP. Data were collected on plant height, girth size, number of leaves and fresh root (t/ha) yield harvested 12 MAP. Data were analyzed statistically using SAS (2002) computer package and means were separated using LSD at 5 % probability

RESULTS AND DISCUSSION
Soil and neem composition
The mean values of the physico chemical properties of the soils of the experimental sites for the two year study are as follows: Texture Sandy clay loam, pH 5.5, organic Carbon 2.50 % , Available P 10.50 mg /kg ,exchangeable K 0.18 cmol / kg, exchangeable Ca 3.32 cmol / kg , exchangeable Mg 2.20 cmol / kg , exchangeable Na 0.08 cmol / kg, Effective Cation Exchange capacity 7.48 cmol/kg total nitrogen 0.16% and exchangeable acidity 1.50 cmol /kg, while neem based fertilizer had the following composition organic Carbon 25 – 30%, Available P 6% and total N 3%. The results indicated that the soil texture is suitable for cassava production consequently, the soil had the following characteristics, low exchangeable K, moderate total

N and available P, moderate organic Carbon and moderately acidic. For sustainable cassava production to be achieved in this soil, these parameters, which are major soil indicators for cassava production, need to be improved.

Performance and yield of cassava

Table 1 shows effect of treatments on plant height, number of leaves, girth size and fresh root yield of cassava. The results showed that the highest plant height of 2.10 m and 2.30 m was obtained with treatment 2 (0kg neem + 750kg NPK 12:12:17+2/ha) in 2012/2013 and 2013/2014 respectively and both values were not significantly (P<0.05) different from values obtained from control and other treatments apart from treatment 3 (750kg neem + 562kg NPK 12:12:17+2/ha) .Treatment 5 (2,2500kg neem + 187.5kg NPK 12:12:17+2/ha) gave the highest girth size (7.49) in 2012/2013 but was significantly (P<0.05) different from values obtained from control and other treatments, apart from treatment 2 (750kg neem +562kg NPK(12:12:17+2/ha). In 2013/2014 treatment 6 (3,000 kg neem + 0 kg NPK 12:12:17+2/ha) had the highest girth size with a value of 8.6 cm , but was significantly different from value obtained from control only. Treatment 5 (2,250kg neem +187kg NPK 12:12:17+2/h), also had the highest number of leaves in both 2012/2013 and 2013/2014 having leave number of 56 and 59 respectively but in 2012/2013 it was significantly (P<0.05) different from the values obtained from control and other treatments apart from treatment 3 (750kg neem +562kg NPK 12:12:17+2/ha), while in 2013//2014 it was not significantly different from values obtained from control and other treatments . In terms of fresh root yield, treatment 5 (2,2500kg neem + 187.5 kg NPK 12:12:17 + 2/ha) gave the highest fresh root yield of 44.71 t/ha in 2012/2013 and 42 .35 t/ha in 2013/2014 but the yield values were significantly (P<o.05) different from the yield values obtained from control and other treatments apart from that of treatment 2 (0kg neem +750kg NPK 12:12:17+2/ha) in both years.

CONCLUSION/RECOMMENDATIONS

From the study, it can be affirmed that neem based fertilizer alone cannot be used for cassava production. Instead the combination of 2,250kg neem + 187.5kg NPK 12:12:17 + 2, which is equivalent to 2,250 kg neem + 150 kg NPK 15:15:15 or 2,250 kg neem+112.5 NPK 20:10:10 or 2,250 kg neem+83.34 kg NPk 27:13:13 is more suitable and therefore is recommended for cassava production in soils derived from Shale in southeastern Nigeria.

Table 1: Effect of treatment of yield and yield attributes of Cassava

Trt No	Treatment	Plant height(cm) 2012/2013 2013/2014	Girth size (cm) 2012/2013 2013/2014	Number of leaves 2012/2013 2013/2014	Fresh root yield t/ha 2012/2013	2013/2014
1	Control	1.90 2.02	6.0 6.7	40 49	27.67	22.61
2	0kg neem+750kg NPK 12:12:17+2/ha)	2. 10 2.30	7.1 7.7	50 53	43.76	41.12
3	750kg neem +562kg NPK(12:12:17+2/ha)	1.95 2.19	6.6 7.8	54 56	39.01	34.52
4	1,500kg neem +375kg NPK(12:12:17+2/ha)	1.95 2.13	6.5 8.7	46 57	33.63	40.42
5	2,250kg neem+187.5kg NPK(12:12:17+2/ha)	2. 00 2.21	7.4 8.1	56 59	44.71	42. 35
6	3,000kg neem + 0kg NPK(12:12:17+2/ha)	1.98 2.20	6.3 8.6	44 50	39.45	38.51
	L SD 0.05	0.25 0.39	0.30 1.09	4.02 23.32	4.13	1.79

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EFFECTS OF COW DUNG APPLICATION RATES AND PLACEMENT METHODS ON THE YIELD OF CABBAGE (*BRASSICA OLERACEAE* L) IN ALFISOLS OF NORTHERN GUINEA SAVANNA, NIGERIA

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ABSTRACT
Cow dung fertilizer is widely accepted as the approach to sustain crop production and maintain soil fertility in urban and peri-urban vegetable production system in northern Nigeria. Because of its availability and accessibility in terms of costs, farmers prefer to use it in sustaining production than to go for inorganic fertilizer with high cost especially in vegetable systems. The effects of cowdung application rates and placement methods on fresh yield of cabbage was evaluated at the peri-urban garden of Bomo,northern Nigeria.The manure was applied at four rates 7.5,15.22.5 and 30t/ha and three placement methods of broadcasting, spot and banding application.The experiment involve factorial combination of these manure rates and the placement methods laid down in randomized complete block design (RCBD) and replicated 3 times. Records of fresh weight of cabbage where taken at full maturity (13 weeks).The result showed that application of 22.5t/ha gave highest fresh weight of cabbage (55.67 t/ha), while the broadcasting and spot placement methods gave the highest fresh weight (50.20 and 49.0 t/ha) of cabbage yield respectively. The response of cabbage yield does not only depend on farmers' management practises, but also on the rates and methods of cow dung application.
Keywords: cow dung rates, application methods, cabbage yield

INTRODUCTION

Urban and peri- urban garden systems are characterized by high nutrient input mainly from the organic sources such as manure, wastewater and municipal waste (Drechsel and Dongus, 2010), and often associated with environmental challenges although a corresponding increase in yield and economic return is obtained (Abdu, 2010; Abdulkadir *et al.*, 2015). Soils of the Nigerian savanna are characterized with weak structure and poor soil fertility (Jone and Wild, 1975; Lawal and Girei, 2013) and crop production depends on the application of fertilizer from organic and inorganic sources. Integrated nutrient management has been shown to have a positive impact in sustainable crop production. Fertilizer management such as application of different rates of organic fertilizer such as cow dung and its placement method have significant influences on improving soil fertility, crop yields and nutrient use efficiency (Chavez, et al 2014).

Cabbage (*Brassica oleraceae* L.) is a cool season crop belongs to the family Brassicaceae (Best, 2000) and a very important vegetable for household nutrition security. It is consumed raw or cooked with other vegetables and mostly grown as a commercial crop by most farmers and income. In Nigeria, there is an increasing demand for the cultivation of cabbage to meet the need of urban markets. Cow dung is an efficient organic fertilizer that is readily available for cabbage cultivation in northern guinea savanna (NGS) agroecological zone of Nigeria. However there are limited studies on the effect of cow dung rates and application method on the production of cabbage in Zaria, NGS of Nigeria.This objective of this study is to see the effect of different rates of cow dung and its placement methods on the yield of cabbage in Zaria, NGS of Nigeria.

MATERIALS AND METHOD

The experiment was conducted in a cabbage garden in Bomo village (Latitude. 11'11.255°, Longitude. 7'37.597 °) in the Northern Guinea Savanna ecology of Nigeria. A garden of 1375m^2 size was selected for the experiment and laid in a randomized complete block design (RCBD). The experiment involved two treatments which are manure and placement methods. The manure was applied at four levels, (7.5, 15, 22.5 and 30 t/ha) and three placement methods that is, Broadcasting (PM1), Spot application (PM2) and banding application (PM3).The cabbage was sown in the nursery for a period of 4 weeks, there after it was transplanted to the field,hoe weeding was carried out 3 times and irrigation was applied at 3 days interval. The crop (cabbage) was monitored to maturity(13 weeks) before harvestingg The final yield (fresh weight) was recorded and the result obtained where compared base on the application methods and the rates of applied manure using a simple statistical package SAS.and DMRT for mean separations.

RESULTS AND DISCUSSION

The properties of soil determine its suitability for agriculture and other uses. Organic carbon, total N and available P content of soils in the study area fall within the range of low fertility class, a typical characteristic of soils of Northern Nigeria (Jones and Wild, 1975)

While the textural classes of surface soils in study area (0-30cm) were sandy loams. This indicates that soils of this region are suitable for agriculture, as most crops thrive best on loam textured soils (Chude *et al.*, 2012).

Effects of Manure Rates on Yield of Cabbage

This study shows highest fresh yield weight of cabbage from application of 22.5 tons ha^{-1} manure. This result agree with a similar investigation of Talekar (2000), who reported that highest head weight per plant and best yields were obtained with application of 20 tons ha^{-1} of decomposed poultry manure. Generally, there was increase in fresh weight of the cabbage with a corresponding increase in rates of manure application although not beyond 22 tons ha^{-1}. These also support the findings of Muhammad *et al*. (2007) who reported that yield and nutritional quality of cabbage was increased with increase in fertilization. This was further corroborated with observations of Choudhary *et al*. (2005) that increase in cabbage vegetable parameters corresponded with increase in levels of nitrogen application and stated that vegetative parameters of cabbage increased considerably with increasing nitrogen rates. This implies that increased in cow dung supply may boost the growth and yield of cabbage as was observed in this study.

Effects of Manure Placement Methods on the Yield of Cabbage

The three different manure application methods (broadcasting, spot and banding) where compared on the basis of the final weight of the cabbage. There was no significant difference between the methods (Table 1). However broadcasting and spot application methods gave best yield of cabbage than banding application. This is an indication that in the two methods, plants effectively utilized the applied nutrients due to proximity to rooting depths, leading to higher yield than it is in banding methods, where plant roots were unable to utilize applied fertilizer at early vegetative growth. This has supported the findings of Akanni *et al*. (2011) that broadcasting of organic fertilizer was more effective in increasing soil nutrient content and yield of vegetable than spot and band applications. In Ghana it was also reported that broadcasting of cow dung manure increased maize yield compared to spot application, which was attributed to overall improvement of soil physical, chemical and microbiological properties (Abunyewa *et al.*, 2006).

CONCLUSION

The highest fresh yield of cabbage will be obtained from application of 22.5tones/ha of cow dung manure, while the broadcasting and spot application of manure increase yield of cabbage than the banding application in a peri urban garden of northern Nigeria savanna.

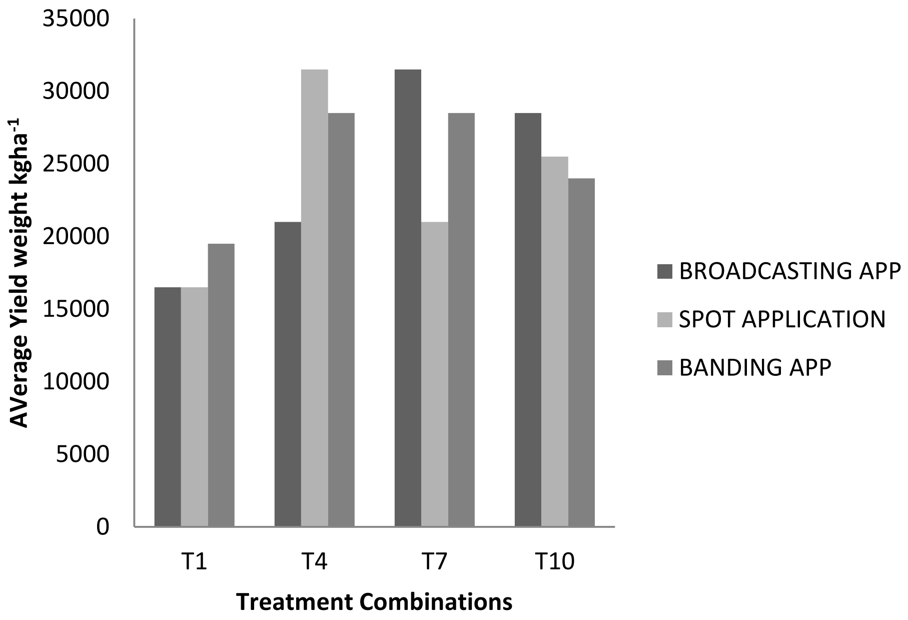

Figure1. Average yield (fresh weight) of Cabbage at three different methods of manure application in a UPA garden of Bomo, Zaria
T1=7.5tons ha^{-1}manure, T2=15tonsha^{-1} manures, T3=22.5tons ha^{-1} manure and T4=30tons ha^{-1} manure

Table 1: Effects of Manure rates, placement methods and their interactions on the yield of Cabbage in a peri-urban garden in Bomo, Zaria

Treatments	Means Fresh Yield Weight of Cabbage (tons ha^{-1})
Manure Rates (tons ha^{-1})	
7.5	31.67^{d}
15	43.33^{c}
22.5	55.67^{a}
30	54.33^{b}
Placement methods	
PM1	50.20^{a}
PM2	49.00^{b}
PM3	46.75^{c}
M*PM	NS
P value	0.83
SEM	0.12

Means with the same letter within the column are not significantly different P<0.05
PM=Placement Method: 1=Broadcasting Application, 2=Spot Application, 3=Banding Application.

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SOIL FERTILITY AND CONSERVATION MANAGEMENT PRACTICES IN ABIA STATE: EXAMINING THE ROLE OF SYSTEM-RELATED AND SOCIO-ECONOMIC VARIABLES

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ABSTRACT
Accelerated soil erosion and declining soil fertility are among major constraints to agricultural production. The study identified organic manure application, inorganic fertilizers and liming as the commonest practices adopted. The coefficient of labour was positively signed and related to adoption of soil fertility and conservation management practices at 10% level, indicating that the more labourers available to a farmer, the higher likelihood event of adoption. The negative coefficient of conservation cost which is significant at 5% implies that if this cost is high, farmers will not adopt these practices. Non-availability of markets to sell products, farm labour constraints, high cost of soil fertility management materials and lack of credit to boost capital were the most influential challenges affecting the full adoption of soil conservation practices. The findings of this study reinforce the fact that in order to achieve sustainable soil fertility and conservation management, institutional and economic factors should be given special attention. In line with this, considering the positive effect of a farm's size and the negative effects of conservation costs on adoption, encouraging peasant farmers to cooperate, consolidating farms, setting agricultural cooperatives and stock farming could be a proper way to encourage conservation methods. Farming systems and extension education courses with relevant content may increase awareness about the effects and consequences of sustainable soil conservation practices among farmers.
Keywords: soil fertility, conservation, management

INTRODUCTION
In recent years, there has been a sharp rise in environment-related problems as a result of the declining climate condition giving rise to unfavourable climate changes of which soil erosion and degradation has been identified the most economical. A group of studies conducted by world bodies on environment-related issues have it that soil erosion is a major global concern as it leads to topsoil removal and to loss of both applied and native plant nutrients (WRI, UNEP, UNDP and WB, 1996). This has been the cause of reduced agricultural productivity per unit area and high costs of production due to the rehabilitation of farmlands. In Africa, the problem of soil erosion is estimated to cause a damage of $26 billion annually to productive soils of the continent (Lal, 2001). Soil erosion results in crop production decrease and gradual decline in fertility of ten million hectares of rain-fed lands of the country (Mahboobi, 2004). Loss of arable land due to soil erosion causes poverty and underdevelopment in the rural communities and it raises migration rate of villagers to surrounding cities, which is followed by social problems in the cities and non-sustainability in the rural areas.
The fertility of soil can be considered in different ways, depending on land use. Deressa *et al*. (2009) identify soil conservation as one of the major strategies farmers in developing countries employ towards the threats of climate change. In addition, Difalco and Bulte (2012) argue that adoption of certain farm management strategies reduces exposure to such shocks, given that agriculture is most exposed to climate change. According to Alimi (2000) and Ologbon *et al*. (2011), resources must be available and efficiently used in order to achieve optimum food crop production level hence, the mission of increasing agricultural productivity to sustain food requirement could be facilitated through efficient management of productive resources and practices, such as soil fertility improvement, proper land preparation, timely cultivation, use of good quality varieties, weed control and use of integrated pest management techniques to check the problems as soil erosion, yield losses and low productivity. Winter *et al* (2004) noted that these practices are for restoring, replenishing, conserving and maintaining the quality of agriculture land in order to increase farmer yield and income levels under the prevailing rate of population growth.
In Nigeria, a number of conservation practices are currently applied by farmers including: terracing, mulching, cover crops between independent variables and adoption of integrated cropping and timely use of fertilizers, to name only a few. Although several soil conservation technologies had been developed and promoted through past decades, the adoption of many recommended measures still minimal. This problem necessitates the urgency to study the level of use of these practices in Abia state.

METHODOLOGY

The area of coverage is Bende Local Government Area of Abia State, South Eastern Nigeria with a population of about 176,565 people based on the 1991 population census; and it is located in the northern part of Abia State. Abia State occupies the area lying between coordinates 6º5' and 4º50'N and between 7º08' and 8º00'E. The major occupation of the people of the area is farming, and rice farming is predominant. Other crops produced include cassava, maize, and beans. Their high level of agricultural practice makes it suitable to study their level of soil fertility and conservation management practices' adoption. A two stage sampling technique was used to select three (3) communities (first stage) and twenty (20) farmers from the three communities (second stage) to make a total of sixty (60) farmers. Well-structured questionnaires were used to elicit data from the farmers. Data were analyzed using simple descriptive statistics and inferential statistics like probit regression. Furthermore, a probit regression model was estimated to capture effects of factors on adoption of soil fertility and conservation practices by the farmers. The model was explicitly specified as:

$$Y^*_i = \alpha + \beta X_i + \mathcal{E}_i \qquad (1)$$

Y_i^* = Y for all farmers who have adopted soil management practice

Y_i^* = an underlying latent variable that indexes the level farmers adoption of soil fertility and conservation practice.

Y = soil fertility management index of the farmer (ratio of soil fertility management practices adopted by the farmer to the listed soil fertility management practices used in the study area); β = vector of estimated parameters; $\mathcal{E}_i$=error term; a=intercept of the function; X_i=set of independent variables, captured as:X_1=Area of land conserved; X_2=Availability of labour (number of adult labourers); X_3=Access to credit (1 = yes, 0 = otherwise); X_4=Cost of conservation (Naira); X_5=Access to extension services (1 = yes, 0 = otherwise)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Farmers

The socio-economic characteristics of the farmers are presented in Table 1.

The result indicates that there were more female farmers (51%) in the area than men, although the difference is relatively little. Traditionally, in the eastern part of the country, women who are divorced by the husbands do not own lands. In line with argument, soil management and conservation practices' adoption may be limited. The result also showed that a majority of the farmers (about 72%) had no formal education. With the alarming rate of rural illiteracy, it must be noted that the ability of a farmer to adopt any farming technology, including soil fertility management techniques, is expected to be improved by attainment of formal education. The income generated from farming activities by the farmers is relatively low, with more than 72% of them earning at most N30,000 per annum. This is expected giving the high rate of illiteracy in the area which could be traced to the poor soil fertility management and conservation practices in the area.

Soil Fertility and Conservation Practices

A list of these practices is identified in Table 2. As shown in the table, use of organic manure as a technique for managing and conserving soil fertility was mostly adopted, as 38.74% of the farmers use it. The farmers who used this method spent on the average, N3,833.33 per farming season. Mulching and fertilizer application were equally used by same proportion of farmers. Mulching which involves the use leaves or green plant residues to protect the soil from excessive heat after planting is an age-long practice in many farming communities in Nigeria. About 19% of the farmers interviewed used mulching as a soil conservation technique. On the average, N4,300.00 was spent by the farmers on purchase of fertilizer in a farming season. Given mean farm size of 3.89 hectare under conservation, a ratio of N1,105.40 is spent on fertilizer per hectare of farmed land. Liming was another option the farmers adopted to conserve their soil.

Factors Affecting Adoption of Soil Fertility Management and Conservation Practice

Adoption of soil fertility management and conservation practice was captured as a ratio of the number of practices the farmer adopted and the number of practices listed. The result is presented in Table 3.

The coefficient of labour was positively signed and related to adoption of soil fertility and conservation management practices at 10% level, indicating that the more labourers available to a farmer, the higher likelihood event of adoption. Conservation cost includes all the money a farmer will have to spend on adopting soil fertility management and conservation practices. The negative coefficient which is significant at 5% implies that if this cost is high, farmers will not adopt these practices. Of course, additional costs arising from conservation practice will reduce farmers' revenue from farming. That is a discouragement to adopting soil conservation practice. Extension services provide the link between research and the farmers. New farming innovations, including soil fertility and conservation management practices usually reach the farming community through extension. The more access a farmer has to these extension services, the greater his disposition to adopt soil conservation practices.

Challenges against Soil Fertility Management and Conservation

The farmers' responses on these challenges are presented in Table 4. About 86% of the farmers indicated that they faced these two major problems of non-availability of markets to sell farm produce and labour constraints. If markets are not available to dispose off-farm output, a large proportion of the produce will be either consumed or lost in poor storage conditions. This loss will discourage farmers from observing any form of soil fertility management. On the other hand, since most of the labour was from household members, its absence will pose a substantial challenge. High cost of soil fertility management materials and lack of credit to boost capital received about 79% responses from the farmers. It may be noted that the top four constraints towards soil fertility management practice are income-related.

CONCLUSION AND POLICY RECOMMENDATIONS

Accelerated soil erosion and declining soil fertility are among major constraints to agricultural production. The study identified organic manure application, inorganic fertilizers and liming as the commonest practices adopted and further showed that labour, conservation cost and extension services were the key variable that affected adoption of these soil fertility and conservation management practices in the study area. Non-availability of markets to sell products, farm labour constraints, high cost of soil fertility management materials and lack of credit to boost capital were the most influential challenges affecting the full adoption of soil conservation practices. These findings of this study reinforce the fact that in order to achieve sustainable soil fertility and conservation management, institutional and economic factors should be given special attention. Since adoption of many recommended soil conservation measures is still minimal in many areas, paying attention to factors which determine adoption is a top priority. In line with this, the following policy recommendations are made. Firstly, considering the positive effects of a farm's size and the negative effects of conservation costs on adoption, encouraging peasant farmers to cooperate, consolidating farms, setting agricultural cooperatives and stock farming could be a proper way to apply conservation methods. In this case, government could make supportive policies to encourage farmers, like granting financial aids or supplying some of the essential inputs to the cooperatives. Farming systems and extension education courses with relevant content may increase awareness about the effects and consequences of sustainable soil conservation practices among farmers while providing them with required knowledge.

Table 1 Distribution of respondents based on some socioeconomic characteristics

Characteristic	Categories	Frequency	%
Gender	Male	29	48.33
	Female	31	51.67
	Total	60	100.00
Household type	Male-headed, married	29	48.33
	Female-headed, widowed/divorced	27	45.00
	Female-headed, husband away	4	6.67
	Total	60	100.00
Educational qualification	No Formal education	43	71.67
	Primary education	0	0
	Secondary education incomplete	4	6.67
	Secondary education complete	5	8.33
	Tertiary education complete	8	13.33
	Total	60	100.00
Farm income (annual)	Less than 10,000	8	13.33
	10,000 – 20,000	18	30.00
	21,000 – 30,000	17	28.33
	31,000 – 40,000	3	5.00
	41,000 – 50,000	2	3.33
	Above 50,000	12	20.00
	Total	60	100.00
Mean annual farm income	71,518.80		

Source: field survey, 2016.

Table 2 Types of soil fertility/conservation management practices

Soil Fertility conservation practice	F	%	Average cost of use per farmer
Mulching		18.92	Na
Cover cropping		3.60	Na
Fertilizer application		18.92	N4,300.00
Manuring		38.74	N3,833.33
Liming		11.71	N2,666.67
Sewage/sludge		0.00	Na
Ash application		8.11	Na
Total	**1**	**100. 0**	

Source: field survey, 2016. Na = not available

Table 3 Probit regression result of factors affecting adoption of soil fertility/conservation practice

Parameters	Coefficient	Std. Error	Z-value	Sig. level
Intercept	-2.022	0.170	-11.900	0.000***
Conserved area	0.023	0.018	1.239	0.216
Availability of labour	0.024	0.012	1.939	0.053*
Access to credit	0.227	0.170	1.337	0.181
Conservation cost	0.000	0.000	-2.142	0.032**
Extension service	0.395	0.104	3.789	0.000***
Pearson Goodness-of-Fit Test				
Chi-square	146.045***			
Df	53			

Source: computed from survey data, 2014. *,**,*** indicate significance at 10%, 5% and 1% respectively.

Table 4 Challenges facing soil fertility management and conservation

Rank		Frequency	%
1	Non-availability of market to sell farm produce	51	85.71
1	Farm labour constraints	51	85.71
2	High cost of soil fertility management materials	47	78.57
2	Lack of credit to boost capital	47	78.57
3	Lack of mechanized implements	43	71.43
3	Insufficient capital to implement soil management practices	43	71.43
4	Unavailability of information on soil management practices	39	64.29
5	Unfavourable government policies	26	42.86
5	Flood	26	42.86
6	Cultural beliefs and practices	13	21.43
	Total	386*	

Source: computed from field survey data, 2016. * multiple responses

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EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON SOIL NON-NUTRIENT FUNCTIONS AND YIELD OF MAIZE ON AN ULTISOL IN ABAKALIKI, SOUTH EASTERN NIGERIA

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ABSTRACT
The agronomic potential of organic and inorganic fertilizers as soil amendments was evaluated. The objective was to determine their effect on soil physical properties and grain yield. Four different manures (Poultry Dropping), NPK 15:15:15, Unburnt Rice Husk and Burnt Rice Husk) as the soil amendment and control were selected and set up in the field using randomized complete Block Design (RCBD). Amendments were applied at the rate of 0.3 t ha^{-1}, 5 t ha^{-1}, 5 t ha^{-1} and 5 t ha^{-1} for NPK, BRH, UBRH and PD respectively. The soil samples were analyzed for particle size distribution, bulk density, total porosity, hydraulic conductivity, % water retention, % Aggregate stability and % Dispersion ratio. The soil was sandy clay loam with moderate silt and low organic matter content. The result of the study showed significant increase in all the parameters studied relative to the control. The lowest bulk density and highest porosity at 90 DAP of 25% and 58% respectively were observed in the plots amended with PD. Results also showed that the plot amended with PD had the highest grain yield, the yield increase in amended plots was in the order of PD>NPK>UBRH>BRH>C. Amending soil with organic manure has better potential for enhancing soil properties for better crop yields.
Keywords: organic, inorganic, soil nutrients, maize, yield

INTRODUCTION
Soil remains the fundamental resource for agricultural production and the most important possession and input for farmers who use the soil as a medium for plant growth. Tropical soils have a wide range of limiting factors for agricultural use: these include nutrient deficiencies, acidity, low water storage and poor physical attributes occasioned by losses of organic matter due rapid oxidation, high temperature and heavy precipitation (Nnoke 2001; Bell and eng, 2005). Due to the heavy rains, the soil undergoes serious structural deterioration. The impacts of the drops separate the fine soil particles and the organic matter from the sand, and the soil pores get clogged. This condition accentuated by long periods of cultivation without addition of amendments triggers leaching, runoff and erosion (Rouw, 2005).

Fertilization will be required to correct and maintain the nutrient balances, increase productivity of the soil so as to raise yields and obtain maximum results from the improved varieties and other practices. Agronomists have long recognized the benefit of maintaining and increasing soil organic matter which enhances soil fertility, water retention and crop production (Mbah and Mbagwu, 2003). A fertile soil is that capable of supplying nutrient to plant in adequate amount and in suitable proportion during growing season while a productive soil is one which is capable in its normal environment to produce a particular plant or sequence of plants under a specified management system (Dorah and Jones, 1996). Good soil management options can help in rehabitation of soils that are badly degraded (Igwe, 2005). Therefore, for a soil to remain fertile and productive especially in the tropics there is need for the application of organic and inorganic fertilizers which will help boost crop yields. Organic manures are derived from organic matter i.e. from plants and animals and their products e.g. Is farm yard manure while inorganic manures are manures that are man-made or manufactured artificially e.g. muriate of potash (Nnoke, 2005).

Although in Abakaliki, South East of Nigeria, some works have been documented on the use of organic and inorganic fertilizers for agricultural production, there is need for more works to inform the rural farmers on the best manure to adopt as well as the best way to use the various soil amendments in order to ameliorate the soil conditions. This study investigates the effect of organic and inorganic fertilizers on soil physical properties and yield of maize in Abakaliki, South East of Nigeria.

MATERIALS AND METHODS
Site description
The experiment was conducted at the teaching and research farm of the faculty of Agriculture and Natural Resources Management, Ebonyi State University, Abakaliki in Ebonyi State South Eastern Nigeria. The area is located within 06^{O} 4N and longitude 08^{O} 65^{O} E in the Derived Savannah Zone of Nigeria. The experimental site lies in the humid tropics with high rainfall and high temperature. The annual rainfall of the area is between 1800

– 2000mm. The annual temperature ranges between 21 – 29^{O}C and the relative humidity is between 60 – 80% during rainy season (Ofomata, 1975). The soil belongs to the order Ultisols and classified as Typic Haplusult (FDALR, 1985).

Materials

The soil amendments used include organic manure (poultry droppings) collected from Nkaliki poultry farm, Abakaliki, burnt and unburnt rice husks collected from the Abakaliki rice mill and NPK 15:15:15 purchased locally in Abakaliki. Maize variety (Oba Super II), used as a test crop was purchased at Ebonyi State Agricultural Development Programme (EBADEP).

Field Layout

The total land area of 588m^2 was demarcated into blocks (replicates) and plots. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replicates and five treatments. The rates of the application of the treatment are as follows; inorganic manure (NPK 15:15:15) at 0.3t ha^{-1} (0.6 kg/plot). Burnt Rice Husks (BRH) at 5t ha^{-1} (10 kg/plot), unburnt Rice Husks (UBRH) at 5t ha^{-1} (10 kg/plot), poultry Droppings (PD) at 5t ha^{-1} (10 kg/plot and the unamended/Control.

Soil Sample Collection

Soil samples were collected from the site before and after planting at the depth 0–20 cm with the aid of soil auger for laboratory analysis. four undisturbed core samples and foru auger samples were collected from the depth of 0 – 20cm in all the plots while the crops were still in the field. The auger samples were composited air dried at room temperature and sieved through a 2mm sieve for analysis.

Grain Yield

Harvesting of cobs was done at maturity, dried, threshed, weighed and the grain yield adjusted to 14% moisture content.

Laboratory Methods

Particle size analysis was carried out by pipette method (Gee and Or, 1994). Bulk density was analyzed by core method (Doran and Mieike, 1984) and total porosity was calculated from bulk density data as follows:

$TP = \left(1 - \frac{BD}{PD}\right) \times \frac{100}{1}$.

(Where TP = Total porosity, BD = bulk density and PD = particle density assumed to be 2.70gcm^{-3}) (Obi, 2000). Hydraulic conductivity was determined using constant head method (Stolt, 1997). Soil water rentention capacity was determined using gravimetric method (Obi 2000). Dispersion ratio was calculated from particle size analysis data using the formula; % DR= $\frac{water\ dispersion}{calgon\ dispersion} \times \frac{100}{1}$.

Aggregate stability was determined using the method described by Kemper and Rosonau (1998).

Data Analysis

Data collected were subjected to statistical analysis using Analysis of Vanarice (ANOVA) for Randomized Complete Block Design (RCBD). Significant means were separated using Fishers' Least Significant Difference (F-LSD$_{0.05}$) as recommended by steel and Torrie (1980).

RESULTS

The values of clay, silt and sand are 25%, 29%, and 46% respectively. The pH value of the soil was 5.3 in KCl and 6.4 in water (Table 1). Table 1 also showed that organic matter content including total nitrogen content of the soil was low. Table 2 showed that the bulk density at 90DAP was significantly affected by the treatment the lowest bulk density at 90DAP was found in the plots amended with PD which was 25% lower compared to the control. Generally, there was reduction in the bulk density of the other amended plots compared to the control. The results also showed that there was inverse relationship between soil bulk density and total porosity (Table 2). The table showed that at 90DAP the highest value of 46.9% for total porosity was obtained in plots amended with PD. The percentage increase in total porosity relative to control at 90DAP is in order of 34.2%, 38.7%, 39.1%, and 46.9% for BRH, UBRH, NPK and PD respectively. Table 2 also showed that the highest mean value for hydraulic conductivity of 1.09cm 1hr was obtained in the plots with PD followed by NPK. The value was 32.9% higher than the value obtained in the control plots. The table also showed the effect of the amendments on soil percentage water retention (%WR). The highest percentage of water retention of 49.40% was recorded by PD. Higher value relative to control were obtained in the soil amended with NPK, URBRH and BRH. The table showed that percentage aggregate stability increased significantly relative to control NPK, PD, UBRH and BRH showed significant increase relative to the control with mean percentage increments of 12.17%, 14.82%, 15.05% and 19.05% respectively. Table 2 also showed the effect of the amendments on percentage dispersion ratio. Although there was no significant increase, PD recorded the highest value and control had the lowest value for dispersion ratio.

Table 2 also showed that the application of several of amendments significantly (P = 0.05) increased the maize grain yield. PD with a cumulative yield of 2.1 t ha^{-1} had the highest grain yield while the lowest grain yield was recorded by the control.

DISCUSSION

The textural class of the soil was sandy clay loam, while the pH of the soil was slightly acidic and the result of the pre-planting analysis showed that the nutrient contents of the soil were low (Table 1). Generally there was a reduction in the bulk density values of all the amended plots when compared to the control at 90DAP. The lowest bulk density was found in plots amended with PD which may be because of the large quantity of organic matter in poultry dropping which helps in opening up the soil. This is in line with the observations of Abive *et al*., (2007). Bulk density of a soil is a measure of soil compaction and lower bulk density may result in easy penetration of roots, hence increase in the feeding area of the plant which will result in higher soil productivity Abu-Hamdeh *et al.,* (2006) and Anikwe and Nwobodo, (2002). All the plots amended with the various amendments recorded low bulk density when compared with the control (Table 2). The highest total porosity at 90DAP was obtained in plots amended with PD followed by NPK, UBRH and BRH. The order of increasing of hydraulic conductivity is PD>NPK>UBRH>BRH>C. The higher hydraulic conductivity in plots amended with PD, NPK, and UBRH could be attributed to the low bulk density and high total porosity that improve hydraulic conductivity. This corroborates the findings of Anikwe (2000) and Brady and Weil (1999) that higher hydraulic conductivity means better water transmission hence reduction in waterlogging. The highest value of 49.40% for percentage water retention was recorded by PD. Higher values relative to the control were obtained in the soil treated with UBRH and BRH. The higher soil percentage water retention obtained in the amended plots agrees with the initial of Obi and Ebo (1995) who stated that increased moisture content may be attributed to the colloidal content of the organic manure which increases soil water holding capacity. Higher values obtained in the percentage aggregate stability of NPK, PD, UBRH and BRH agrees with the earlier reports of Martens, (2000), Anikwe (2000) and Abiven *et al.*, (2007) that the addition of organic and inorganic fertilizer increases biological activities and the aggregate stability of the soil. The percentage soil dispersion ratio showed no significance difference among the treatments at P=0.05. The results showed that the highest value for grain yield was obtained from PD and the lowest was from the control. Other amendments such as BRH, UBRH, NPK treated soils increased grain yield by 87.5%, 100% 125% respectively relative to the control plots. This agrees with the earlier findings of Bierman, (2000) who stated that increase in the yield of maize has been obtained with the application of organic and inorganic fertilizers. The relative high yield obtained from the PD amended plots agree also with the findings of Maritus and Vleic (2001) who reported that the fertility of the soil provided by organic matter from manures had effects on flowering date, tasseling time, silking time hence the maturity and the crop yield.

CONCLUSION

Organic and inorganic fertilizers are useful soil amendments and improves the soil physical properties especially the organic manure like poultry droppings due to its high content of organic matter needed in the soil. The soil amendments NPK, UBRH, BRH also improved the physical properties of the soil and crop yield when applied appropriately but organic manure (PD) is the best option and is recommended.

Table 1: Pretreatment soil properties

Particle size distribution	
Clay%	25
Silt%	29
Sand%	46
Textural class	SCL
Soil pH (KCl), (H_20)	5.3, 6.4
Exch. Ca (cmol kg^{-1})	4
Exch. Mg (cmol kg^{-1})	1.6
Exch. Na (cmol kg^{-1})	0.37
Exch. K (cmol kg^{-1})	0.3
CEC (cmol kg^{-1})	23.2
Exch. Acidity (cmol kg^{-1})	3.8
%TN	0.112
%OM	2.51
Av.P (mg kg^{-1})	25.87

Table 2

Treatment	**BD(gcm^{-3})**	**TP(%)**	**SHC(cm/hr)**	**WR(%)**	**AS(%)**	**DR(%)**	**Grain Yield t/ha**
Control (C)	1.89	29.6	0.82	31.24	11.44	0.77	0.8
Poultry Dropping (PD)	1.41	46.9	1.09	49.40	15.05	0.84	2.1
Unburnt Rice Husk (UBRH)	1.62	38.7	1.02	45.88	14.82	0.79	1.6
Burnt Rice Husk (BRH)	1.77	34.2	08.7	44.10	12.17	0.79	1.5
NPK 15:15:15(NPK)	1.61	39.1	1.08	38.03	19.05	0.83	1.8
F-LSD(0.05)	**0.0689**	**4.5277**	**0.3157**	**4.5079**	**3.5213**	**NS**	**0.2**

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MAIZE DRY MATTER ACCUMULATION AS INFLUENCED BY INCORPORATED LEGUMES AND NITROGEN FERTILIZATION

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ABSTRACT
This trial was conducted in the rainy seasons of 2006 and 2007 at the Research Farm of the Institute for Agricultural Research, Ahmadu Bello University, Zaria, to evaluate the influence of incorporated legumes and nitrogen application on total dry matter yield of two maize (Zea mays L.) varieties. The treatments consisted of two maize varieties (SAMMAZ 12 and SAMMAZ 27) and five nitrogen rates (0, 30, 60, 90 and 120kg N ha^{-1}) in the main plots while three green manure crops (Lablab (Lablab purpureus), Mucuna (Mucuna pruriens) and Soybean (Glycine max (L.)Merrill)) and a weedy fallow were accommodated in the sub-plots. The treatments were laid out in a split-plot design with three replicates. SAMMAZ 12 and SAMMAZ 27 were similar in dry matter accumulation. Plots that received nitrogen fertilization caused significant increases in maize dry matter yield compared with maize grown in plots without nitrogen treatment. Application of nitrogen at 60kg N ha^{-1} was found to be adequate for increased dry matter yield of maize. Incorporation of mucuna, lablab and soybean significantly incresed dry matter accumulation in maize plants compared with maize plants grown in plots with incorporated weedy fallow.

Keywords: dry matter, fertilization, legume, nitrogen

INTRODUCTION
Maize is one of the most widely grown crops in Nigeria especially in the Savanna zone of Nigeria, where it has been reported to account for over 70% of the maize production in the country (Uyovbisere *et al.*, 2001). The zone is known to be deficient in nitrogen (Singh, 1987) which is a very important plant nutrient and a major yield determining factor needed for increased maize production (Adediran and Banjoko, 1995; Shanti *et al*., 1997). This necessitates a regular addition of this nutrient to the soil either through inorganic or organic source. Economic challenges have made chemical fertilizers especially nitrogen, which are often used by farmers to correct depleting soil fertility, to be beyond the reach of the resource poor farmers who produce the bulk of food in Nigeria. The viable alternative is to opt for organic source to restore soil fertility. Legume incorporation as green manure has been a very promising cropping system approach in improving soil fertility through generation of organic matter which is a livewire for sustainable crop production. Soil organic matter is a vital regulator of various environmental constraints to productivity of crop (Woomer et al, 1994). Hence, soil residues are a generator of soil organic matter which maintains the physical and physic-chemical properties of soil, thus enhancing soil fertility such as soil exchange capacity and soil structure (Fenning, *et al*, 2009).
Crop growth and productivity depend on the degree of effectiveness of such a plant to absorb and mobilize the nutrients that are available in the soil for plant growth and dry matter accumulation (Adesoji, 2015a). Crop growth rate depends on the amount of radiation intercepted and its conversion into dry matter (Fageria, 2000). Total biomass production of a crop, without water limitations, is the product of solar radiation intercepted by the crop canopy over the duration of the cropping period and the efficiency at which the crop converts light energy into plant dry matter (Richards, 2000). Economic yield of any crop is dependent on the biomass performance of the crop which means the more the dry matter accumulation the more the economic yield of the crop. Thus, the higher dry matter per plant, the more assimilate it could translocate to fill the grains for consequent higher grain yield (Adesoji, *et al*, 2015b). Despite its importance, the information on the influence of incorporated legumes and nitrogen application on maize biomass is still scanty. Therefore, the objective of this study was to evaluate the effect of incorporated legumes and nitrogen on maize biomass performance.

MATERIALS AND METHODS
The study was carried out in the rainy seasons of 2006 and 2007 at the Research Farm of the Institute for Agricultural Research, Samaru (11^0 11^1 N, 07^0 38^1 E, 686 m above sea level) in the Northern Guinea Savanna ecological zone of Nigeria. The annual rainfall for the duration of the study in 2006 and 2007 was 1086.7 and 900.4mm, respectively. The soil of the experiment site was loam. The treatments consisted of two maize varieties

(SAMMAZ 12 and SAMMAZ 27), five levels of N (0, 30, 60, 90, and 120 kg N/ha), and three green manure crops (*Lablab purpureus, Mucuna pruriens and Glycine max* (L.) Merrill) and a weedy fallow. The experiment was laid out in a split-plot design with nitrogen and variety as main plot treatment and green manure as the sub plot treatment. The experiment was replicated three times.

Leguminous green manure crops were planted on the flat with narrower inter-row spacing of 37.5 cm. The lablab was sown at 2 stands per hole at 20cm within row and mucuna was sown at a stand per hole at 20cm within row. The soybean was planted drilled. The leguminous green crops were incorporated at 49 days (7weeks) after planting. After 3 days of incorporation, maize seeds were planted with two or three seeds per hole at a spacing of 25cm on the ridges of 75cm apart. The maize seedlings were thinned to one seedling per stand at two weeks after sowing. The experimental plot consisted of six ridges of 4.5m apart and 4m long (gross plot) and net plot was 3m x 3m (9m^2). The green manure crops were fertilized using 20kg P_2O_5 ha^{-1} and 10kg N ha^{-1} to boost their growth. Nitrogen fertilizer as urea (46%N) was applied to the maize at 2 and 6 weeks after sowing (WAS) according to treatment. Basal applications of 60kg P_2O_5 ha^{-1} and 60kg K_2O ha^{-1} were carried out at sowing. Weeds were controlled using Paraquat (Gramaxone) at 3 litres ha^{-1} to kill weeds that were not properly incorporated and hoe weeding was done at 6WAS.

Samplings on total dry matter were done at 6, 9 and 12 weeks after sowing (WAS) from three randomly selected plants from each plot (border rows). The samples were oven dried at a temperature of 70^{0}C to a constant weight and weighed using atop loading Metler P1210 weighing balance and the mean dry weight was recorded as a total dry weight(g) per plant. Total dry matter (kg ha^{-1}) was determined at harvest by cutting the entire plants in each net plot from ground level after they had been properly sun-dried and weighed using Salter scale model 250. The weight per plot was recorded. Stover yield was determined at harvest by weighing above ground dry weight of entire plants in each net plot after the cobs had been removed. The weighing was done using Salter scale model 250 and recorded. Data collected from the observations were subjected to statistical analysis of variance (ANOVA) as described by Gomez and Gomez (1984) using SAS package version 9.0 of statistical analysis (SAS institute, 2002). The differences among treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955). Effects were considered statistically significant at 5% level of probability.

RESULTS

Variety effect was not significant on total dry matter per plant, total dry matter per hectare and stover yield (Table 1). Application of nitrogen beyond 30kg N ha^{-1} did not significantly increased total dry matter per plant in 20006 and 2007. However, addition of nitrogen caused the maize plants to accumulate more dry matter than maize plants in plots without nitrogen. Increasing N level up to 90 kg N ha^{-1} in 2006 and 30 kg N ha^{-1} kg N ha^{-1} in 2007 significantly increased total dry matter accumulation of maize plants at harvest. Application of nitrogen beyond 30 kg N ha^{-1} did not significantly increase stover yield both years under study (Table 1).

Incorporation of green manure crops performed significantly better on total dry matter plant, total dry matter per hectare and stover yield than the incorporation of weedy fallow in all the two years of study (Table 1). There was no significant difference among the leguminous crop incorporated on total dry matter plant in 2006 while incorporation of lablab produced significantly higher total dry matter per plant than incorporation of soybean in 2007. Incorporation of lablab performed significantly better on total dry matter per hectare than incorporation of mucuna and soybean in 2006 while incorporation of lablab produced significantly higher total dry matter hectare than incorporation of soybean in 2007. Incorporation of lablab produced significantly higher stover yield than incorporation of soybean in 2007.

DISCUSSION

Varietal effect between SAMMAZ 12 and SAMMAZ 27 on total dry matter per plant, total dry matter per hectare and stover yield was not significant which could be as a result of the inherent ability of earliness of both varieties. The similarity between both varieties could have been that they were genetically similar in the accumulation of dry matter. Significant increases obtained on total dry matter per plant, total dry matter per hectare and stover yield after application of nitrogen could be attributed to the significant increases observed on maize growth parameters such as number of leaves, plant height and leaf area index as earlier reported from another aspect of this study (Adesoji, *et al.*, 2013). The marked increases observed on these parameters could also be attributed to the important roles nitrogen plays in cell division, cell expansion and increase in size of all morphological parts (Idem, 1989), which could have enhanced chlorophyll production and photosynthetic ability of the maize plants for improved assimilate production in leaves for subsequent translocation and partitioning to various parts of the crops for increased biomass production. It has been reported in a path coefficient analysis in an earlier study that the most important contributors from growth parameters to maize grain yield were total dry matter per plant and crop growth rate (CGR) (Adesoji *et al*., 2015b).

The larger dry matter accumulation observed on maize plants that received incorporated legumes could be linked to the potency of green manure to increase soil nitrogen (Pushpavalli *et al*., 1994), release phosphorus (Singh *et al*., 1992; Palm *et al.*, 1999), maintain and renew the soil organic matter and improve the soil physical and chemical characteristics (Tiwari *et al*.,1980). The favourable maize dry matter accumulation in the legume green manure-treated plots in this study could be attributed to the increases in the amount of N fixed by legumes and quantity of N and P derived from the decomposition of the incorporated green manure crops.

CONCLUSION

Based on the results obtained from this study, it can be concluded that SAMMAZ 12 and SAMMAZ 27 exhibited similarity in dry matter accumulation. Nitrogen fertilization was observed to cause great improvement in dry matter yield of maize plants compared with plots without nitrogen which showed smaller dry matter accumulation. Application of nitrogen at 60 kg N ha^{-1} was found to be adequate to cause marked increases in dry matter accumulation in maize plants. Incorporation of mucuna, lablab and soybean enhanced great increases in dry matter accumulation in maize plants compared with incorporated weeded fallow which showed a lesser dry matter yield.

Table 1: Influence of legume incorporation and nitrogen on total matter (TDM) and stover yield of maize in 2006 and 2007.

	TDM/plant (g) at 9WAS		**TDM (kg ha^{-1})**		**Stover yield (kg ha^{-1})**	
Treatment	**2006**	**2007**	**2006**	**2007**	**2006**	**2007**
Variety(V)						
SAMMAZ 12	103.1	112.3	8791	6250	5359	4619
SAMMAZ 27	104.8	110.1	8064	6200	4878	4544
SE±	4.13	3.76	377	224.5	228.6	129.3
Nitrogen(N) Kg ha^{-1}						
0	69.6c	69.7c	4569c	3770d	3136c	3048d
30	93.7b	109.6b	7370b	5787c	4613b	4323c
60	109.7ab	113.0b	9225a	6592bc	5580ab	4780bc
90	121.6a	126.6ab	10204a	7272ab	5972a	5261ab
120	125.0a	137.1a	10769a	7703a	6291a	5497a
SE±	6.53	5.95	596.2	355	361.5	204.4
Green manure (G)						
Weedy fallow	72.0b	75.9c	5552c	4413c	3494c	3323c
Mucuna	115.0a	121.7ab	9142b	6659ab	5465b	4802b
Lablab	120.3a	132.4a	9968a	7239a	6047a	5350a
Soybean	108.5a	114.8b	9047b	6588b	5466b	4852b
SE±	4.02	4.28	262.5	214.9	152.3	137.2

Means followed by the same letter(s) within the same column and treatment are not significantly different at 5% level of probability using DMRT.

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SOIL QUALITY ASSESTMENT OF AN EXISTING PLANTAIN (*MUSA SPP*) FIELD TREATED WITH POULTRY MANURE RATES IN EDO STATE NIGERIA

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ABSTRACT
Assessment of soil quality changes in an existing plantation could provide an indicator of the nutrient requirement of crops for sustain growth and yield. An experiment was conducted to evaluate soil quality assessment of an existing plantain (Musa Spp) field treated with poultry manure in the teaching and research farm of Ambrose Ali University, Ekpoma Edo state Nigeria in the 2015 cropping season. The treatment consists of five rates of poultry manure (0, 15, 25, 35 and 45 t/ha) arranged in a randomized complete block design (RCBD) and replicated three times. Selected soil physical and chemical quality indicators were asses on soil samples collected from two depth (0-15 and 15-30 cm) in the field. Results reveal that application of poultry manure does not significantly translate to an increase soil total N and pH. However, higher concentration of K and P were reported with the application of 35 tons/ha of poultry manure. Exchangeable Ca and Mg were significantly improve with the application of manure up to the highest rate of 45 tons/ha. Significantly higher percentage of organic matter was reported in all the plots which are intended to leave a residual effect. In all cases, higher plant nutrients were reported in the top soil than sub soil. The investigation however revealed that supplementary inorganic nitrogen is needed to balance the high K, Ca and Mg supply by 35 tons/ha of poultry manure for sustain growth of plantain under similar condition in Edo state.

Key words: Plantain, soil quality, soil depth, poultry manure

INTRODUCTION

Plantain (*Musa* spp) is one of the important staple foods in the tropical and sub-tropical regions of the world (Englberger *et al*., 2006). The fruit is an important source of carbohydrate, vitamins, proteins, potassium, iron, calcium, carotenes and ascorbic acid and also contains moderate amounts of thiamine, riboflavin, nicotinic and folic acid (Rasheed, 2003). Like most crops, Plantains require high amounts of nutrients for optimum growth and fruit production. Plantain cultivation has been reported to pose a significant declining effect on the soil nutrient reserve. For instance, the amounts of elements removed from the soil in the yield (Kg/Ha/Year) is K-1500; N-500; P-70; Ca-235; Mg-155; Mn-13; Fe-5.5; Zn-1.7; B-1.4; Cu-0.55 and their uptake of macronutrient is of the order; potassium (K) > nitrogen (N) > calcium (Ca) > magnesium (Mg) >phosphorus (P) and micronutrients in the order of manganese (Mn) > iron (Fe) > boron (B) > zinc (Zn) > copper (Cu) (Moreira and Fageria, 2009). In Edo State, farmers depend solely on the soil supply of most of the nutrients need of the crops thus making the yield of the crops to be sub optimal thereby compounding the current problem of food insecurity in the region. Research findings have shown some positive response of the crop to organic manure (poultry manure) as reflected in the size of bunches and fruits, total dry matter content and yield (Ndukwe *et al*, 2011). Similarly, even though most farmers seem to appreciate the positive role poultry manure could have on the crop yield, there is still a dearth of information on the frequency of application of organic materials base on soil test results to existing field. Hence, the objective of this study is to evaluate some selected physico-chemical soil quality indices of an existing plantain field treated with poultry manure rates in Edo state Nigeria.

MATERIALS AND METHODS

The experiment was sited at the teaching and research field of Ambrose Ali University, Ekpoma Edo State during the 2015 cropping season. The treatment consists of five rates of poultry manure (0, 15, 25, 35 and 45 t/ha) applied to a newly establish plantain farm arrange in randomize complete block design (RCBD) and replicated three times (3). Prior to field establishment and treatment administration, soil samples were collected from designated point across the field at a depth of 0 – 15 and 15 – 30 cm using an auger. The samples were bulk to form a composite sample upon which sub samples were taken out for physico-chemical analysis.

Similarly, at one year after field establishment, another group of soil samples were obtained from a depth of 0 – 15 cm and 15 – 30 cm base on individual plots to assess the nutrient status of the soil. All samples collected were air dried, sieved using 2 mm merge sieve and bagged in a well label polythene bags in readiness for laboratory analysis of the following physico-chemical properties; total nitrogen, exchangeable calcium, (Ca) magnesium (Mg) and potassium (K), available P, Soil pH, organic matter and soil texture. These soil properties were purposely selected based on their intensity of uptake as defined by Moreira and Fageria, (2009), and analyze using standard laboratory procedure as described by IITA (1991). Similarly the poultry manure use for this study was also analyzed using the same procedure and the results presented in figure 1 below.

Statistical analysis: The collected soil parameters were subjected to analysis of variance using GENSTAT Release 7.2DE, Discovery Edition 3 (GENSTAT, 2007) and the treatment means were separated using LSD at 5% and 1% level of probability.

RESULTS AND DISCUSSION

Results of the soil properties before planting of plantain are shown in Table 2. Results show that the pH of the soil was acidic at both the top (5.75) and sub (4.92) soil level. This pH value fall below the range of 5.0 to 6.8 reported for most agricultural soils in the tropics (Udo and Dambo, 1979); but represents the typical characteristics of ultisols of southern Nigeria. The pH value decreases with depth. Particle size distribution of the soil showed clearly that the soils are sandy loam and sandy - clay - loam at the 0-15 and 15-30 cm layer respectively with high proportion of sand and clay. Proportion of the main primary nutrients, N, P and K were all low except available P which was slightly higher in the 0-15 cm layer (68.99) than the sub soil (15- 30 cm) 60.03 mg/kg. N and K maintain the same trend at both depths. Irrespective of depth, base saturation were high in the soil with relatively higher values (99.80 %) reported in the top soil.

Soil properties at plantain fruiting

Result of the analysis of variance as shown in Table 2 indicates that pH of the experimental soil ranges from 5.04 to 5.962. The highest and lowest soil pH value was reported with the application of 15 and 45 tons/ha respectively of poultry manure. Application of poultry manure at higher rates tend to increase soil pH but not significant ($p<0.05$) to cause any serious changes on the soil pH status. This could be attributed to the lower pH value of the poultry manure incorporated. Soil pH on the other hand was significantly higher in the top soil (0-15 cm) than the sub soil (15-30 cm). Irrespective of soil depth, soil pH was strongly acidic thus depicting typical characteristics of ultisols of southern Nigeria. The concentration of nitrogen for instance fall within the range of 0.148 to 0.168 percent; which were consider low in all the treatment groups including the control. Significantly higher percent N was reported in the top soil than the sub soil. Increasing the rate of poultry manure does not translate to an increase soil N content. Similarly, the significant variation of N content with depth in all the treatments is a reflection of the high uptake/utilization of the available N in the top soil by the actively growing plant thereby creating no room for nutrient loss via leaching. Phosphorus content of soil was relatively higher in all the treatment including the control. The application of 35 tons/ha of poultry manure gave the highest (48 mg/kg) value of P. The higher value of P reported in the experiment could be related to the higher P content of the poultry manure (230 mg/kg) use in the trial in line with the work of Herencia *et al*. (2007) who reported that animal manure applied to soils have high soil P, K, Ca, Mg and NO_3 than soils to which inorganic fertilizers have been applied.

Potassium (K) content of the soil follow similar trend with other nutrients earlier discussed. K content of the soil fall within the range of 0.417 to 0.560 Cmol/kg. Increase application of manure does not significantly increase the K content of the soil. K was reportedly higher in the top soil than the sub soils. In practical terms, soil exchangeable K was within the standard range of 0.3 – 0.6 Cmol/kg and thus consider moderate. However, considering the fact that K is one of the limiting nutrient for plantain growth, relatively high (0.6 – 1.2) to very high (1.0 – 2 cmol/kg) K content is ideal to achieve significant yield of the crop. Research findings have shown that insufficient K supply reduces the total dry matter production and its distribution within the plant (Haifa, 2014). Calcium and magnesium content of the soil were moderate to high in all the treatment groups and posed no significant limitation to the continues existence of the plantation. As at the time of soil assayed, organic matter content of the soil were significantly higher in all the treatment with higher value reported in the 35 tons/ha rate of application. In general terms, the higher concentration of P, Ca, Mg, K and Mg observed in the top soil could be due to their limited mobility in the soil (Anderson *et al*., 2010).

CONCLUSION

Soil pH and texture were improved with increase application of poultry manure up to 45 tons/ha. All the nutrients were significantly higher in the top soil than the sub soil. The investigation however revealed that supplementary inorganic nitrogen is needed to balance the high P. K, Ca and Mg supply by the 35 tons/ha poultry manure for sustained growth of plantain under similar condition in Edo state.

Table 1: Physico-chemical properties of soil before treatment administration and planting

	pH(H_2O)	OM	Ca	Mg	K	Na	Al	H	P	N	Sand	Silt	Clay	ECEC	PBS
		%			Cmol/kg				Mg/kg		%				
0-15	5.75	2.33	7.2	4	0.5	0.02	0.01	0.01	69	0.1	81	2.3	7.7	13.33	99.8
15-30	4.92	1.72	8	4.6	0.5	0.09	0.05	0.01	60	0.1	69	2.3	29	14.84	99.1

NB: PBS= percent base saturation

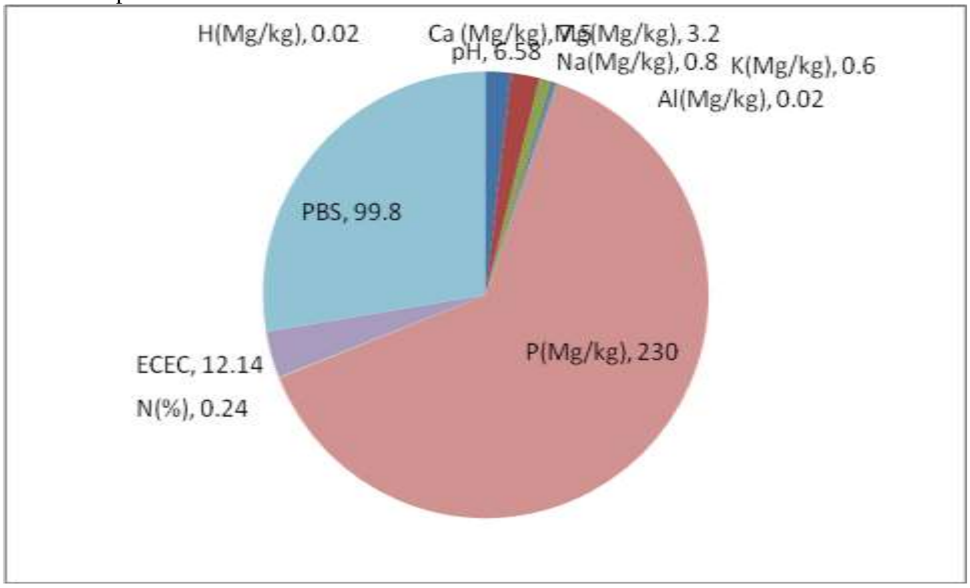

Fig. 1: Physico-chemical properties of poultry manure used

Table 2: Effects of Poultry manure rates on soil quality

Manure rate (MR)	pH(water)	N (%)	P (Mg/kg)	K	Ca	Mg	OM	Sand	Silt	Clay
				Cmol/kg	→ (%) ←					
0	5.26	0.155	35.80	0.532	5.82	2.4	3.134	80.66	3.23	16.11
15	5.042	0.152	107.20	0.417	6.03	3.22	3.61	81.78	2.53	15.69
25	5.153	0.162	26.10	0.56	5.35	3.00	3.75	82.33	2.65	15.02
35	5.313	0.168	48.10	0.443	6.53	2.03	4.42	81.33	2.36	16.26
45	5.962	0.148	34.20	0.368	6.62	2.33	3.81	77.50	3.43	19.07
$LSD_{(0.05)}$	0.343	0.035	60.62	0.2431	1.859	1.246	0.631	3.474	0.752	2.497
Depth										
0-15	5.357	0.179	73.60	0.633	6.29	2.67	4.74	86.86	3.06	10.06
15-30	4.935	0.135	27.00	0.295	5.85	2.53	2.84	74.63	2.62	22.81
$LSD_{(0.05)}$	0.217	0.015	NS	0.1538	0.56	0.788	0.399	2.197	0.476	1.579
MR X Depth										
Significance	NS	NS	NS	NS	2.63	1.762	NS	NS	NS	NS

NS=Not significant at 5% level of probability

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USE OF MAIZE COB ACTIVATED CARBON TO REMOVE AMMONIA FROM AQUACULTURE WATER

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ABSTRACT
This study using maize cob activated carbon to remove ammonia from aquaculture water was conducted at the laboratory of the Department of Fisheries, Modibbo Adama University of Technology Yola, Nigeria. The activated material was impregnated with 30% aqueous solution of potassium hydroxide (KOH) as activation agent. Ten juveniles of Clarias gariepinus of 7g average weight were randomly selected and stocked into four respective tanks and were administered diet of 30% CP (T1), 35% CP (T2), 40%CP (T3) and the fourth tank being the control was fed with 30% CP at 7% of body weight per day. Two hours after stocking, the water samples were collected from each tank and analyzed for ammonia. The results indicated positive presence of ammonia. 30g of the granular activated carbon was applied to each of the treatment tanks except the control tank. Then after three hours the water was collected and tested for ammonia concentration. The result indicates a reduction in the accumulation of ammonia but an increase of ammonia concentration in the control with the following correlation values between the treatment tanks and control: 0.08mg/l - 0.032, 0.22mg/l - 0.032mg/l, 0.32mg/l - 0.14mg/l and 0.08mg/l - 0.44mg/l and the correlation values are: -0.71984, -0.68166 and -0.32965. The data generated were analyzed statistically by using one way Analysis of Varriance (ANOVA). The mean and correlation were separated by Duncan Alpha range test.

INTRODUCTION

Ammonia is the major waste product in the elimination of excess amino acids from the breakdown of proteins in fish (Durborow et al., 1997). When fish is fed with high protein diet, they utilize the amino acids from protein digestion and excess amino acids are converted to ammonia which is excreted through the gills and in the faeces. In water, ammonia occurs in two forms represented as ammonium ions (NH4+) and unionized ammonia(NH_3). Between the two forms, the unionized form (NH3) is more poisonous to fish (Durborow et al., 1997). Ammonia is acutely toxic to fish and can cause loss of equilibrium; increased breathing, cardiac output, and oxygen uptake, and in extreme cases; convulsions, coma and death. Fish exposed to low levels of ammonia, overtime, are more susceptible to bacterial infections and will not tolerate routine handling (Svobodova et al., 1993). Several factors have been shown to modify acute ammonia toxicity in fresh water. Some factors alter the concentration of NH_3 in water by affecting the aqueous ammonia equilibrium,while other factors affect the toxicity of NH_3itself, either by ameliorating or exacerbating its effects (Kefi, 2008). Activated carbon is an environmentally friendly adsorbent which can be derived from many different local raw materials and can be produced in varying production processes. The raw materials used, activation process, and process parameters determine the physical properties and performance characteristics of the resulting carbon. Hence maize cob is readily available, commonly known and very cheap.

The performance of activated carbon is indicated by its adsorptive characteristics, which is derived from the specific surface area, pore size and pore volume, of the product (Lartey *et al*., 1999). The two basic methods of producing activated carbon from carbonaceous materials are thermal and chemical activation methods. Tsai *et al.*, (2001) reported successful production of activated carbon from corn cob with BET specific surface area exceeding 1600m2/g using a combination of the two methods. However, most products in the market are obtained from either thermal or chemical activation method. Some useful properties of activated carbon have been known since ancient times as stated by Bansal and Goyal (2005), Coulson and Richardson (2002), Beguin and Frackowiak (2010) and Jankowska *et al.* (1991)

The study was done to determine the use of maize cob activated carbon to remove ammonia from aquaculture water and determine the best level of application and its absorption time range.

MATERIALS AND METHODS

The method of Sichula *et al*.(2011) was adopted for this research. The Maize cob was obtained and thoroughly cleaned to remove unwanted particles. Then 100g of the material was weighed on a sensitive weighing balance and soaked in prepared 30% wt aqueous solution of potassium hydroxide in the ratio1: 6 and left overnight for twelve (12) hours.

Water was drained from the material and then oven dried for thirty minutes at a temperature of 100°C. Pyrolysis of the mixture was done using a Cestar 2123 model muffle furnace and charred for twenty (20) minutes at a temperature of 600^0C and cooled using a dessicator The sample was the washed with distilled water until the water pH was 6.5-7.0. This was done so that the materials being impregnated with the strong base doesn't increase the pH of the experimental tank water. After the washing, the material was again oven dried at a temperature 100^0C overnight and cooled. The activated carbon was then stored in an air tight bag.
Fourty juveniles of *Clarias gariepinus* were collected from Teaching and Research Fish Farm of the Department of Fisheries MAUTECH, Yola and acclimatized to the laboratory condition for one day. Thereafter they were transfered into the experimental tanks. Three experimental tank and one control tank were used. Ten juveniles of the *Clarias gariepinus* were randomly selected and stocked in each of the respective tanks. Tank 1 was administered diet containing 30% CP, tank 2 was administered diet containing 35% Cp and tank 3 was administered with 40% CP diet. The control tank was administered 30% CP diet. The fish were fed at 7% of the total body weight.
Thirty (30) grams of the granular activated carbon of mesh size 2-2.8mm were weighed and applied to the treatment tank 1, 2 and 3. In tank 1, the activated carbon was immersed to the bottom, in tank2, the activated carbon was suspended midway and in tank 3, the carbon were scattered on the surface of the water. While in the control tank no carbon was applied.
The water in each tank was tested for NH_3, pH and temperature before commencement of the experiment and thereafter at two hours interval until the adsorption limit of the activated carbon became constant.
The data collected were analyzed using one way Analysis Of Variance (AVOVA) and means were separated using Duncan Alpha range test. Correlation was used to compare the significant difference between the various treatment of means.

RESULTS AND DISCUSSION

Table 1 shows the *ammonia* concentration for a period of eight hours. At the initial time of zero hour, in the control, the highest value of *ammonia* is 0.44mg/l at the 8th hour while the lowest value of 0.05mg/l was recorded at the zero hour of the control. In treatment 1, at the initial time of zero hour, the *ammonia* was 0.05mg/l while the highest value of *ammonia* was 0.03mg/l at the 8th hour. In treatment 2, the lowest value recorded for ammonia was 0.05mg/l at the initial while the highest value was also 0.03mg/l at the 8th hour. And in treatment 3, the lowest value recorded for *ammonia* concentration was 0.05mg/l at zero hour and has the highest of value of 0.14mg/l being recorded at the end of the 8th hour with the respective values for Hydrogen potential (pH) and temperature during the experiment.

Figure 1 shows the *ammonia* concentration profile in the treatments and the control when *activated carbon* applied after 2 hours. In treatment 1, the level of *ammonia* reduced from 0.08mg/l to 0.03mg/l after the 8 hour. In treatment 2, the value of *ammonia* decreases from 0.22mg/l to 0.03mg/l after the 8 hour, while for treatment 3, the reduction was from 0.32mh/l to 0.14mg/l when the activated carbon was applied. In the control tank (without *activated carbon*) the *ammonia* concentration increased from 0.08mg/l to 0.44mg/l at the 8 hour.
In table 2, the mean *ammonia* concentration for the control tank did not show any significant difference throughout the 8 hours of the experiment. In treatment 1 (T1),the mean value obtained after 3 hours was significantly different from the mean values obtained after 4, 6 and 8 hours. In treatment 2 (T2), the mean value obtained after 2 hours was significantly different from the initial mean value and the value obtained after 4 hours. In treatment 3 (T3), the initial value was significantly different from all the other mean values obtained after 2 hours, 3 hours, 4 hours, 6 hours and 8 hours ($p<0.05$).
In Table 3, Treatment 1 is negatively correlated to the control (r=-0.71984), T2 is negatively correlated to control (-0.68166), and T3 is also negatively correlated to the control with a value of -0.32965 while T1, T2 and T3 are positively correlated. In Table 4, the quantity of *ammonia* increases from 0.08mg/l to 0.44mg/l at 8hours in the control tank (without activated carbon). In T1, the quantity reduces from 0.08mg/l to 0.03mg/l at 8hours. In T2 (with activated carbon) the quantity reduces from 0.22mg/l to 0.03 and in T3 (with *activated carbon*) the quantity reduces from 0.44 to 0.14mg/l at 8hours. The statistical analysis indicated significant negative correlation between the concentrations of *ammonia* and time (hours) in treatment 1 and control was found to be significant at r=-0.71984, 0.68166 in treatment 2 and for treatment 3 at r =- 0.32965.This agrees with the work of Sichula (2011) who fed the fish with 40% CP and after the application of the activated carbon, he noted the concentration decreases towards a constant value which indicates the adsorptive capacity of the *activated carbon* in the water. The result of the mean *ammonia* concentration in this experiment after the application of *activated carbon* shows that all the methods of application (bottom, midway and surface) of the activated carbon were effective however when the activated carbon was suspended midway of the tank (treatment 2) followed by when it was submerged

at the bottom of the tank (treatment 1). Sichula *et al*. (2011) carried out a related study and found the concentration of ammonia to decline when the *activated carbon* was produced using physical activation method and work done by Ajayi and Olawale (2009) proved that chemical activation method was more effective when a suitable precursor was selected. However, bottom application of activation carbon to aquaculture water may not be good for earthen ponds and concrete tanks with a lot of sediments at the bottom as this could block the micro pores of the activated carbon.

The result of this study differs from the result obtained by Sichula *et al.* (2011) due to the large quantity of the activated carbon applied which led to the short period of time before obtaining constant value of the ammonia being absorbed by the activated carbon.

CONCLUSION

In conclusion, the best method established from the experiment in the application of the activated charcoal was found to be more useful when the charcoal was suspended at the water column. And this could be attributed to the fact that the uneaten feed has the tendency of blocking the micro pores of the *activated carbon*. Therefore, by implication it means that it is not advisable to use the *activated carbon* in earthen ponds where there are a lot of soil sediments and other organic substances at the bottom. Likewise, scattering the *activated carbon* on the surface of the water is not very suitable as part of the *activated carbon* will be outside and this portion of the material may not be useful during the adsorption process.

The adsorption time range varied with the crude protein content of the feed administered which gave an indication that the more the accumulation of *ammonia* the more the quantity of the *activated carbon* that should be used.

Table 1: Water quality parameters measured during the experiment at different times (hrs).

	Initial			**2hrs**			**3hrs**			**4hrs**			**6hrs**			**8hrs**		
	NH_3 (mg/l)	pH	T (^{0}C	NH_3 (mg/l)	pH	T (^{0}C)	NH_3 (mg/l)	pH	T (^{0}C)	NH_3 (mg/l)	pH	T (^{0}C)	NH_3 (mg/l)	pH	T (^{0}C)	NH_3 (mg/l)	pH	T (^{0}C)
C1	.05	6.4	28	.08	6.4	28	.08	6.4	28	0.14	6.6	28	0.32	6.5	28	0.44	6.7	28
T1	.05	6.5	28	.08	6.4	28	.08	6.4	28	.03	6.4	28	0.03	6.5	28	0.03	6.6	28
T2	.05	6.5	28	0.22	6.5	28	.0.22	6.6	28	0.14	6.6	28	0.03	6.4	28	0.03	6.5	28
T3	.05	6.6	28	0.44	6.6	28	0.32	6.4	28	0.32	6.6	28	0.22	6.5	28	0.14	6.5	28

Table 2: Mean *ammonia* concentration in the treatment tanks (with *activated carbon*) and in the control tank.

Ammonia concentration (mg/l)	Initial	2hours	3hours	4hours	6hours	8hours
Control	0.05[a]	0.075[a]	0.075[a]	0.14[a]	0.315[a]	0.44[a]
T1	0.05[a]	0.075[a]	0.075[a]	0.025[b]	0.025[b]	0.025[b]
T2	0.05[a]	0.215[b]	0.215[b]	0.14[a]	0.025[b]	0.025[b]
T3	0.05[a]	0.440[c]	0.315[c]	0.315[c]	0.215[c]	0.14[c]

Mean values in the same row with different superscripts are statistically different P<0.05.

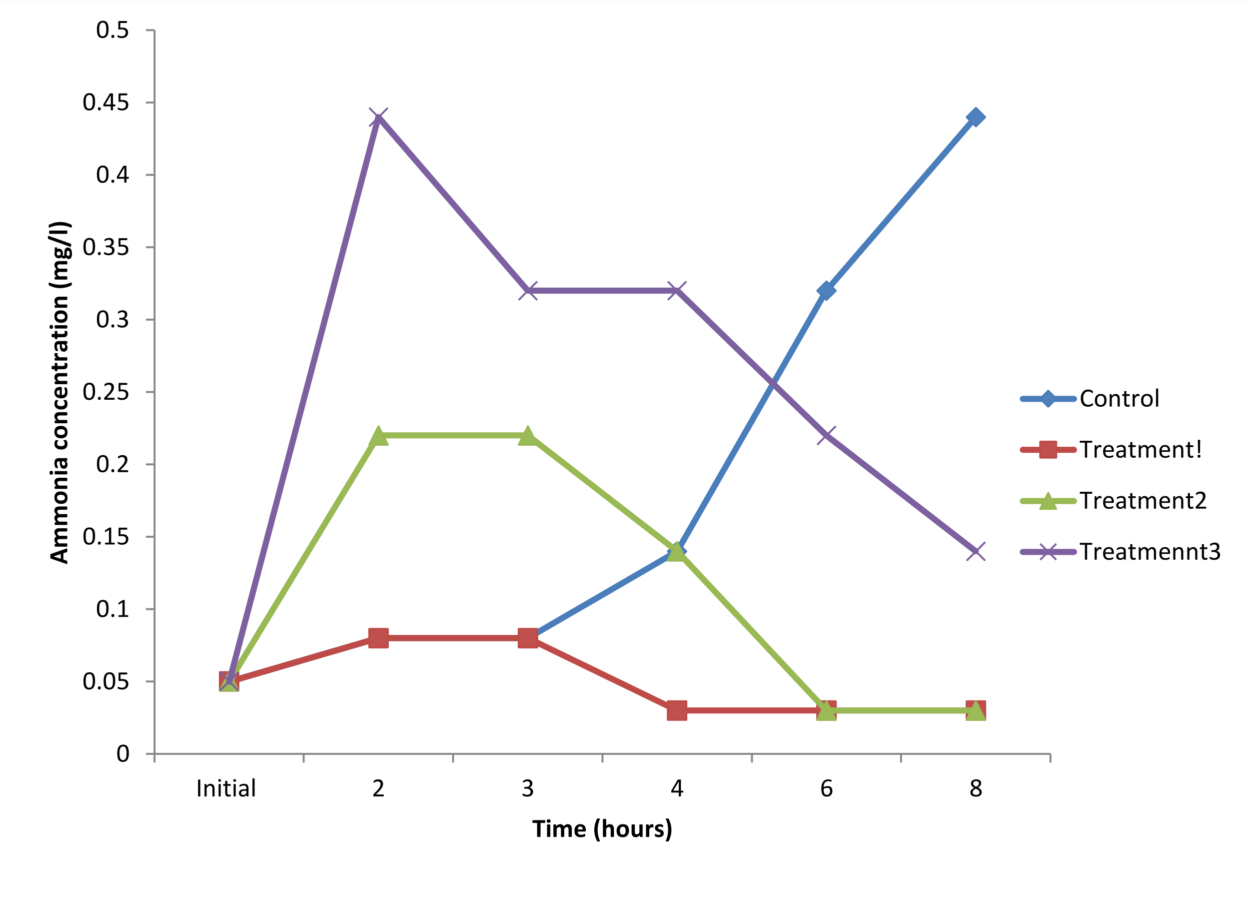

Figure 1: Ammonia concentration profile during period of 8 hours

Table 3: Pearson correlation matrix of control and treatments

	Control	Treatment 1	Treatment 2	Treatment 3
Control	1			
Treatment 1	-0.71984	1		
Treatment2	-0.68166	0.79014	1	
Treatment 3	-0.32965	0.481262	0.838722	1

Table 4: Quantity of *ammonia* reduced by *activated carbon*

Tanks	*Ammonia* concentration (mg/l) generated 2hours after feeding	*Ammonia* concentration (mg/) 8 hours after application of *activated carbon*	Quantity of *ammonia* reduced (mg/l) at 8hours after application of *activated carbon*
Control	0.08	0.44	0.36
Treatment 1	0.08	0.03	-0.05
Treatment 2	0.22	0.03	-0.19
Treatment 3	0.44	0.14	-0.30

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SOIL DEGRADATION: A REVIEW

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ABSTRACT
Soil degradation has become the most important challenge to sustainable agriculture and food security. Soil degradation is a global problem caused by many factors including excessive tillage, inappropriate crop rotations, excessive grazing or crop residue removal, deforestation, mining, construction and urban sprawl. Consequently, per capita food production, income and savings have been falling. Nonetheless, despite the seriousness of soil degradation problems and its negative consequences on food security and income to individual households and the nation at large, the magnitude of the threat that soil degradation poses on current as well as future income and how best to address the problem is not well known. To meet the needs of an expanding global population, it is essential for humankind to recognize and understand that improving soil health by adopting sustainable agricultural and land management practices is the best solution for mitigating and reversing current soil degradation trends.
Keywords; Soil, degradation, deforestation, plant residues

INTRODUCTION
The term 'Soil degradation' refers to processes that causes a reduction in the capacity of the soil to produce goods and services for needs and benefit of current and future generations (Pittekow *et al*., 2014). Soil degradation is undesirable since it results in land becoming less useful and productive. The ability of soil to support plants and animals declines due to reduction in its capacity to retain and supply adequate moisture and nutrients required for optimal growth of crops (Sanchez and Swaminathan, 2005, Gracia-Franco *et al*., 2015). It is therefore, important that we understand what causes soil degradation and what is required to prevent soil degradation for sustained agricultural productivity and related services that the soil provides. Soil degradation is also the decline in soil quality caused by its improper use, usually for agricultural, pastural, industrial or urban purposes. Soil degradation is a serious global environmental problem and may be exacerbated by climate change (Graves *et al*., 2015). It encompasses physical, chemical and biological deterioration. Examples of soil degradation include: loss of organic matter, decline in soil fertility, decline in structural condition, erosion, adverse changes in salinity, acidity and alkalinity. Soils host the majority of the world's biodiversity and healthy soils are essential to securing food and fiber production and providing an adequate water supply over the long term. Ecosystem services provided by soils are integral to the carbon and water cycles and include cultural functions. There are strong links between climate change and soil condition. Increases in soil carbon can help to mitigate greenhouse gas emissions and enhance adaptation to climate change (Guo and Gifford, 2002; Johnson *et al*., 2009)

Soil Degradation
Soil degradation is the temporary or permanent lowering of the productive capacity of soil caused by overgrazing, deforestation, inappropriate agricultural practices, over exploitation of fuel wood leading to desertification and other man-induced activities (Wall and Six, 2015). Processes of soil degradation are grouped into six classes: (Van *et al*., 2013; Vepraskas *et al*., 1986; Willison *et al*., 1995). Water erosion, wind erosion, soil fertility decline, salinization, water logging and lowering of the water table. (i) Soil erosion by water includes inter-rill and rill erosion, gullying, and land sliding caused by clearing of vegetation and road construction. Soil erosion by wind produces sand dunes. (ii) Soil fertility decline refers to deterioration in soil physical, chemical and biological properties caused by (a) reduction in soil organic matter status, leading to decline in soil biological activity; (b) degradation in soil physical properties (structure, aeration, water holding capacity) caused by reduced organic matter(c) adverse changes in soil nutrient status, including reduction in availability of the major nutrients (N, P, K), initiation of micronutrient deficiencies and development of nutrient imbalances; and (iv) build up of toxicities (by heavy metals, xenobiotics, and acidification through incorrect use of fertilizers). (iii) Water logging is caused by over irrigation, and restricted infiltration of water into the soil. This lowers land productivity through rise in ground water close to the soil surface. (iv) Salinization refers to all types of land degradation brought about by increased concentration of salts in the soil. It occurs by planning mistakes and mismanagement of irrigation schemes (salinization in the strictest sense), and sodification (also called alkalinization), which refers to the dominance of the exchange complex by Na^+. (v) Lowering of the water table is brought about by pumping of ground water for irrigation which exceeds the natural recharge capacity. Pumping of water for urban and industrial

use also causes this form of land degradation. Other types of land degradation include (i) deforestation, (ii) forest degradation (reduction in biotic resources and lowering of the productive capacity of forests), (iii) range land degradation (lowering of the productive capacity of range lands), (iv) acid sulphate formation, (v) soil pollution, (vi) soil destruction through mining and quarrying activities, (vii) urban and industrial encroachment on to agricultural land, (viii) destruction of irrigation schemes, and (ix) potential effects of global climatic change (including global warming which may lead to modifications in the general atmospheric circulation, causing changes in rainfall pattern) (Amundson *et al*., 2015).

Causes of Soil Degradation

1. Physical factors, e.g. loss of fertile top soil due to water or wind erosion.
2. Chemical factors e.g. depletion of nutrients or the toxicity due to acidity or alkalinity (salinization) or water logging.

Physical Degradation

Physical degradation is caused when agricultural practices impact the physical property of soils in ways that result in adversely impacting critical soil functions (Lal, 2015). In intensively cultivated soils, repeated use of heavy farm machinery for tillage related activities often results in compaction and formation of hard pan at the plough depth. Compacted soil layers restrict root growth and penetration. Physical degradation is also caused by practices that expose the soil (cultivation) (Powlson *et al*., 2014) to direct impact of rain and wind causing soil erosion resulting in physical displacement of soil particles. High wind speeds particularly during summers, carry the smaller sized clay and silt particles that can remain suspended in the air for days (Lal, 2012). The heavier sand sized particles on the other hand move from one place to another to varying distances depending on wind velocity, soil condition, etc. Similarly, when high velocity raindrops strikes bares oil surface, the soil aggregates break down clogging the soil pores, causing much of rain water flow as runoff carrying the top organic matter rich soil with it.

Chemical Degradation

Chemical degradation refers to processes that cause changes in the chemical environment of soils adversely impacting their productive capacity. Amongst common farming practices, inappropriate use of chemical fertilizers and pesticides can contribute significantly to the degradation process (Sousana and Lemaire, 2014). Tate (2015) showed that prolonged use of heavy doses of fertilizers can result in soils becoming more acidic that has serious implications in terms of long term productivity of soils. Inappropriate, viz. imbalanced or excessive, use of fertilizers is a major cause of pollution of ground waters or surface water bodies resulting from inefficient use of applied nutrients. Distribution of wheat roots in sodic and normal soil, about 100 days from planting Results of most long term studies emphasize the need to use chemical fertilizers conjunctively with recycling of organic farm wastes for sustained productivity. Gaseous N2 losses from fertilizers constitute a significant part of GHG emissions from agriculture related activities contributing to global warming Turpault et al., 1996; Reay and Nedwell, 2004). Pest control chemicals utilised to eliminate unwanted pests (or weeds, insects etc) are also detrimental to living organisms in the soil, vital to soil health and productivity. Rational and wise use of chemicals is therefore important to minimise adverse impacts associated with their use. In a large fraction of irrigated agriculture, groundwater is the primary source of irrigation. Ground water invariably contains varying amounts of salts that tend to accumulate in the root zone over a period of time. Excessive salts in root zone are detrimental to plant growth and in extreme cases render the soil completely unproductive (Qadir *et al*., 2014)

Biological Degradation

Soils are a habitat to a large variety of flora and fauna that constitute a significant part of our biodiversity resource. Organic matter is the main food base of living organisms in the soil and soil organisms perform vital functions that contribute to sustained productivity of soils. Reduced recycling of organics through the soil is the primary factor leading to a decline in the extent and diversity of living organisms within it. Agricultural practices that donot emphasize integrated nutrient management involving the optimum use of on-farm residues together with such practices as tillage, burning of crop residues etc. cause depletion of organic matter and in turn result in loss of a soil's biological population. Other agricultural practices like mono-cropping where the same crop (eg cereals) are grown repeatedly year after year without adopting crop rotations also lead to decline in soil biodiversity. Punjab farmers burn crop residue to prepare land for next sowing.

CONCLUSION

Soil degradation is a complex issue. It is caused by the interaction of physical forces and human activities. Its impact is increasing and is having a negative effect on food production. Some areas are more badly affected than others but in a globalized world the impacts are felt worldwide. The method of dealing with soil degradation depends on the cause of the problem, but also the resources available to the host country. Degradation is likely to increase over the next decades as a result of: climate change; population growth; the use of increasingly marginal areas for living and food supply.

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COSMOVISION IN SOIL RESOURCES MANAGEMENT

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ABSTRACT
Cosmovision of soil resource management is an intellectual resources that can be lost due to globalization. Yet it sustained and still stains agriculture in traditional farming system. Some of the measures adopted includes presentation of sacred groove, agroforestry system, land rotations, inter-cropping system and organized manuring to prevent soil erosion and increase soil productivity. Having examined critically the importance of cosmovision, it is anticipated that familiarity with it and the culture of any area of interest in relation to natural resource management need to be studied to know where the people are and any interventions from outsiders to improve on the peoples knowledge.
Keywords: cosmovision, soil fertility, management, agroforestry

INTRODUCTION
Cosmovision refers to the way certain populations understand life, the world, and the cosmos. The relationships between the social world, the natural world, and the spiritual world are central to people's cosmovisions. Cosmovision explains the ways in which natural processes take place and the roles played by supernatural powers. Philosophical and scientific premises are made explicit (Haverkort and Hiemstra 1999).
Huizer (1999) describes it as a *"holistic awareness"*, an inner civilisation from which we can learn. For many rural, but also urban people throughout the world, their cosmovision still feeds many aspects of their life, including their spirituality, day-to-day actions, rituals, symbols and arts, food production, and relationships with nature and other community members. Cosmovision has a significant impact on the way people organize their lives. Traditional ecological knowledge has a historical continuity of resource use practice that is based on an integrated system of knowledge, practices, and beliefs including cosmology (Berkes*et al*., 2000). Therefore, knowledge about the cosmovision of a people is important for any outsider wanting to develop technologies together with them.
In 70 nations, over 370 million indigenous people have retained their cultural, social and economic characteristics that are distinct from those of the dominant societies in which they live (Schmidt and Peterson, 2009). This has far-reaching implications for field methods such as Participatory Technology Development. The case descriptions on PTD have generally been based on the assumption that farmers use a "western logic" in their experimentation. Anthropological research (e.g. Reader 1988) suggests that the cosmovision demands that more variables be taken into account than merely biophysical factors.
The cosmovision of soil resource management aim to improve situation in the soil and proper conservation and management of the soil, it is crucial to understand processes and relationships in the sociosphere. However, it is argued that a thorough understanding of cultural roots, beliefs tradition and power relations is essential for the conservation and sustainable management of resources at community level.

INDIGENOUS KNOWLEDGE
Indigenous knowledge (IK) is gaining increasing attention and its' importance in sustainable development is well-recognized (Warren and Rajasekaran 1993; Kolawole 2001; Samal *et al*, 2010). In various places in the world, scientists and indigenous people are collaborating to build bridges between modern science and indigenous knowledge, among others, to improve ecological management of a particular region (Reijntjes 2004, 41). Policy makers and agricultural development planners are beginning to recognize the need to understand indigenous knowledge systems and have shown renewed interest in this type of knowledge (Warren and Rajasekaran 1993).The importance of integrating indigenous knowledge into contemporary conservation and sustainable management of natural resources has also been well reviewed (Rist and Dahdouh-Guebas ;2006). Recognizing indigenous knowledge means acknowledges locally developed solutions, based on existing culture, values, and beliefs and practices which otherwise could be barrier in development efforts. Moreover, farmer's ideas which were in the past regarded as primitive or misguided are now being seen as appropriate and sophisticated (Chambers 1983). Farmers have quite a sophisticated knowledge of agriculture based on insights from several generation (Kolawole, 2011). Most of the cosmovision knowledge is taught to the young by elders orally. Much of that knowledge is preserved in the form of folk songs, proverbs, myths, and sages. Generally folk songs are mostly retained by village women, whereas the knowledge relating to the agricultural activities of men is often

preserved in the form of dance and instrumental music. Instruments, such as the sacred drum and horn are used at special occasions by elders (Linquist and Adolph 1996).

COSMOVISION IN SUSTAINABLE SOIL DEVELOPMENT

Historically, along with collection of forest resources the hunter gatherers or tribal societies have been practicing marginal agriculture. The agricultural practices of tribal communities follow some traditional norms including rituals, festivals and techniques. These practices are followed to increase the land fertility, soil conservation, moisture balance and pest control that subsequently have developed a wide range of site specific technologies (Haverkort, 1995; Cleveland, 1998). In India, the traditional agricultural practices may vary across the agro-climatic zones. The diversity in soil types and diverse geographical conditions lead to diverse agricultural systems. The important forms of agriculture in India are settled, shifting and agroforestry based agriculture systems (Ramakrishnan, 2002; Kala *et al*., 2008). All these forms of agriculture are under pressure with the changing land use practices, increasing human population, and overexploitation of land resources that have subsequently resulted in the land degradation, particularly declining soil fertility and escalating soil erosion. Land degradation has been a problem ever since humans settled the land and started domesticating plants and animals (Sanders, 2004), hence the farmers had devised some indigenous practices and systems of land use to maintain and restore the quality of their lands, which remained an indispensable tool for sustained crop production (Tekwa *et al.*, 2010). Unfortunately, these indigenous practices have seldom been recognized in the race for modernization and development; therefore, at present, most of such practices have reached to the verge of extinction.

However, the importance of traditional agricultural practices has been receiving attention for food security (Rajasekaran and Whiteford, 1992), quality control and for biodiversity conservation (Gadgil *et al*., 1993). Some agro-forestry based studies show that traditional agriculture enhances the soil quality and helps agriculture in a sustainable ways (Berkes, 1999; Ramakrishnan, 2002; Kala, 2012).

The cause-effect relationship between human activities, such as soil tillage and crop husbandry, and crop performance are accepted and understood. Agricultural production can be improved by improving husbandry practices. Yet, such husbandry practices are only part of reality. The other part includes the spiritual influence on rainfall, health, crop performance and yield. This is acknowledged and requires sacrifices, festivals and taboos for funerals, drumming and war crises during certain periods in the growing season.

SOIL AND WATER MANAGEMENT

Herweg (2002), described role of IK in soil management to overcome labor shortage and optimize farm operations. The practices described include working arrangements (sharecropping and animal fatting) and gradual terrace building for degraded farm plots. Use of manure, compost and crop residue, soil burning, temporary structure (trash line) and indigenous grass and vegetation strip. Review by Herweg shows the role of IK practices in improving physical soil properties, nutrient recycling and fertility improvement. Liniger *et al* (2011) reviewed best practices in sustainable land management in sub-Saharan Africa and described a case study on traditional water harvesting system focusing on runoff and floodwater farming in Ethiopia. There are also reviews on traditional conservation measures by Reij (1991), bench terracing for chat (*Catha edulis*), Nyssen, *et al.,* (2000) on traditional technique "daget" in Tigray and indigenous fallowing in Wolyita Zone (Amede, 2001).

Experiences on how traditional African soil and water conservation concepts can be matched with participatory approaches are accumulating. They are resulting in increased understanding of farmer livelihoods, and more and more programmes today put farmers in the centre of their activities. However, many of these programmes hardly address the African worldviews, beliefs systems and the traditional systems of land tenure on which these practices are based. In the development literature, a general lack of information about the spiritual dimension of soil and water has been observed. Traditional functionaries, such as the earth priests, the spirit media and rainmakers who are traditionally consulted for issues related to land and water management by rural people, are hardly involved in rural development projects. In practice, the divide between anthropologists and development workers with a technical focus is quite deep.

CROPS AND TREES

An overview of literature on traditional management of crops and trees reveals that the subjects most frequently dealt with are sacred groves, agro-forestry, plant breeding, and crop cultivation. Again, the literature gives more information about the bio-physical aspects of traditional use of trees and crops, than about the cultural and spiritual dimensions, with exception of the studies on sacred groves. Several studies stress the importance of sacred groves in relation to the efforts of the rural people to appease the spirits related to rainmaking, good crops or health. Traditional spiritual leaders play an important role in the management of these important patches of high biodiversity. Several authors also indicate that sacred groves can be an important starting point for development and rehabilitation of savannah areas, forests and wetlands.

Indigenous agro-forestry is widespread and several systems are described in literature. Farmers know the equalities of trees, what they can be used for, and the possibilities and limitations of combining trees with crops. Some tree species have a spiritual significance, which is reflected in taboos and rituals associated with them .Many studies on the traditional cultivation practices of crops, including traditional food crops and wild plants ,can be found.

LIVESTOCK KEEPING

Livestock systems in Africa are extremely complex. In a broad sense we can distinguish between two major livestock systems, which are the extremes of a continuum: livestock systems associated with settled farmers and pastoral husbandry systems. The role of animals in the spiritual life of African rural people is quite unique and has been the subject of several studies. Literature describes beliefs and practices related to livestock on aspects like feeding, breeding, animal health, small stock and wild animals.

Literature also shows the immense changes that African livestock productions systems are undergoing currently, especially the pastoral systems, due to modernization, population growth and government policies. It is necessary to look at indigenous knowledge related to livestock in the context of the culture of the people involved. In many ethno-veterinary and animal husbandry studies, this aspect has been overlooked, focusing mainly on the use of medicinal plants for curing diseases. There is much potential in activities that combine ethno-veterinary aspects with village based animal health care. There is a imbalance in the extent to which the different animal species are studied, and the use and importance of the species in rural peoples' lives. For example, most literature on fowl deals with chicken, though many families s use a combination of species including guinea fowls, ducks, turkeys and pigeons. There is potential for working with rural people, especially women, by focusing on these 'non-traditional' species.

The role of women related to livestock is subject to many changes. In some cases they become more involved in livestock, in others less; the effect on their social position and status also shows a wide variation. In the last decades there has been a decline in 'conventional' livestock projects, due to disappointing results, especially the range development projects, and the projects based on the import of exogenous breeds. Meanwhile, the number of 'innovative' projects, for example on ethno-veterinary medicine and village-based animal health care, has increased.

CONCLUSION AND RECOMMENDATIONS

Cosmovision is the secret behind sustainable land management in many rural communities in Nigeria and other parts of the tropical world. Familiarity with the cosmovision and the culture of any area of interest in relation to natural resource management, need to be studied to know where the people are and any interventions from outsiders to improve on the peoples knowledge. A non-bias, but critical relationship with the traditional and spiritual leaders, and with other members of the community is recommended.

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EFFECTIVENESS OF ANIMAL MANURE TYPES ON SOME ACIDITY INDICES OF LEACHATE VERTISOLS IN BENDE L.G.A OF ABIA STATE, NIGERIA

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ABSTRACT

Applying animal manure to the soil is one of the ways of improving the soil properties for crops production. An incubation study was carried out at the Department of Soil Science and Meteorology laboratory of Michael Okpara University of Agriculture, to investigate the effect of types of animal manure on some soil acidity indices. The treatments comprised of Poultry manure (PM), Pig waste (PW), Cow dung (CD), Goat manure (GM) and a Control (C which has no amendment). The application rates of the animal manure were 0t/ha, 1.5t/ha, 3.0t/ha, 4.5t/ha, 6.0t/ha, and 7.5t/ha. Their various grams equivalent were applied to 300 grams of soil used for the study. The applied treatments were replicated three times in a 4x6 factorial experiment in a Completely Randomized Design. The experiment lasted for sixty-three days and the leachates were analyzed at twenty-one days intervals. The pre-treatments soil analysis and the chemical composition of the treatments were determined. The following leachate analyses were determined: soil pH and exchangeable acidity using the standard laboratory procedures. The results obtained showed that at day one of the incubation, the leachates from containers that received PW significantly ($p \leq 0.05$) increased the pH to 7.1 when the treatments was applied at 7.5t/ha as against the control that gave 5.66. The value of pH 10 was recorded for the leachate of the PM amended soil at 7.5t/ha whereas the control gave 5.53 at the 42nd day of incubation. Treatments applied at 7.5t/ha irrespective of the animal manure type, gave the lowest significant ($p \leq 0.05$) mean values of 0.47, 0.15, 0.09 and 0.06comlkg^{-1} for exchangeable acidity at day 1, 21st, 42nd and 63rd day of incubation respectively. The results generated from the study gave an explicit indication that PM and PW have the abilities of increasing the pH and decreasing the exchangeable acidity of the soil leachate. Carrying out further research studies to authenticate the incubation result is recommended.

Keywords: Vertisols, animal manure, incubation, leachate.

INTRODUCTION

One of the natural functions of the soil is to support plant lives. This it does by providing the plants with the necessary nutrients for its growth and development. Unfortunately, these nutrients are always limited in the soil when the plants need them. The reasons for this may be because the nutrients are depleted by previous plant uptake, leaching or fixation. Fixing of nutrients usually take place in acidic condition. Soil gets acidifies when H^+ ions are released in the soil from processes which include transformation and cycling of C, N and S in managed ecosystems (Bolan, *et al.*, 2003). In acidic soils, there is decrease in pH, base saturation, and unbalanced availability of elements in the root environment as well as decrease of the acid neutralizing capacity (ANC) of the soil (Van Breemen, 1991).

Other situations found in acidic conditions are sorption of large concentration of H^+, which creates positive charges (Adriano, 2001) on the variable charge surface in soil. As soil acidic increases, there is a decrease in pH and this increases the concentration of Al, Fe and Mn in soil solution. When this happens, it leads to the adsorption or precipitation of phosphorus which will result in its unavailability for the crops and deficiency (Haynes, 1984). Many materials have been used to ameliorate the soil acidity, one of which is animal manure. Animal manure when added to acidic soil, increase the pH. This it does by forming phenolic humic –like materials which are organic anions and take up protons from the soil which raise the pH (Narambuye and Haynes, 2006; Haynes and Mokolobate, 2001). The incorporation of animal manure into the soil is a long term agricultural practice that had been used to improve the soil properties and fertility status of the soil. It is also an effective way of disposing the waste, which if left unattended to would cause environmental and health issues to the society (Sommer, *et al.*, 2013).

Various types of animal manure have different chemical compositions and as well as affect the soil properties different. It is important to determine the animal manure that would enhance the soil properties. It is therefore based on this fact that the objective of this work was established to investigate some chemical changes that occurs in the soil pH and exchangeable acidity of the soil leachate as types of animal manures were applied to the soil.

MATERIALS AND METHODS

The experiment was an incubation study carried out at the department of Soil Science and Meteorology laboratory at Michael Okpara University of Agriculture Umudike (05° 29` N, 07° 33` E and 122 m above sea level). The mean annual rainfall of Umudike is 2200 mm and this is distributed over a period of nine to ten months in bimodal rainfall pattern (NRCRI 2015). The soils used for the study were vertisols collected from the farms of some smallholder rural farmers located at Bende L.G.A (5° 74'N, 7° 52'E) of Abia State, Nigeria. Soil samples were collected randomly with a soil auger from the depth of 0- 15 cm. The samples were bulked, air-dried, ground, and pass through a 2.00mm sieve mesh. From the composite soil, 300g of the soil was taken for each treatment and weighed into 500mL plastic containers. Each of the containers was uniformly perforated at the base and a cheese cloth used to line the base of the beaker to prevent loss of soil. Another container of equal volume was fitted underneath it for the collection of the drained water. The containers with the soils were labelled appropriately and kept on the laboratory benches.

The treatments comprised of four types of animal manure namely: Poultry manure (PM), Pig waste (PW), Cow dung (CD), Goat manure (GM) and a Control (C which has no amendment). The animal manures were all collected from the livestock unit of Michael Okpara University of Agriculture, Umudike. They were cured for three weeks and were applied after being passed through a 2 mm sieve mesh. The application rates were in tons/hectare but their grams equivalents were applied because of the weight of the soil used. The rates were 0t/ha (control), 1.5t/ha (12.95g), 3.0t/ha (25.90g), 4.5t/ha (38.85g), 6.0t/ha (51.80g), and 7.5t/ha (64.75g). The chemical properties of the treatments are presented on Table 1.

Table 1: Chemical composition of the amendments used for the study

Properties	Cow dung	Goat manure	Poultry manure	Pig Waste
pH (H_2O)	5.86	5.78	6.98	6.62
% N	2.10	2.94	3.31	3.71
% P	0.86	0.82	1.66	0.94
% K	0.94	1.70	1.97	0.86
% Na	0.17	0.28	0.37	0.24
% Ca	2.51	2.52	4.92	3.12
% Mg	0.73	0.76	1.22	1.44

The treatments were added to the soils and both were mixed thoroughly. The experiment was a factorial experiment and the treatments laid out in completely randomized design (CRD). The treatments were replicated three times. The samples were incubated for sixty three days; the process started from Wednesday 8th July and ended on Wednesday 2nd August 2015. Thirty- three centiliter of deionized water was added to soil on 21st, 42nd and 63rd days of incubation and this stimulated the flow of the drainage water. The leachate samples from each of the containers were collected until the drainage water stopped over a period of 24 hours after which it was weighed. The following soil properties were determined; particle size analysis was done using Bouyoucos hydrometer method (Klute, 1965); soil pH was determined with the pH meter in water at a ratio of 1:2.5 soil to distilled water suspension (Thomas 1996); exchangeable acidity was determined by the method of Mclean (1982) as outlined by Udo *et al.*, (2009) using 1M KCI as the extracting solution and titrating with 0.01M NaOH, using phenolphthalein as the indicator. Others were organic carbon, which was determined by dichromate – oxidation method of Walkley and Black wet oxidation method as described by Nelson and Somner (1982); exchangeable calcium, magnesium, sodium and potassium were extracted with NH_4OAC. Calcium and magnesium were determined using Ethylene Diamine Tetra – Acetic (EDTA) titration method while potassium and sodium were determined by flame photometer (Rhoades, 1982). Effective cation exchange capacity (ECEC) was calculated as the sum of exchangeable basis (Ca, Mg, K & N) and exchangeable acidity expressed in cmol kg $^{-1}$. Available phosphorus was determined by Bray 2 method as described by Bray and Kurtz (1945) and total Nitrogen was determined by the micro Kjeldahl method (Bremmer and Mulvary 1965). The pH and exchangeable acidity of the leachates were determined using the methods of Udo *et al.*, (2009)**.**

The data generated were subjected to analysis of variance (ANOVA) for factorial experiment in Completely Randomized Design (CRD) using the GENSTAT package. The means were separated using the Fisher's Least Significant difference (LSD).

RESULTS AND DISCUSSION

The pre- treatment analysis of the soil is shown on Table 2. The result showed that the soil textual class was clay typical of vertisols. The soil values were 358gkg-^{1}, 314gkg-^{1} and 328gkg-^{1} for sand, silt and clay respectively. The pH of the soil was 5.5 and this value according to Chude *et al.*, (2004) is rated slightly acidic. The available

phosphorus was 19.10 $mgkg^{-1}$, the value was rated moderate according to Chude *et al.*, (2005) and it is above the critical level of 12 -15 $mgkg^{-1}$ given by Enwezor, *et al.*, (1989) for the soils of Southeastern Nigeria.
The result of the effect of animal manure types and rates on the pH of the leachate at day one of the incubation is shown on Fig 1. The result showed that there were no significant differences between the animal manure types and rates. The effect of the animal types and rates on pH of the leachate after 21 days of incubation show, that the applications of PM at all the rates gave higher pH leachate values than the rates of the other treatments. The highest significant ($p \leq 0.05$) leachate value was recorded at 7.5t/ha of PM. At the 42nd day of incubation (Fig 3), PM applied at 7.5 t/ha significantly ($p \leq 0.05$) increased the pH of the leachate. The values gotten for the applied poultry manure where statistically at par with the values obtained for leachates where PW were applied.
The applied PW significantly ($p \leq 0.05$) increased the pH of the leachate over the other treatments. Except for 0t/ha and 1.5t/ha, all the other rates of the PW had higher values over their counterparts rates. The highest significant ($p \leq 0.05$) value for the incubation at the 63rd day was obtained at the applied 7.5t/ha of PW. From the result of the mean effect of treatments on pH of leachate at days of incubation, PM gave the highest significant ($p \leq 0.05$) values of 6.67 and 6.87 respectively at the 21st and 42nd days of incubation. It was also observed that as the days of incubation progressed, the pH of leachate increased. Throughout the days of incubation, the treatments applied at 7.5t/ha irrespective of the treatment type, had significantly ($p \leq 0.05$) higher values over the other treatments rates. It was also observed that the pH of the leachates increased as the rates of application increased.
The result gotten on the effect of the animal manure types and rates on exchangeable acidity of the leachate at day 1 of incubation showed that there were no significant differences among the treatments and rates. At the 21st day of incubation, the rates of cow dung applied at 1.5, 3, 4.5 and 6t/ha had significantly ($p \leq 0.05$) lower exchangeable acidity values over the other treatments except at the 7.5t/ha where the poultry manure gave the lowest value of exchangeable acidity. At the 42nd day of incubation, all the rates of applied poultry manure significantly ($p \leq 0.05$) reduced the exchangeable acidity of the leachate over the other rates. The lowest reduction was recorded at the application of 7.5t/ha of the poultry manure. All the treatments and rates significantly ($p \leq 0.05$) reduced the leachate exchangeable acidity over the control at the 63rd day of incubation (Fig 10). From that same figure, the applied poultry manure at 7.5t/ha significantly ($p \leq 0.05$) reduced the exchangeable acidity of the leachate. The result has the mean effect of treatments on exchangeable acidity of the leachate at the days of the incubation. The result showed that there were no significant differences among the treatment means at the days of the incubation but the values of the exchangeable acidity decreased as the days progressed. The result obtained, which has the mean effect of rates on exchangeable acidity at days of incubation showed that at the days of the incubation, 7.5t/ha significantly ($p \leq 0.05$) reduced the leachate acidity.

DISCUSSION

The reason for the increase in the pH of the leachates of the soils that received poultry manure could be due to their humic fraction content. According to Noble *et al*., (1995), poultry manure contains humic fractions. These humic fractions are made up of mostly fulvic and humic acids and these occur as Ca-Fulvates and Ca-humates, which has the ability to increase the pH. This same reason was buttress by Wong *et al.*, (1998). They reported that the increase in the pH could be as a result of the functional group of the phenolic humic and fulvic materials from organic residue which are able to consume protons at their natural pH values, causing increased pH. Their capacity to consume protons is a major factor controlling their buffer characteristics and therefore their ability to neutralize soil acidity. The reason for the decrease in exchangeable acidity may be due to the fact that as the pH increases, the solubility of Al decreases and this makes Al to precipitate. Another reason for the decrease could be that the humus substances found in the manure may have form complex with Al and thereby detoxifying them. Organic acids from the poultry manure can form stable chelating complex with Al in solution (Stevenson and Vance 1989). The higher the rate of application of poultry manure, the more the pH increases and the lower the exchangeable acidity. Similar result of increasing application rates of chicken manure with progressive increase in pH of Ferralic Arenosol and Vertic Luvisol was observed by Dikinya and Mufwanzala (2010). It was also observed that the applied poultry manure and pig waste increased the pH as the day of incubation increased; this work is in agreement with the result reported by Rodella *et al.* (1995) who observed that there was an increase in soil pH from 4.90 to 7.50 in a 90 day incubation study when poultry manure was applied.

CONCLUSION

The study on the impact of types of animal manure on some soil acidity indices of the leachate of Vertisols in Bende L.G.A of Abia State Nigeria shows that animal manure: Poultry manure, Pig waste, Goat dung and Cow dung increased the soil pH leachate and reduced the exchangeable acidity all through the experimental period. Poultry manure and pig waste applied at 7.5t/ha gave outstanding results in improving the pH as well as reducing the exchangeable acidity. The study shows the potential of animal manure specially poultry and pig manure when applied to vertisols.

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LEAD SORPTION BY SOIL AGGREGATES OF TWO TROPICAL SOILS: EFFECTS OF RESIDENCE TIME AND INITIAL METAL CONCENTRATIONS

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ABSTRACT
It is important to examine mechanisms of lead (Pb) sorption in soils to understand their bioavailability. The ability of the aggregates of two tropical soils to adsorb Pb was evaluated. Results obtained showed that equilibrium adsorption occurred faster on larger soil aggregate sizes. The adsorption of Pb on > 4, 2 - 1 and 0.5 - 0.25 mm soil aggregates of Amakama soils reached equilibrium in 180, 180 and 210 minutes, respectively. In Ajata-Ibeku soil, equilibrium was achieved in 120, 180 and 180 minutes, for > 4, 2 - 1 and 0.5 - 0.25 mm aggregates, respectively. Biphasic kinetics was observed, a rapid reaction rate followed by a slower reaction rate. Such biphasic kinetics suggested the presence of two types of sites - such as, external readily accessible sites and internal, difficult to access sites, with differing reactivities. Adsorptive efficiencies of the aggregates from the kinetics study varied in this order in both soils: 0.50 - 0.25 mm > 2 - 1 mm > > 4 mm. The quantity of Pb adsorbed by Ajata-Ibeku soils aggregates (3.39 mg/g) was higher than the quantity adsorbed by the Amakama soils aggregates (2.93 mg/g). The higher adsorption capacities obtained for Ajata-Ibeku soil relative to Amakama soil was attributed to the composition of the two soils. The distribution coefficients (K_d), were consistently higher in Ajata-Ibeku soils (213.7 l kg^{-1}) than in Amakama soils (33.2 l kg^{-1}), suggesting that Pb(II) was removed from solution by Ajata-Ibeku soils aggregates more than by Amakama soil aggregates. The distribution coefficients of Pb on the aggregates did not follow any particular trend in both soils, however, maximum partitioning of Pb to the solid phase of the soil aggregates was observed on 2 – 1 mm soil aggregates in both soils (692.05 and 12649.52 mg/kg in Amakama and Ajata-Ibeku soils, respectively).
Keywords: Tropical soils; Bio-availability; Sorptivity; Peds; Heavy metals; Contamination.

INTRODUCTION
Soil contamination by Pb is of great concern because of its toxicity to humans (Adriano, 2001). This element is used in many industrial, urban, and agricultural applications (Kabata-Pendias and Pendias, 1992; Adriano, 2001) and is often found at sites contaminated with heavy metals. Therefore, it is important for environmental scientists and engineers to understand its adsorption on soils aggregates, to be able to explain its bioavailability in the soil. The term 'sorption' has been used to describe the removal of metals in solution by the soil solid phase (Hooda and Alloway, 1998) including any retention mechanism that controls metals availability and mobility. When heavy metal ions are placed in aqueous soil system the ions tend to be distributed between the liquid and solid phases. Most of the metal ions become attached to the soil surface while some may penetrate the soil matrix. The metal ions attached to the soil surface is said to be adsorbed on the soil while the ones in the soil matrix is said to be absorbed by the soil. The two processes go together and are referred to as sorption. Since the amount of the metal ions absorbed by the soil is insignificant compared to the amount adsorbed on the soil, when a solution of metal ions is shaken with soil and the amount of metal ions left in the liquid phase is determined, the difference between the initial concentration of the metal ions in the liquid phase and the concentration after equilibration is often considered to be due to adsorption of the metal ions on the soil surface. The adsorption on soil particles would therefore be viewed as nature's process of removing the toxic metal from the environment and getting it sequestered. The consequences of heavy metal addition to a soil with high adsorption capacity will be lower than that with lower adsorption capacity. Understanding the sorption characteristics of Pb on soil aggregate sizes of two benchmark soils of southeastern Nigeria can improve management strategies aimed at reducing the bio-availability of this toxic metal in the study soils.

MATERIALS AND METHODS
Top soil (0 – 30 cm) of two tropical benchmark soils of southeastern Nigeria, represented by Amakama soil (Fine-loamy, mixed, semi-active, isohyperthermic Rhodic Kandiudult) and Ajata-Ibeku soil (Fine, mixed, semi-active, isohyperthermic Aquic Haplustalf) (Chikezie *et al*., 2010), were used in this study. Amakama is located on Lat: 5º 26′ 40″ N and Long: 7º 28′ 49″ E, while Ajata-Ibeku is located on Lat: 5º 32′ 51″ N and Long: 7º 33′ 34″ E. Amakama soil is formed on coastal plain sands, while Ajata-Ibeku soil is formed on Bende-Ameke (clay shales) formation. The two soils which will be referred to subsequently, as Amakama and Ajata-Ibeku soils, were chosen

for this study because they represent some important agricultural soils of southeastern Nigeria with contrasting parent materials and chemical properties. Field-moist soil samples were air-dried and sub-samples of the dry soil screened and fractionated into five different aggregate-size fractions. The remaining soil samples were ground and passed through a 2-mm sieve for background Pb determination.

Kinetics of Lead Sorption

In carrying out the kinetics study, three aggregate sizes (> 4 , 2 - 1 and 0.50 - 0.25 mm) were considered at ten contact times (30, 60, 90, 120, 150, 180, 210, 240, 270, and 300 mins). Batch experiments were performed by adding 40 ml of the metal solutions (100 mg/L Pb) to 2 g soil aggregate. The soil suspensions for each initial metal solution concentration were shaken on an end-over-end shaker (30 rpm) in a controlled room temperature (25^{o}C ±2) for 30, 60, 90, 120, 150, 180, 210, 240, 270, and 300 mins. The suspensions were filtered (Whatman No. 42) before the supernatants were analyzed for Pb using UNICAM 919 solar atomic absorption spectrophotometer (AAS). The adsorption amount was calculated as follows:

qe = (Ci – Ceq)V/m ……………………………………….(1)

Where qe the quantity of the adsorbate (metal) in milligram held by 1 g of the adsorbent (soil), Ci is the initial concentration (mg l^{-1}), Ceq is the equilibrium concentration (mg l^{-1}), V is the volume of solution (l), and m is the mass of adsorbent (g). Blank solutions were also prepared and analyzed.

In order to analyze the rate of adsorption and possible adsorption mechanism of lead onto soil aggregates, the pseudo-first-order and pseudo-second-order models were applied to the kinetics experiments data. The pseudo-first-order model is given as (Ho and Mckay, 1998):

In (qe – qt) = Inqe – K_1t ………………………………….. (2)

Where qt is the amount of lead ions adsorbed at time t (mg g^{-1}), qe is the amount of lead ions adsorbed at equilibrium (mg g^{-1}), and K_1 is the pseudo-first-order rate constant (min^{-1}) for the first-order adsorption. A plot of In (qe – qt) against t will give a straight line if the adsorption reaction obeys the pseudo-first-order reaction. The slope of the straight line is K_1, while the intercept is the natural logarithm of the metal ion adsorbed at equilibrium. The pseudo-second-order model was expressed as (Ho and Mckay, 2000):

t/qt = 1/K_2qe^2 + t/qe ……………………………………….. (3)

Where K_2 is the equilibrium rate constant of pseudo-second-order adsorption (g/ mg/min). Values of K_2 and qe were calculated from the slopes and intercepts of the linear plot of t/qt against t. The rate constants K_1, K_2, and qe and the correlation coefficient R^2 were calculated from the relevant plots. If the r^2 value is nearer to 1, it indicates that the respective equation better fits the experimental data, and the calculated q_e should also approximate the experimental q_e..

Sorption Isotherms as a Function of Initial Lead Concentration

Five soil aggregate-sizes were agitated in ten metal concentrations (50, 100, 150, 200, 250, 300, 350, 400, 450, 500 mg l^{-1} Pb - ranges which cut across concentrations regarded as 'normal' and toxic in real agricultural soils (Kabata-Pendias and Pendias, 1992)) of the metal, and 2 g soil aggregate was weighed into 100 ml soft bottle. Metal solution (40 ml) was added into 100 ml bottle containing soil sample and agitated on an end-over-end mechanical shaker for 210 mins, filtered through a Whatman No 42 paper, stored and analyzed on the AAS. The adsorption amount was calculated according to equation 3

RESULTS AND DISCUSSION

Characterization of adsorbents

Selected physico-chemical properties of the study soils are presented in Table 1. All the soils were moderately acidic in the surface horizons with differences between Amakama pH and Ajata-Ibeku pH being less than 0.5. In Amakama and Ajata-Ibeku soils, exchangeable acidity accounted for 86% and 72% of the ECEC, respectively, while Ca was the dominant cation in the two soils accounting for the 10 and 21% of the ECEC, respectively. Amakama soils had lower ECEC, pH, clay and organic matter contents than Ajata-Ibeku soils. The initial Pb in the two soils studied were 26.30 and 17.55 mg kg^{-1} in Amakama and Ajata-Ibeku soils, respectively. Available background Pb content of the Ultisol (Amakama soil) was greater than that of the Alfisol (Ajata-Ibeku soil). This was expected as the amounts of available Pb in the soils would be proportionally higher in soils with lower CEC value (Table 1), due to reduced adsorption of Pb. The fact that greater CEC in Ajata-Ibeku soil results in lesser background Pb suggests that exchangeable sites and not high affinity sites was responsible for metal levels in the soils. The mineralogy of clay particles (< 0.002 mm) as reported by Chikezie *et al.* (2010) showed that Amakama soil has mixed mineralogy dominated by kaolinite. Small quantities of goethite, gibbsite and haematite are also present. In the Ajata-Ibeku soil, the mineralogy is kaolinite in the upper 100 cm of the profile.

Sorption Kinetics

The effect of time on the amount of Pb adsorbed by select Amakama and Ajata-Ibeku soil aggregates (> 4, 2 - 1 and 0.5 - 0.25 mm aggregate-sizes) is shown that equilibrium adsorption occurred faster on larger soil aggregate sizes. The adsorption of Pb on > 4, 2 - 1 and 0.5 - 0.25 mm soil aggregates of Amakama soils reached equilibrium in 180, 180 and 210 minutes, respectively. In Ajata-Ibeku soil, equilibrium was achieved in 120, 180 and 180 minutes, for > 4, 2 - 1 and 0.5 - 0.25 mm aggregates, respectively. The plots revealed that the rate of percent Pb removal is higher at the beginning. This is probably due to presence of uncovered adsorption sites at the beginning of adsorption of Pb(II) ions. As surface adsorption sites become exhausted, the uptake rates are controlled by the rates at which the adsorbate is transferred from the exterior to the interior sites of the adsorbent aggregates. Extension of time beyond the equilibrium time obtained for each aggregate-size did not lead to more adsorption of Pb(II) ions. Thus, explaining the plateaus obtained in the curves. The number of available sites per unit mass of soil for adsorption increases with decrease in soil aggregate size. More sites for adsorption are therefore available on soils of 0.5 - 0.25 mm aggregate-size than on > 4 mm aggregates. This may also account for the longer time (210 min), 0.5 - 0.25 mm aggregates, with the largest surface area took to reach equilibrium in Amakama soil. It was therefore concluded that 210 minutes was sufficient for Pb adsorption to attain equilibrium in both soils. The quantity of Pb adsorbed by Ajata-Ibeku soils aggregates (3.39 mg/g) was higher than the quantity of Pb adsorbed by the Amakama soils aggregates (2.93 mg/g) (Table 2). The higher adsorption capacities obtained for Ajata-Ibeku soil relative to Amakama soil may be as a result of composition of the two soils. Chikezie *et al*. (2010) reported that the clay fraction of Ajata-Ibeku top and sub-soils were dominated by kaolinite and to a lesser extent by montmorilonite and very small goethite. They also reported that Amakama top and sub-soils contained clay mixture with less kaolinite and very small gibbsite, hematite and goethite. Sorption reactions are often more rapid on clay minerals such as kaolinite than on vermiculite and micaceous minerals. This is in large part due to the availability of sites for sorption. Kaolinite has readily available planar external sites and sorption on the planar sites is almost complete in minutes. The presence of montmorilonite, a 2:1 expanding clay mineral provides Ajata-Ibeku soil with greater cation exchange capacity than Amakama soil. Thus ensuring high metal sorption capacity as it provides the soil with multiple sites for retention of metals and high cation exchange capacity, an established factor regulating the sorption of heavy metals by soils (Kuo and Baker, 1980; Hooda and Alloway, 1998; Gomes *et al*., 2001). The initial faster rate of removal of Pb ion may be due to the availability of the uncovered surface area of the adsorbents, since adsorption kinetics depends on the surface area of the adsorbents (Veeresh *et al*., 2003). The variations in percentage removal of Pb by the three aggregate-sizes (> 4, 2 - 1 and 0.50 - 0.25 mm) of both soils show slight increase as the aggregate-sizes decrease. The sequence of increase in removal of the metal by the aggregates was: > 4 < 2 - 1 < 0.50 - 0.25 mm. The trend obtained is in the order of the surface area per unit mass of the soil which has direct relationship with the number of adsorption sites on the soils.

Sorption of Pb by Soil aggregates as a Function of Initial Metal Concentrations

The effect of soil aggregates on the removal of Pb(II) from soil solutions was studied with five aggregate sizes (> 4, 4 - 2, 2 - 1, 1 - 0.5 and 0.50 - 0.25 mm). The amount of metal adsorbed (mg kg^{-1}) when plotted against the equilibrium concentration (mg l^{-1}) produced a non-linear regression model that provides for drawing tangents at the points where adsorption started to drop, to locate the critical equilibrium concentrations of the metals in solution, at which, presence of metal in solution starts to reduce adsorption. The equilibrium concentration of Pb (x) (mg l^{-1}) at the maximum kinetics models described well the adsorption of Pb on both soils. Lead adsorption was obtained by equating the first derivative of Pb adsorbed (y) (mg kg^{-1}) with respect to equilibrium concentration (x) to zero, and the value of x substituted in the relevant equation. The data contained in these models were used to calculate a distribution coefficient or the partitioning between the solution phase and the solid phase, which is a ratio of solid phase concentration to solution phase concentration (Table 3). Examination of the data presented in Table 3 indicates that these coefficients were consistently higher in Ajata-Ibeku soils (213.7 l kg^{-1}) than in Amakama soils (33.2 l kg^{-1}), suggesting that Pb(II) was removed from solution by Ajata-Ibeku soils aggregates more than by Amakama soil aggregates. This could be attributed to the comparatively higher CEC, organic matter content, clay chemistry and moderate acidity of Ajata-Ibeku soil which promoted adsorption. Weber (1991) and Stevenson (1992) have reported that amount of clay and organic matter, pH, water content and some properties of the particular metal ion are some of the physicochemical properties that determine sorption properties of a soil. The distribution coefficients of the metals on the aggregates did not follow any particular trend in both soils, however, maximum partitioning of Pb to the solid phase of the soil aggregates was observed on 2 – 1 mm soil aggregates (692.05 and 12649.52 mg/kg in Amakama and Ajata-Ibeku soils, respectively). Average equilibrium concentrations of Pb were greater than 100 mg/l but less than 200 mg/l in Amakama aggregates, and greater than 50 mg/l and less than 100 mg/l in Ajata-Ibeku aggregates. Further enrichment of the soils with Pb beyond the reported upper limits did not result in any significant adsorption of the metal, but instead caused desorption of the heavy metal. This was so because at those solution concentrations almost all adsorption sites have been occupied by the metal concerned.

CONCLUSION

The study found out that the equilibrium time for Pb adsorption on soil aggregates was uniform after 210 mins across the two soils studied. However, a biphasic kinetics was observed, namely, a rapid reaction rate, followed by a much slower reaction time. The rapid reaction rate occurred at the external planar sites of the soil aggregates due to presence of uncovered adsorption sites at the beginning of the adsorption of Pb(II) ions. As surface adsorption sites became exhausted, the adsorption rates became slower and were controlled by the rate at which the adsorbate was transferred from the exterior to the interior sites of the adsorbent aggregates. Extension of time beyond 210 mins did not lead to more adsorption of Pb(II) ions by the aggregates. Adsorptive efficiencies of Pb from the kinetics study were more on soil aggregates with large surface area, compared with aggregates with smaller surface area, in both soils. Average maximum Pb uptake (3.84 and 3.43 mg g^{-1} for Ajata-Ibeku and Amakama soils, respectively) occurred on 0. 50 - 0.25 mm aggregates, while the least Pb uptake (2.74 and 2.44 mg g^{-1} for Ajata-Ibeku and Amakama soils, respectively) occurred on > 4 mm aggregates. Equilibrium adsorption capacities of Pb and their distribution coefficients (K_d) on Ajata-Ibeku soil aggregates were higher than those for Amakama soil aggregates. The kinetics data for the adsorption process of Pb fitted the pseudo-first-order kinetics model for Amakama aggregates, whereas the kinetics data obtained from Ajata-Ibeku aggregates fitted the pseudo-second-order kinetics model. This supports the assumption that the rate-limiting step of Pb adsorption onto soil aggregates varied with soil.

Table 1: Physico-chemical properties of the study soils at 0 – 30 cm depth

Soil property	Amakama soil	Ajata-Ibeku soil
Sand (%)	74.1	23.3
Silt (%)	3.3	20.5
Clay (%)	22.6	56.3
Texture*	SCL	C
pH (H_2O)	4.6	5.0
Total nitrogen (%)	0.087	0.269
Phosphorus (mg/kg)	45.9	5.6
Organic matter (%)	0.86	2.14
Calcium (cmol kg^{-1})	1.15	5.35
Magnesium (cmol kg^{-1})	0.41	1.25
Potassium (cmol kg^{-1})	0.06	0.35
Sodium (cmol kg^{-1})	0.08	0.20
Total exchangeable bases (cmol kg^{-1})	1.70	7.15
Exchangeable acidity (cmol kg^{-1})	10.05	18.0
Effective cation exchange capacity (cmol kg^{-1})	11.75	25.15
Base saturation (%)	14.50	28.40
Background Pb (mg kg^{-1})	26.30	17.55

*Texture: SCL = Sandy clay loam; C = Clay

Table 2: Pseudo-first-order and pseudo-second-order adsorption rate constants and calculated $q_{e\ calculated}$ values of Pb(II) ions onto three soil aggregates of two soils of southeastern Nigeria at 27° C.

			Pseudo-first-order			Pseudo-second-order		
Soil	Aggregate-size (mm)	q_e experimental (mg g^{-1})	K_1 (min^{-1})	q_e calculated (mg g^{-1})	R^2	K_2 (g mg^{-1} min^{-1})	$q_{e\ calculated}$ (mg g^{-1})	R^2
Amakama	0.5 - 0.25	3.43	0.006	3.184	0.977	0.00046	7.246	0.743
Amakama	2 - 1	2.93	0.018	3.128	0.999	0.00531	3.556	0.990
Amakama	> 4	2.44	0.012	2.811	0.710	0.00200	3.693	0.860
Ajata-Ibeku	0.5 - 0.25	3.83	0.019	5.740	0.932	0.00219	5.200	0.972
Ajata-Ibeku	2 - 1	3.62	0.032	7.130	0.962	0.00613	4.216	0.987
Ajata-Ibeku	> 4	2.74	0.020	1.441	0.949	0.03370	2.844	0.998

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PHOSPHORUS FORMS IN TEXTURAL SIZE FRACTIONS OF SELECTED LOW-LAND SOILS OF EGBEMA, IMO STATE, NIGERIA

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ABSTRACT
Phosphorus forms in textural size fraction of soils play important role in estimating P retention and release and thus its sustainable management. Phosphorus forms (total, organic, saloid, Al, Fe, Ca and residual) in textural size fractions of soils of three land units (upland, levee and backswamp) in Egbema were evaluated using sequential extraction procedures. Phosphorus forms in various size fractions differed distinctly (LSD 0.05) being a decreasing sequence for sand fraction of total P > organic P > occluded P > residual P > Fe-P > Al- P > Ca-P > saloid P > H_20 soluble P in the levee and backswamp and total P > organic P > residual P > Fe-P > Al- P > occluded P > Ca-P > saloid P = H_20 soluble P in upland units, total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P = saloid P > water soluble P in the upland, total P > organic P > residual P > occluded P > Fe-P > Al-P = Ca-P > saloid P > water soluble P in the levee and total P > organic P > residual P > Fe-P > occluded P > Al-P > Ca-P > saloid P > water soluble P in the backswamp for silt fraction and total P > organic P > Fe-P > Al-P > residual P > occluded P > Ca-P > saloid P > water soluble P in upland, total P > organic P > occluded P > residual P > Fe-P > Al-P > saloid P > Ca-P > water soluble P in levee and total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P > saloid P > water soluble P for clay fraction. Phosphorus forms were higher in clay than other textural fractions and in the subsoil than surface soil of most landunits. This suggests that clay soils will be most active in regulating P activities in the land units
Keywords: Phosphorus, Texture, lowland soils, landunits and southern Nigeria

INTRODUCTION

Phosphorus is a component of nucleic acids and nucleoside triphosphates, the basis of enzyme synthesis and energy transfer systems at the cellular level (Uzoho, 2010). It is associated with eutrophication of surface and ground water systems and thus important in the sustainability of environmental quality (Azadi and Baghernejad, 2016; Zhang and Li, 2016). Phosphorus involves in several complex soil reactions that affects its solubility and mobility. Its two forms are organic and inorganic, with the organic constituting 20-80% of total soil P and include inositol phosphate, nucleic acids, nucleotides, phospholipids and sugar phosphates (Mustapha et al., 2007; Uzoho, 2010). Inorganic phosphorus fractions include Fe-P, Al-P, Ca-P, Saloid bound P, Occluded and residual P and important in regulating soil P availability as well as losses through uptake, leaching and erosion (Azadi and Baghernejad 2016). Soloid bound P represent the easily soluble and loosely bound P fraction extractible with NH_4Cl, Al, Fe and Ca-P are fractions extractible with 0.5N NH_4F, 0.1N NaOH and 0.5N H_2S0_4 respectively
Distribution of soil phosphorus fractions varies and affected by land use types, landscape position, soil management, pH, redox potential and climatic condition (Solomon et al., 2002; Mustapha et al., 2007; Sheklabadi et al., 2014;Aminda Moreira de Carvalho et al., 2014; Ghulam, 2015) . Impact of land use, soil management and climate has been reported to include increased $NaHCO_3$ and NaOH inorganic P fractions at 5-10 cm soil depth under no-tillage in the rainy season and a high organic P concentration at 0-5 cm depth for no-tillage and 5-10 cm depth for conventional tillage systems in the dry season for Oxisols under Cajanus cajan land use type in Central Savanna region of Brazil (Arminda Moreira de Carvalho et al., 2014). Also, a decreased order of Total P > Fe-P > Al-P > Occlude Fe-Al-P > Reductant Soluble –P > Ca-P > Available P in surface and subsurface depths of various landscape positions have been reported for some Haplic Plinthaquults in Bauchi, Nigeria (Mustaphar et al., 2007). Others included high labile relative to occluded P in herbaceous perennial and reverse of occluded to labile fraction in annual agroecosystems (Crews and Brookes, 2014), available and Ca-P in plantation and Fe-P in arable in soils of three cropping systems in Lower Indo-Gangetic Alluvial plain, India (Ghulam, 2015) and high Ca-P in Andisols across Riparian buffer and adjacent cropped area in Dian Lake, China (Zhang and Li, 2016).
Concentration of soil P forms differs with textural class fractions. It has been reported that soil texture can modify P equilibrium and availability due to its influence on P sorption-desorption-diffusion processes and through soil organic matter mineralization (Suner and Galantini, 2015). Several workers have noted increased concentration

of P fractions in fine (clay and silt) than coarse soil fractions (Suner and Galatini, 2015; Zhang and Li, 2016). High concentration of P forms in the clay fraction has been ascribed to its being both a source for the labile and sinks for recalcitrant P fractions (Suner and Galatini, 2015) and enrichment of organic P in the fine fraction (Zhang and Li, 2016). Others noted that low inorganic P concentration in coarse particle size fractions could be as a result of assimilation by vegetation, transformation of inorganic P, leaching and erosion (Roberts et al., 2012).
Egbema lies in the low area of southeastern Nigeria with most it usually flooded during the raining. This causes the submergence of most of the soils and the alteration of the chemistry of some nutrients especially P. It has been indicated that P in submerged soils is dominated by Fe-P and Al-P fractions (Gbulam, 2015) since its concentration is in governed by drainage (Nartey et al., 1997). Phosphorus forms exist in soil textural fractions and this influences the soil P availability, retention and activities. Despite the relevance of soil texture in regulating the distribution of P forms, there appears a dearth of information in P status of soils of this area. The main objective of the present study was to determine the P forms in textural size fractions of low land soils of Egbema, southeastern, Nigeria.

MATERIALS AND METHODS

Study Location and Soil Sampling

The study location, soil sample collection and preparation have been described in another study (Uzoho *et al.*, 2016). Fractionation of particle size fraction was conducted using the method described by Sequaris and Lewandowiski (2003). Particle size distribution (Gee and Or, 2002), pH in 1:2.5 soil/water ratio (Thomas, 1996), Available P (Olsen, 1982), Exchangeable cations (Thomas, 1996), OM (Nelson, 1996) and bulk density (Blake and Hartage, 1986). Phosphorus fractionation was conducted on the first (surface) and second (subsoil) depths of each land unit using sequential extraction technique as outlined by Hedley *et al*., 1982).

Statistical Analysis

Data generated on phosphorus forms was subjected to Analysis of variance (ANOVA) and means separated using LSD at 5% probability levels.

RESULTS AND DISCUSSION

Phosphorus Fractions

Concentration of P forms in sand, silt and clay size fractions of soils of the various land units are presented in Tables 3, 4 and 5 respectively. Phosphorus forms in the sand size fractions of the various land units differed significantly LSD (0.05) being a decreasing order of total P > organic P > occluded P > residual P > Fe-P > Al- P > Ca-P > saloid P > H_20 soluble P in the levee and backswamp and total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P > saloid P = H_20 soluble P in upland (Table 3). Concentrations of the different forms were higher in the sub than surface soil of most land units. Averaged over horizons, upland land unit had the least concentration of the P forms while the difference between levee and backswamp varied depending on forms.

Differences in P forms of the silt size fractions differed distinctly (LSD 0.05) and decreased in the order total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P = saloid P > water soluble P in the upland, total P > organic P > residual P > occluded P > Fe-P > Al-P = Ca-P > saloid P > water soluble P in the levee and total P > organic P > residual P > Fe-P > occluded P > Al-P > Ca-P > saloid P > water soluble P in the backswamp (Table 4). Concentrations of most forms were lower in surface than subsoil of some land units. Averaged over surface and subsoil horizons, mean concentrations of most P forms followed a decreasing sequence of levee > upland > backswamp.
Phosphorus forms in clay fraction of the soils differed seriously with soil horizons and landunits (Table 5). Averaged over soil horizons, concentrations decreased in the order total P > organic P > Fe-P > Al-P > residual P > occluded P > Ca-P > saloid P > water soluble P in upland, total P > organic P > occluded P > residual P > Fe-P > Al-P > saloid P > Ca-P > water soluble P in levee and total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P > saloid P > water soluble P. Concentration of most P forms were better in the subsoil than surface soils and with mean value in the levee significantly (LSD 0.05) higher than the other land units. In general, P forms of the soils varied between land units, horizon depth and textural size fractions. Variation in P forms due to landscape position, soil depth, land use, management practice, soil and textural fractions have been reported (Mustapha et al., 2007; Malik and Khan, 2012; Sheklabadi et al., 2014;Aminda Moreira de Carvalho et al., 2014; Ghulam, 2015; Suner and Galatini, 2015; Zhang and Li, 2016). Concentrations in textural size fractions were higher in the levee than backswamp and upland land units probably due to depressed P sorption in the levee as a result of poor drainage (Ghulam, 2015). Concentration of large number of the P forms were higher in the subsoil than surface horizons of most land units due probably to burial of sediments at lower depths with alluvial deposition and from leaching or erosion by runoff (Zhang and Li, 2016). Nartey et al.(1997) noted increased distribution with depth of two landscapes with those of well drained soils due to profile maturity and those of low

lying soils due to drainage. Variation in most P forms in textural size fractions included high concentrations in clay and silt than sand fractions for most land units. Similar observations have been reported for clays and fine size fractions and ascribed to existence of surfaces for P retention (Suner and Galantini 2015; Zhang and Li, 2016) and accumulation of sesquioxides (Nartey et al., 1997). It could also be attributed to the enrichment of organic P in the finer particle size fractions (Christensen, 2001).

CONCLUSION

Phosphorus forms in textural size fractions differed significantly with landunits and soil horizons with mean distribution being a decreasing order of total P > organic P > occluded P > residual P > Fe-P > Al- P > Ca-P > saloid P > H_20 soluble P in the levee and backswamp and total P > organic P > residual P > Fe-P > Al- P > occluded P > Ca-P > saloid P = H_20 soluble P in upland units for sand fraction, total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P = saloid P > water soluble P in the upland, total P > organic P > residual P > occluded P > Fe-P > Al-P = Ca-P > saloid P > water soluble P in the levee and total P > organic P > residual P > Fe-P > occluded P > Al-P > Ca-P > saloid P > water soluble P in the backswamp for silt fraction and total P > organic P > Fe-P > Al-P > residual P > occluded P > Ca-P > saloid P > water soluble P in upland, total P > organic P > occluded P > residual P > Fe-P > Al-P > saloid P > Ca-P > water soluble P in levee and total P > organic P > residual P > Fe-P > Al-P > occluded P > Ca-P > saloid P > water soluble P for clay fraction. Concentration of most P forms were higher in the clay than other textural fractions and in the subsoil than surface soil of most landunits

Table 3. Phosphorus Forms (mg kg^{-1}) in Sand Fraction of the Soils

Land Units	Depth (cm)	Horizon	Total P	Org. P	Saloid P	Al-P	Fe-P	Ca-P	Occl P	H_2O Sol P	Residual P
Upland	0-12	Surface	3.00	1.68	0.10	0.25	0.80	0.11	0.21	0.13	0.66
	12-45	Subsoil	3.85	1.99	0.20	0.80	0.75	0.23	0.45	0.17	1.11
	Mean		**3.43**	**1.84**	**0.15**	**0.53**	**0.78**	**0.17**	**0.33**	**0.15**	**0.89**
Levee	0-7	Surface	5.52	0.96	0.48	0.81	0.88	0.43	0.91	0.10	0.93
	7-13	Subsoil	6.82	3.24	0.83	0.89	1.40	0.96	1.84	0.37	1.38
	Mean		**6.17**	**2.10**	**0.66**	**0.85**	**1.14**	**0.70**	**1.38**	**0.24**	**1.16**
Back Swamp	0-10	Surface	5.84	2.23	0.43	0.60	1.00	0.36	1.00	0.37	0.44
	10-40	Subsoil	5.95	2.26	0.73	0.80	1.02	0.81	1.85	0.40	1.85
	Mean		**5.90**	**2.25**	**0.58**	**0.70**	**1.01**	**0.69**	**1.43**	**0.39**	**1.14**
LSD 0.05	Fact A		0.65	-	0.10	-	0.13	0.07	0.08	0.06	0.38
	Fact B		0.47	-	0.04	-	0.08	0.05	0.04	0.04	0.27
	Fact A x B		0.74	-	0.10	-	0.14	0.08	0.08	0.07	0.43

Fact A = Land units, Fact B = Horizon, Org P = Organic P and Occl P = Occluded P

Table 4. Phosphorus Forms (mg kg^{-1}) in Silt Fraction of the Soils

Land Units	Depth (cm)	Horizon	Total P	Org. P	Saloid P	Al-P	Fe-P	Ca-P	Occl. P	H_2O Sol P	Residual P
Upland	0-12	Surface	4.00	1.05	0.56	0.81	0.96	0.11	0.23	0.12	0.34
	12-45	Subsoil	5.20	2.78	0.10	0.81	0.85	0.55	1.05	0.49	1.31
	Mean		**4.60**	**1.39**	**0.33**	**0.81**	**0.91**	**0.33**	**0.64**	**0.31**	**0.83**
Levee	0-7	Surface	5.25	2.62	0.81	0.49	0.90	0.60	1.10	0.42	0.92
	7-13	Subsoil	6.50	2.86	0.12	0.80	0.85	0.69	1.48	0.35	2.11
	Mean		**5.88**	**2.74**	**0.47**	**0.65**	**0.88**	**0.65**	**1.29**	**0.39**	**1.52**
BackSwamp	0-10	Surface	4.25	1.68	0.20	0.68	0.77	0.30	0.51	0.16	1.27
	10-40	Subsoil	4.26	4.72	0.40	0.15	0.76	0.45	0.86	0.16	1.56
	Mean		**4.26**	**3.20**	**0.30**	**0.42**	**0.77**	**0.38**	**0.69**	**0.16**	**1.42**
LSD 0.05	Fact A		0.50	0.01	0.01	0.01	0.01	0.10	0.05	0.01	0.01
	Fact B		0.40	0.01	0.004	0.01	0.01	0.08	0.04	0.01	0.01
	Fact A x B		0.70	0.01	0.01	0.02	0.02	0.14	0.07	0.01	0.02

Fact A = Landunits, Fact B = Horizon, Org P = Organic P and Occl P = Occluded P

Table 5. Phosphorus Forms (mg kg^{-1}) in Clay Fraction of the Soils

Land Units	Depth (cm)	Horizon	Total P	Org. P	Saloid P	Al-P	Fe-P	Ca-P	Occl P	H_2O Sol P	Residual P
Upland	0-12	Surface	8.01	6.90	1.30	4.76	5.50	4.30	4.24	1.32	4.95
	12-45	Subsoil	8.21	6.26	1.67	4.75	4.59	4.42	4.90	1.62	4.54
	Mean		**8.11**	**6.58**	**1.49**	**4.76**	**5.05**	**4.36**	**4.57**	**1.47**	**4.75**
Levee	0-7	Surface	8.86	6.59	2.15	4.13	4.86	4.17	4.31	1.30	4.23
	7-13	Subsoil	14.9	9.29	2.13	4.82	5.34	5.06	7.60	1.70	4.56
	Mean		**11.88**	**7.94**	**2.14**	**4.48**	**5.10**	**4.62**	**5.96**	**1.50**	**4.40**
Backswamp	0-10	Surface	9.32	6.36	0.90	4.60	4.91	4.34	4.95	1.54	4.99
	10-40	Subsoil	9.40	5.66	1.02	4.14	4.87	4.35	4.53	1.32	5.12
	Mean		**9.36**	**6.01**	**0.81**	**4.37**	**4.89**	**4.35**	**4.74**	**1.43**	**5.06**
LSD 0.05	Fact A		0.07	0.06	0.06	0.06	0.01	0.05	0.07	0.05	0.01
	Fact B		0.06	0.04	0.05	0.05	0.01	0.04	0.05	0.04	0.01
	Fact A x B		0.10	0.08	0.08	0.08	0.02	0.07	0.09	0.07	0.01

Fact A = Land units, Fact B = Horizon, Org P = Organic P and Occl P = Occluded P

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IMPACT OF AGRICULTURAL ACTIVITIES ON WATER QUALITIES OF OHAIYIMIRI RIVER UMUDIKE, SOUTHEASTERN NIGERIA

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ABSTRACT
The impact of agricultural activities on the qualities of the waters from Ohaiyimiri Umudike rivers which flows across the Western farms of the National Root Crops Research Institute Umudike was investigated. Results indicated that some of the physical parameters studied varied from one sampling point to another. The water PH, temperature, Electrical conductivity and total dissolved solids variations also causes changes in some aspects of the water chemistry. The oxidation reduction potential, the salinity and electrical conductivity reflected I the values obtained in total dissolved solids (124.80 to 1638.0mgl^{-1}). Chloride, Phosphate, Calcium, Potassium and the mineral nitrogen in all the sampling points, fell within the range recommended by the World Health Organization and Nigerian Industrial standards for portable water. The NH_4^-N (2.80-140mgl^{-1}), the Ca (40.10-168.3mgl^{-1}) K (0.86-4.10mgl^{-1}) and P (0.485-0.80mgl^{-1}). I provide adequate mineral for aquatic life and irrigation advantage. The heavy metals in the soil were also low but high at the entering point of the river to the study area because of the human influence and traffic flow at the point. However, inspite of the use of modern agricultural inputs across the study sites, the water quantities remained recommended for aquaculture and irrigation.
Keywords: Agriculture activities, water quantities Ohaiyimiri river.

INTRODUCTION
Water is unarguable the most essential and precious of all natural resources, it is a universal solvent that provide the ionic balances and nutrients needed to support all forms of life (Okorie and Nwosu, 2014). The amount of water on the planet earth is estimated at 1388 billion cubic meters, out of which only 37.5 billion cubic meters are fresh water, 1348 billion cubic meters are salt waters in the oceans 8450 million cubic meters as ground waters and 127 billion cubic meters as lakes and rivers (Chorus *et al;* 1998). Water quality relates to physical, biochemical and biological characteristics of such water bodies as lakes, rivers and oceans used for drinking and other uses (Lamikanra, 1999; FAO, 1997). Recently water quality monitoring has become a matter of concern because of the careless disposal of effluents, runoff from agricultural field, atmospheric deposition, domestic and industrial discharges to aquatic dispositions.
An agricultural activity which is our major target in this study and other land uses within the water sheds has great impact on the water quality of rivers. The qualities may degrade due to changes in the land cover patterns and management practices as human activities increases. Some of the identified effect of agricultural activities on river bodies includes nutrient dynamics, water quality deterioration and destruction of spawning ground for aquatic life's (Nwadiora and Orji 1985). Recent agricultural transformation has encouraged use of chemical substances such as inorganic fertilizers, pesticides, herbicides and hormones in food production. Reckless use of these chemical substances creates nutrient imbalance, soil acidification and contaminations of surface and underground water systems. (Zublena *et al;* 1999; Nwosu *et al;* 2014). The objectives of the present study is to evaluate the impact of agricultural activities on water qualities of Ohaiyimiri River which transverses the Research farms of National Root Crops Research Institute, Umudike through Michael Okpara University of Agriculture Umudike and beyond.

MATERIALS AND METHODS
Water samples were collected along the Ohaiyimiri River which ran across the Research farms in the Western and of the National Root Crops Research Institute Umudike, Abia State, and Southeastern Nigeria. Umudike lies between latitudes 5^0 29" N and longitudes 7^0 32" E at altitudes of 122m above sea level. The climate is essentially humid tropical characterized by wet and dry seasons, with an average annual precipitation of 2164mm. The vegetation is secondary forest tending towards derived Savannah (Nwosu *et al*; 2013).

Sample Collection
The sampling was carried out in April 2016. A clean sample bottle was initially rinsed with water from each sampling points and place inversely to the water flow until the container is filled avoiding any air space in the sample bottle. Sampling was collected from the end of the river across the bridge along Umuahia- Ikot - Ekpene Road (OBR1) and subsequently at a distance of 200m apart through the residential quarters (NRQ2), the staff

school (NSS3), through the farms (NRF4), (NRF5) (NRF6) (NRF7) (NRF8) the dam (NDM9) and the boundary to MOUAU (NBM 10).

Laboratory Analysis

The samples were taken to soil science laboratory of the National Root Crops Research Institute, Umudike for physical, Biochemical and chemical analysis according to the methods of Udo *et al;* (2009).The water pH was measured using glass electrode pH meter while the electrical conductivity with conductivity meter. Total dissolved solids (TDS) were measured with a multimeter for water analysis. The dissolved oxygen (DO), salinity, Oxidation Reduction Potential (ORD) was also determined by the use of $H_1$9828 Hannah multimeter (Nwosu *et al;* 2015). Total Nitrogen, Ammonium-Nitrogen and Nitrate Nitrogen were determined by the semi-micro Kjedahl method Chloride was determined by the silver Nitrate titration method using potassium chromate as indicator (Ajayi *et al;* 2008), Total Hardness, Calcium and Magnesium were determined by EDTA versanate complexometric titration method, Phosphorus was by spectrophotometric method, potassium and sodium by the flame photometric method. The micronutrients were determined by the Atomic absorption spectrophotometer (AAS) method. The results were subjected to statistical analysis using the means.± standard deviation of triplicate analysis.

RESULTS AND DISCUSSION

The impact of some land use and farming activities of the research farms of the National Root Crops Research Institute on some physical quantities of the waters of Ohaiyimiri Umudike flowing across the Western end of the institute is shown in Table 1. Water temperature measured at the point of sampling ranged from 27.60±0.96 to 30.80±0.79^{0}C, the temperatures were high at the point of much activities; OBR1, NRF5 and NDM9. The pH an important limiting chemical factors for aquatic life is disturbed in the acidic weakly acidic and basic levels having a wide range of PH 4.90±0.06 to 9.60±0.14. It is obvious that with the range of this pH values some biochemical reactions of aquatic organisms will be disrupted in the extreme acidic and alkaline pH. The electrical conductivity measures the flow of electrical current in water which is an indirect measure of some inorganic dissolved solids in the water body (Sridhar, 1999). The electrical conductivity ranged between 1.96us to5.28us, this is an indication of presence of inorganic substances in the water body. Total dissolved solids had values that are in agreement with values obtained in the electrical conductivity and the oxidation-reduction potential; between 124.80 to 1638mgl^{-1} total dissolved solids are highest in the residential area of the institute and are above the WHO 1984 and 1995 standard for portable water.

Table 2 is showing some chemical characteristic of the river as influenced by agricultural activities oxidation reduction potential is in the range of 26.50 to 125.50mv, the water across the residential area had the highest values 125.50 and 60.30mv, the salinity is low while the inorganic nitrogen form are widely spread without any definite pattern NH_4^-N and $N0_3^-$N are in the range of 2.80-28.40mgl^{-1} and 1.40-9.80mgl^{-1} respectively. Nitrogen is important to all forms of life it is the byproduct of living organisms which includes such natural materials as proteins and peptides, nucleic acids, urea and numerous synthetic organic materials.(streamkeeper's field guide, 1991). The values obtain for chloride 35.45 to 88.60mgl^{-1}, Calcium 40.10 to 168.30mgl^{-1} potassium 0.86 to 4.10mgl^{-1} and phosphorus 0.48 to 0.825mgl^{-1} respectively were also with the desirable and permissible levels in drinking and irrigation water. (WHO, 2007; NIS, 2007). Chloride is an essential anion for osmotic and water current balance, it is of no known health implication but buffers the water body (Amajor *et al;* 2012). Phosphorus and calcium are also important mineral elements in aquaculture, they enriches the water body and improve plant growth and other microorganism leading to eutrophication and increase in biochemical oxygen demand.

Table 3 is shoeing the heavy metal concentration in the water body as influenced by the activities across the NRCRI Umudike on the Ohaiyimiri River. The effects of these metals in water ranged from being beneficial through troublesome to dangerously toxic. Some metals are essential; others adversely affect aquaculture depending on their concentration (Obodo, 2001). The following heavy metals were investigated in the water; Zinc, Iron, Copper, Lead and chromium. The values obtained were 1.24 to 16.20mgl^{-1}, 4.28 to 182.20mgl^{-1}, 0.18 to 2.92mgl^{-1} 0.034 to 0.94mgl^{-1} and 0.036 to 0.096mgl^{-1}, of Zn, Fe, Cu, Pb and Cr respectively. The highest level of the metals is seen in OBR1 sampling point. The high heavy metal concentration at the OBR1 sampling point could be because of the activity that goes on at the point which included car washing, heavy traffic that moves across the Umuahia Ikot-Ekpene road and the seemingly stagnant nature of the water.

CONCLUSION

The results obtained from this study showed that generally most of the mineral elements in the water samples occur in trace and moderate quantities. They are essential nutrients for many photosynthetic autotrophs and have been identified as growth factors. The concentrations are less serious environmental problem. There are many factors that has influenced the impact of farming operations on the quality of the river, which may include the water current, the temperature and pH, fluctuation, the presence of aquatic plants in the water have been beneficial to the healthy nature of the water bodies. The river had been identified as a good for aquaculture and irrigation practices.

Table 1: Impact of the NRCRI Research Farms on some Physical Qualities of Ohaiyimiri Umudike, River.

Sampling Location	Temperature (^{0}C)	Parameters Ph	EC (μs)	TDS (mgl-1)
OBR 1	30.80 ± 0.76	4.90 ± 0.06	6.28 ± 0.04	156.70 ± 3.90
NRQ 2	28.64 ± 1.20	9.60 ± 0.14	2.56 ± 0.06	948± 0.75
NSS 3	28.80 ± 0.94	8.40 ± 0.03	3.41 ± 0.40	1638 ± 0.06
NRF 4	29.70 ± 0.66	6.30 ± 0.07	2.76± 0.16	448.6 ± 0.11
NRF 5	30.10 ± 0.44	6.80 ± 0.04	2.44 ± 0.13	137.2 ± 0.06
NRF 6	29.40 ± 0.38	5.80 ± 0.11	2.74 ± 0.44	156.9 ± 0.38
NRF 7	29.80 ± 0.50	6.60 ± 0.08	1.96 ± 1.80	124.8 ± 1.60
NRF 8	28.40 ± 0.39	4.85 ± 0.24	2.24 ± 0.09	246.3 ± 0.20
NDM 9	30.40 ± 0.18	6.54 ± 0.64	2.91 ± 0.26	191.40 ± 0.70
NBM 10	27.60 ± 0.96	6.20 ± 0.09	4.66 ± 0.28	91.6 ± 0.40

OBR1 = Ohaiyimiri point at Umuahia – Ikot Ekpene Road convert
NRQ = NRCRI Western residential quarter area
NSS = NRCRI staff school / Anglican church base
NRF = NRCRI Research Field area
NDM = NRCRI water Dan area
NBM = NRCRI boundary area with MOUAU
EC = Electrical conductivity
TDS = Total Dissolve Solids

Table 2: Impact of the NRCRI Research Farms activities on the chemical characteristics of the Ohaiyamiri Umudike, River

Sampling Points	Parameter ORP MV	Salinity (mgL^{-1})	NH_4-N (mgL^{-1})	NO_3-N (mgL^{-1})	Cl (mgL^{-1})	Ca (mgL^{-1})	K (mgL^{-1})	P (mgL^{-1})
OBR 1	26.5 ± 0.02	0.06 ± 0.01	2.80 ± 0.01	1.40 ± 0.00	63.81 ± 1.60	168.3 ± 0.036	0.86 ± 0.4	0.485 ± 0. 1
NRQ 2	125.5 ± 0.01	0.08 ± 0.00	28.4 ± 0. 14	9.80 ± 0.020	42.50 ± 2.90	152.30 ± 0.04	2.74 ± 0.4	0.605 ± 0.03
NSS 3	60.3 ±60.3	0.11 ± 0.03	7.00 ± 0.20	5.6 ± 0.30	35.45 ± 3.5	88.1 ± 0.08	2.20 ± 0.05	0.640 ± 0.02
NRF 4	55.2 ± 0.02	0.20 ± 0.03	8.40 ± 0.4	5.6 ± 0.80	45.5 ± 0.80	60.1 ± 0.02	1.26 ± 0.3	0.725 ± 0.4
NRF 5	54.0 ± 0.00	0.04 ± 0.00	5.60 ± 0.14	4.20 ± 0.2	45.40 ± 2.0	70.2 ± 0. 1	1.50 ± 0.6	0.585 ± 0. 15
NRF 6	27.40 ± 0.14	0.06 ± 0.02	7.0 ± 0.4	6.40 ± 0.01	75.00 ± 0.00	72.1 ± 0.4	1.26 ± 0.0	0.480 ± 0.3
NRF 7	40.7 ± 0.60	0.07 ± 0.10	4.20 ± 0.40	2.80 ± 0.00	53.17 ± 1.5	40.10 ± 1.2	1.45 ± 0.2	0.550 ± 0.4
NRF 8	30.80 ± 0.06	0.09 ± 0.00	11.20 ± 0.08	7.00 ± 0.10	77.99 ± 3.40	64.13 ± 2.0	1.90 ± 0.3	0.825 ±
NDM 9	28.30 ± 0.60	0.04 ± 0.02	14.00 ± 0.3	8.4 ± 0.20	70.90 ± 0.06	88.2 ± 0.07	3.3 ± 0.6	0.795 ± 0.5
NBM 10	35.00 ± 0.20	0.06 ± 0.11	7.80 ± 0.00	5.60 ± 0.28	88.60 ± 2.5	96.1 ± 0.09	4.1 ± 0.02	0.700 ± 0.4

ORP = Oxidation Reduction Potential
NH_4-N = Ammonium nitrogen
NO_3 = Nitrate
Cl = Chloride
Ca = Calcium
K = Potassium
P = Phosphorus
Mgl-1 = Milligram per litre

Table 3:Impact of NRCRI Research Farming activities on some Heavy metal content in Ohaiyimiri Umudike River

Sampling Points	Zn (mgL^{-1})	Fe (mgL^{-1})	Parameter Cu (mgL^{-1})	Pb (mgL^{-1})	Cr (mgL^{-1})
OBR 1	16.20 ± 0.24	182.2 ± 0.05	2.92 ± 1.40	0.94 ± 0.02	0.096 ± 0.02
NRQ 2	1.31 ± 0.02	9.03 ± 0.15	0.82 ± 0. 1	0.070 ± 0.02	0.020 ± 0.01
NSS 3	1.33 ±0.11	6.70 ± 0.09	0.70 ± 0.29	0.080 ± 0.03	0.06 ± 0.03
NRF 4	1.45 ± 0.28	5.12 ± 0.05	0.36 ± 0.08	0.059 ± 0.00	0.048 ± 0.02
NRF 5	1.55 ± 0.06	6.52 ± 0.12	0.30 ± 0.00	0.34 ± 0.04	0.052 ± 0.01
NRF 6	1.24 ± 0.01	4.28 ± 0.03	0.37 ± 0.20	0.11 ± 0.06	0.036 ± 0.02
NRF 7	1.60 ± 0.00	5.40 ± 0.04	0.29 ± 0.01	0.064 ± 0.01	0.80 ± 0.05
NRF 8	1.32 ± 0.04	4.32 ± 0.90	0.32 ± 0.11	0.48 ± 0.01	0.051 ± 0.02
NDM 9	1.95 ± 0.05	12.3 ± 0.04	0.18 ± 0.20	0.106 ± 0.03	0.090 ± 0.06
NBM 10	1.76 ± 0.16	7.62 ± 0.11	0.33 ± 0.02	0.214 ± 0.10	0.95 ± 0.04

Zn = Zinc
Fe = Iron
Cu = Cupper
Pb = Lead
Cr = Chromium

COMPARATIVE ASSESSMENT OF NUTRIENT STATUS OF SOIL UNDER *HEVEA* (NATURAL RUBBER*)* BUDWOOD GARDEN OF DIFFERENT AGES AND THEIR UPTAKE

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ABSTRACT
The soil chemical properties and leaf nutrient contents of Hevea budwood garden of different ages (2, 5, 10, 15, 20 years) were assessed at Rubber Research Institute of Nigeria, Substation Akwete, Abia State, Nigeria for proper fertility management scheme. Soil samples were collected at the depth of 0 - 15 cm across the various budwood garden ages and corresponding leaf samples obtained from budstick for nutrient content determination before the annual cut back or harvest. Samples were analyzed using standard procedures. Samples were analyzed using standard procedures. Generally, soil pH was higher in the older gardens with the values ranging from 5.2 – 5.8 between 10 and 20 years old garden. The concentration of organic carbon, total nitrogen, available phosphorus and exchangeable bases followed the same trend as the pH and their values differed significantly (P < 0.05). The age of the budwood gardens significantly (P < 0.05) affected leaf nitrogen, phosphorus, potassium and calcium contents except magnesium, with the values obtained from older budwood gardens being relatively higher. The results show inadequate soil nutrient concentration for the production of vigorous budwood materials. Hence, consistent routine soil nutrient assessment is required for adequate nutrient supply and production of healthy and viable Hevea planting materials.
Key words: Budwood, soil nutrient, foliar nutrient, nutrient, *Hevea* planting material.

INTRODUCTION

Rubber (*Hevea brasiliensis*) is predominantly grown in southern Nigeria where the soils are characterized by low fertility and productivity due to high rainfall regime and intensity and associated leaching of nutrients and weathering (Igwe *et al*., 1995; Awodun *et al*., 2007). Therefore the need for sustainable soil nutrient management programme and this requires knowledge of the soil's nutrient status and or its physico-chemical properties (Nwosu *et al*., 2015; Ehigiator *et al*., 2015). Rubber being propagated mainly through vegetative methods, exhibits tree to tree intra-clonal variation in growth and yield which reduces the realization of maximum returns of rubber yield (Seneviratna, 2000; Senevirathna *et al*., 2007).

Budwood gardens are generally established for the multiplication of desired clones for production of quality rubber planting materials. According to Mercykutty (2014), the quality of budwood plants from which buds are harvested for budding, contribute to the quality and growth of plants and optimum yield will not be attained even with favourable environment if the scion used is not a high yielding one. Budwood garden being a regular bearer that puts forth budstick materials for budding during season flush needs sufficient and continuous supply of nutrients for regeneration. Absence or scarcity of essential elements in the soil cause nutrient deficiencies in the plant and so affect vital processes. Soil and plant analysis have been used extensively as a diagnostic tool for assessment of the nutritional status of crop (Rupa *et al*., 2014) and is based on the relationship between the concentration of nutrient elements in specific leaves at certain stages of plant development and the growth performance of plants (Monastraf, 1975; Rupa *et al*., 2014).

In rubber, no previous investigation on the effect of budwood garden age on soil properties and nutrient content of leaf has been carried out. Most established budwood gardens in Nigeria are more than 15 years old with the assumption that it would not deteriorate the quality of budwood / budstick or buds as juvenility is maintained through cutting back the budwood plants every year. Thus, challenges in maintaining budwood nurseries are transferred to plantation. The nutrient content of budwood leaves vary depending on the genotype and soil. The present investigation was undertaken to assess the soil chemical properties and nutrient uptake that may occur over time in the budwood garden of different ages.

MATERIALS AND METHODS

The research was carried in 2013/2014 *Hevea* planting material production season at the Rubber Research Institute of Nigeria (RRIN), Substation Akwete, Abia State (longitude 7^0 00′ and 7 ^{0} 19′ E and latitude 4 ^{0} 50′ and 4^0 65′). The soil is a typical tropudult with rainfall distributed over nine to ten months in a bimodal rainfall pattern. These are early rain (April - July) and late rain (August - October) with five months of dry season and a short dry spell in August. The monthly maximum air temperature ranged from 28 to 35 ºC (NRCRI , 2008 ; Kamalu *et al*.,2014).

The soil (0- 15cm depth) and plant samples were taken from budwood gardens of 2, 5, 10, 15 and 20 years old. Both (plant and soil) samples were collected in replicates of three before the annual cut back. The soil samples were air dried, sieved with 2mm sieve and analyzed for potential of hydrogen (pH), Organic carbon (O C),total nitrogen (N), available phosphorus (P- Bray- 1), exchangeable Potassium (K^+), Magnesium (Mg^{2+}) and Calcium (Ca^{2+}).The plant samples were processed by washing and oven drying for 48hrs, at the temperature of 70 ^{0}C. The samples were analyzed for N content, using micro- kjeldahl method and the P, Ca, Mg and K contents determined using wet oxidation method, all as described by IITA (1979). Data collected were subjected to analysis of variance using Genset, 2008 and significant means separated with Least Significant Difference (LSD).

RESULTS

Soil properties chemical

The chemical properties of the soil indicated low fertility status and significantly differed ($P < 0.05$) except pH (Table 1). The soil pH recorded ranged from 4.5 to 5.8 showing very strongly to strongly acidic soil conditions. These values generally increased as the budwood garden age increases. The increased acidity was however highest in 5- year old budwood garden and lowest in 20 – year old budwood. Organic carbon followed similar trend as the pH with a mean of 1.43 %. 20 – year old budwood garden recorded the highest organic -carbon value of 1.82 %, while 5 – year old budwood garden had the lowest value of 0.92 %. Total nitrogen (N) % was significantly lower in younger budwood garden ($P > 0.05$) and the % concentration increased with the increasing age of the budwood garden (Table 1). It ranged from 0.01 to 0.15 % with a mean of 0.08 %. 20 – year old budwood garden had the highest mean total nitrogen value of 0.15 %, which could be as a result of its deep root to absorb decomposed materials. However, 2 and 5 – year budwood garden had the lowest mean value of 0.01 %. The available phosphorus (P) varied significantly and ranged from 2.53 to 10.11 Mg/kg indicating relative availability in the soil. 20- year old budwood had the highest P concentration 10.11 Mg/kg with 5 – year budwood recording the lowest value of 2.53 Mg/kg. The Calcium values ranged from 0.98 to 3.10 Cmol/kg with a mean of 2.07 Cmol/kg indicating that the soil is moderate in calcium. Calcium is needed in small quantities for tree plants. The highest mean calcium value of 3.01 Cmol/kg was obtained by 20 - year budwood garden, while the lowest value was obtained in 5 – year old budwood garden. Potassium levels in the soils varied significantly ($P < 0.05$) and ranged from 0.44 Cmol/kg (5 – year budwood) to 0.91 Cmol/kg (20 – year budwood) with a mean of 0.65 Cmol/kg. Similarly, Magnesium levels in the soil ranged from 0.28 Cmol/kg to 0.90 Cmol/kg with a mean of 0.58 Cmol/kg; increasing with increase in budwood age except in 5 – year budwood garden (Table1).

Leaf nutrients

Leaf N, P, K, Ca, Mg contents from budwood garden of different age as analyzed are presented in Table 2. The concentration of nutrients in the leaf varied among the budwood ages. The N content of the leaves differed significantly among the budwood ages. 20 – year budwood garden recorded the highest N (4.82 %) and 5 – year budwood garden the lowest N (2.11 %). The budwood ages significantly differed with respect to P and K concentrations. Concentration increases as budwood ages increases and ranged from 0.12 %, 0.99 to 0.72 %, 1.11 % with mean value of 0.44 %, 0.98 % for P and K respectively for 2 – year budwood garden and 20 – year budwood garden. The concentration of Mg and Ca in budwood leaves widely varied. The values of Ca were generally higher compared with Mg. Highest % Ca was observed in 20 – year budwood garden (1.44 %) and the lowest % Ca in 2 – year budwood garden (0.44 %). The % Ca concentration in 20 - year budwood was at par with 15 – year budwood garden. The concentration of Mg in the leaf ranged from 0.12 % (5- year budwood garden) to 0.15 % (20-year budwood garden) with a mean value of 0.16 %.

DISCUSSION

Plants and soils in the tropical rainforest are in equilibrium involving an almost closed cycling of nutrients achieved by a very high rate of litter production, rapid mineralization and a rapid attainment of equilibrium with respect to organic matter relationships (Bernherd-Raversat, 1987; Vitousek and Sanford, 1986; Terborgh, 1992). However, whenever the vegetation is cleared for cultivation, the plant – soil relationship is disrupted irrespective of whether field or tree crops are planted (Adejuwon and Ekanade, 1988). The differences observed in the soil and leaf nutrient properties in the budwood garden confirmed these assertions. The studied soils are acidic and are within the pH range obtained by Attoe and Amalu, 2005; Pusharajah, (2005); Kamalu *et al.*, (2014) for *Hevea* cultivation. The variations in acidity gradient across the buwood ages could be attributed to influence of leaching on younger budwood garden beyond plant root reach. This is in agreement with findings of Foth (2006). Though, the Organic carbon was higher in older budwood garden, the values obtained were less than the critical value and is considered low (Chude *et al*.; (2011; Malami *et al*., 2011). The low organic carbon content in the younger budwood garden may be attributed to the low organic input relative to older gardens where annual pruning (cut back) takes place with the foliage being left in situ, thus contributing to the soil organic matter. The younger budwood gardens therefore need soil amendments to increase the soil pH value by application of liming materials (Onwuka *et al*., 2009; Whalen *et al*., 2000; Nikoli and Matsi 2011). Nitrogen in the soil followed a similar trend as organic carbon. Though, the total nitrogen (TN) increases with respect to the age of the budwood garden, the TN values were lower than the range obtained by Kamalu *et al*., (2014) at 0 – 18 cm soil depth. This is similar to the finding of Oku *et al*., (2012) that there is huge nutrient accumulation in older rubber plantations preventing direct rainfall impact and nutrient leaching. Furthermore, it is deduced that the low level of nitrogen in younger budwood garden could be due to low levels of phosphorus as fixation of nitrogen is influenced by phosphorus availability in the soils (Malami *et al*., 2011). Relatively lower P range obtained was lower than the P values obtained by Lekwa and Whiteside (1986) and Kamalu *et al*; (2014). The exchangeable bases (Ca, K amd Mg) were higher in older budwood garden. According to London (1991), tropical soils with Ca levels as low as 0.2 Cmol / kg are good for agricultural crops and forest tree for growth as it is needed in small quantity. Similarly, London (1991) reported that Mg levels of 0.5 Cmol / kg in the soil are considered deficient in the tropical environment. Thus, Mg levels obtained in the 2 – 5 years budwood garden are inadequate, hence requires soil amendments for better budwood growth. Potassium levels showed a direct relationship with the trend of soil Mg. General higher values of Ca, K and Mg in older budwood garden could be due to higher pH that favoured the decomposition of accumulated litter fall (Malami *et al*., 2011; Ipinmoroti and Ogeh, 2014).. Similarly, the foliar nutrient contents followed the same trend with soil nutrient status of the budwood garden across various ages. Phosphorus, magnesium and calcium concentrations increase as the budwood ages increases. The significantly higher foliar nutrient concentration from the older budwood garden relative to the younger ones could be partly attributed to their well developed root system that have been found to enhance nutrient uptake and conservation among tree crop management systems.

CONCLUSION

The soils studied were low in pH. The concentrations of organic carbon, total nitrogen, available P, potassium were inadequate, while calcium and magnesium were moderate. Though the elements were generally higher in older budwood garden, constant monitoring of soil and leaf nutrient status in budwood garden is necessary for proper soil amendment or improvement for efficient budwood garden growth and development, consequently the production of viable planting materials.

Table 1: Soil nutrient and pH values of *Hevea* budwood garden of different ages at RRIN Substation Akwete

Age of Budwood garden (YAP)	pH (H_20)	O C (%)	Total N (%)	P (Mg/kg)	Ca	K	Mg
					<----------	(Cmol/Kg)	-------->
2	4.8	1.02	0.01	3.23	1.35	0.52	0.32
5	4.5	0.92	0.01	2.53	0.98	0.44	0.28
10	5.2	1.34	0.09	4.56	2.10	0.61	0.54
15	5.6	1.61	0.13	8.04	2.93	0.78	0.84
20	5.8	1.82	0.15	10.11	3.01	0.91	0.90
Mean	5.2	1.34	0.08	5.70	2.07	0.65	0.58
LSD (0.05)	NS	0.32	0.05	3.24	1.14	0.11	0.40

YAP = Years after planting, NS = Not significant

Table2: Foliar nutrient content of budwood garden of different ages (%)

Age of Budwood Garden (YAP)	N	P	K	Mg	Ca
2	2.34	0.12	0.99	0.32	0.44
5	2.11	0.41	1.62	0.12	0.82
10	3.51	0.32	0.85	0.09	1.32
15	4.61	0.61	1.20	0.14	1.42
20	4.82	0.72	1.11	0.15	1.44
Mean	3.45	0.44	0.98	0.16	1.09
LSD (0.05)	1.03	0.23	0.05	0.61	0.11

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EFFECT OF DIFFERENT RATES OF COW-DUNG MANURE ON THE SOIL PROPERTIES, GROWTH AND YIELD OF BAMBARA GROUNDNUT (*VIGNA SUBTERRANEA)* IN AN ULTISOL

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ABSTRACT
Experiments were carried out at the student experimental station, Kabba college of Agriculture Kabba, Kogi State in 2014 and 2015, to investigate the effects of different rates of cow-dung manure on the soil properties, growth and yield of Bambara groundnut. Seed were obtained from International Institute Tropical Agriculture, Ibadan. There were five treatments which were as follows: 0t/ha, 2t/ha, 3t/ha, 4t/ha and 5t/ha. The treatment were arranged in a Randomised Complete Block Design and replicated three (3) times. Data was taken on soil physical and chemical properties, agronomic traits such as plant height, leaf area, stem girth and number of leaves. Yield parameters taken were grain weight per plot and yield (t/ha). The data were statistically analyzed using GENSTAT. The analysis of variance (ANOVA) was performed to find out the significance of variation among the treatments while the significant difference between mean treatments were separated using least significance Difference at 5% level of probability. The study indicated that plots treated with 5t/ha cow dung produced the highest pod yield per plot (4.64kg) and seed dry weight (3.80t/ha) and improved better the soil physical properties. It is therefore concluded that plant should be treated with 5t/ha to get good yield of Bambara nut in the study area.
Keywords: Cow dung, Manure, Legume species, Different rate, Subterranean, Bambara groundnut,

INTRODUCTION

Bambara groundnut (*Vigna subterranea (L) Verdc*) is a pulse with subterranean fruit-set and is cultivated by small holders over much of semi-arid Africa (Linnemann and Azam-Ali, 1993). The crop is a legume species of Africa origin (Borget, 1992). Food legumes have a major role to play in the fight against malnutrition. The protein of bambara groundnut is of good quality and has surplus lysine with complement cereals in the diet Ocran et al., (1998). The composition of the seed from the point of view for human nutrition is very well balanced, as they contain 20% soluble carbohydrate and 8% fats (Messiaen, 1992). It is high in protein unlike ordinary groundnut contains very little oil (Tweneboah, 2000). The high carbohydrate (65%) and relatively high protein 18% content of bambara groundnut make it a complete food (Doku, 1995).

In Nigeria, bambara groundnut (*Vigna subterranea (L) Verdc*) was for a long time at par with cowpea (*Vigna uniguiculata*) in terms of production and utilization. The status of the nut however, started to decline from 1970's with introduction of high yielding varieties of groundnut (*Arachis hypogaea*) and pest control methods of cowpea (Doku,1995). The majority of ultisols located in the southern guinea savanna zone of Nigeria are strongly weathered and inherently low in nutrients and organic matter. Crop yields on these soils are low (Ogundare, 2012). Even though farmers are advised to use inorganic fertilizer, this input is scarce and beyond their reach. Also the use of inorganic fertilizers alone to sustain high crop yield has not been quite successful due to enhancement of soil acidity, nutrient leaching and degredation of soil physical and organic matter status.

Bambara groundnut was ranked the third most important legume after groundnut and cowpea in semi-arid Africa (Linnemann and Azam-Ali, 1993), but has not been accorded due attention in research. Little research has been done to date to improve bambara groundnut. The work done on the crop has been limited to mass selection of a few local varieties, followed by purification phase for the main agronomic characteristics. International Institute of Tropical Agriculture (IITA) has recently evaluated a large collection of bambara groundnut comprising more than 1000 introduction collections from all over Africa (Baudoin and Mergeai, 2001). The researcher tends to find out how the use of cow dung manure will improve soil properties, growth and yield of bambara groundnut in the study area.

MATERIALS AND METHODS

Experimental site

The experiment was carried out for two consecutive growing seasons (2014 and 2015) at the research site of Horticultural Section, College of Agriculture, Kabba. The site is located at latitude of 07° 35' N and longitude of 06° 08' E and is 423 m above sea level, in Southern Guinea Savanna Agro Ecological Zone of Nigeria, where the dry seasons are dry and hot while, wet seasons are cool. The rainfall spans between April to November with peak in June. The dry season extends from December to March. The mean annual rainfall is 1570mm per annum with an annual temperature range of 18°C - 32°C. The mean relative humidity (RH) is 60% (Meterological data, 2011). The major soil order within the experimental site is Gleysol (Higgins, 1957; Babalola, 2010).

Determination of soil physical properties

Soil Physical properties were taken at 30 and 60 days after planting. Five undisturbed samples were collected at 0-15cm depth from each plot using core samplers and were used for the determination of bulk density, total porosity and gravitational moisture contents after oven dried at 100^0C for 24 hours. Total porosity was calculated from the value of bulk density and particle density. Soil temperature was determined at 15.00 hr (3pm) with a soil thermometer inserted to 5cm depth. Five readings were made per plot at each weekly determination.

Experimental Design

The experiment was laid out in a randomized complete block design (RCBD) with three replications to investigate the effect of different rates of cow-dung manure on the soil properties, growth and yield of bambara groundnut (*vigna subterranea)*. The experiments were arranged in a randomized complete block design (RCBD) and replicated three times. The treatments consisted of the followings: T1= 0t/ha of cow dung, T2 = 2t/ha of cow dung, T3= 3t/ha of cow dung, T4= 4t/ha of cow dung and T5= 5t/ha of cow dung. The seeds for the experiment were collected from International Institute Tropical Agriculture, Ibadan. Sites were cleared manually using cutlass and later ridged with hoes and in the field, Seeds of Bambara nut were sown on a flat bed. Organic manure were uniformly spread on the flat beds and incorporated with hoes two weeks before planting. The seeds were planted at the rate of two - plant-per-hole at a spacing of 50cm by 30cm which make up forty- nine stands per plot. Plots were weeded manually at three weeks intervals. Data collected were statistically analyzed using GENSTAT. The analysis of variance (ANOVA) was performed to find out the significance of variation among the treatments while the significant difference between mean treatments were separated using least significance difference at 5% level of probability.

RESULTS AND DISCUSSION

Properties of the Experimental Site and Chemical Properties of Cow Dung Used

The properties of the soil at the site of the experiment are presented in Table 1. The soils are predominantly sandy, slightly acidic with relatively high bulk density. The organic matter, total N, available P, exchangeable K and Ca were low. The chemical composition of cow dung used is show in Table 2. The chemical characteristics of cow dung shows relatively high in essential nutrients required for the growth and development of crop. However, C/N was also high (15.9). The properties of the soil at the site of the experiment are presented in Table 1. The soils are predominantly sandy, slightly acidic with relatively high bulk density. The organic matter, total N, available P, exchangeable K and Ca were low.

Physical Properties of the soil as affected by application of different rate of cow dung

The physical properties of the soil as affected by application of different rate of cow dung are presented in Table 3. Significant difference was observed in soil porosity and soil moisture content, while, both bulk density and soil temperature were not affected significantly. Highest bulk density and least values of both porosity and soil moisture content were observed in plots without cow dung amendment. Plots treated with cow dung were significantly better irrespective of the rate of it application than plots without cow dung application. However, no significant difference in the soil porosity and soil moisture content of the amended plots irrespective of the rate of application. The result agreed with the findings of (Agbede 2007) and Ewulo et al. (2008). They found that soil bulk density reduced and moisture content increased in the plots where poultry manure was applied. This was attributed to the enhancement of soil organic matter by organic residues applied. No significant response was observed in soil temperature as a result of treatment imposed irrespective of it rate of application.

Growth Characteristics of Bambara nut as affected by application of different rate of cow dung

Effect of different rate of cow dung on growth characters of Bambara nut are presented in Table 4. Plant height, number of leaves, stem girth and leaf area were significantly affected by the application of different rate of cow dung. It was also observed that all the growth characters increased with increase rate of cow dung. Plots treated with 5t/ha producing highest plant height, number of leaves, stem girth and leaves area while, the least values of all these were observed in the control plots. Cow dung improves the growth characters of Bambara nut which agreed with findings of Suge *et al*. (2011). They attributed the better performance of crop in term of growth characters to gradual release of nutrient by the organic manure applied.

Yield Characteristics of Bambara nut as affected by application of different rate of cow dung

Table 5 presented the effect of application of different rate of cow dung on yield characters of bambara nut. Pod yield per plots and seed dry weight were significantly affected. Both pod yield per plots and seed dry weight in tons per hectare increased with increase rate of application of cow dung. Pod yield per plots and seed dry weight per hectare were highest in plot treated with 5t/ha cow dung while, the least values of pod yield per plot and seed dry weight in tons per hectare were lowest in unamend plots. All the plots with the application of cow dung increased yield better than plots without cow dung. The findings corroborated the work of several workers that organic residues increase growth and yield of crops Ogundare et al. (2014) on okra; Akpeokhai et al. (2014) ; Bello et al. (2013) on maize and Agbede (2007) on sorghum.

CONCLUSION

The study indicated that plots treated with 5t/ha cow dung produced the highest pod yield per plot (4.64kg) and seed dry weight (3.80t/ha) and improved soil physical properties. It is therefore concluded that plant should be treated with 5t/ha to get good yield of Bambara nut in the study area.

Table 1: Pre -Planting Soil Sample

Properties	2014	2015
Particle size (%)		
Sand	60.4	62.3
Clay	24.0	21.1
Silt	15.6	16.6
Soil texture	Sand clay loam	Sand clay loam
p^H (H_2O)	5.52	5.54
Bulk density	1.51	1.49
Total N	0.14	0.16
Available P	2.7	2.4
Organic matter	1.8	1.6
Exchangeable cation $Cmol^{-1}$		
K	0.2	0.3
Ca	1.9	1.7
Mg	1.8	1.6

Table 2: Chemical Composition of Cow Dung Manure Used

Properties	cow dung
Organic carbon (%)	43.4
Total N (%)	2.8
C/N	15.9
Phosphorus (%)	1.1
Potassium (%)	0.8
Calcium (%)	1.2
Magnesium (%)	0.2

Table 3: Physical Properties of the soil as affected by application of different rate of cow dung (mean of two years)

Cow dung	Bulk density (g/cm^3)	Soil porosity (%)	Moisture content (%)	Soil temperature (^0c)
0t/ha	1.36	35.41	13.46	34.1
2t/ha	1.23	40.63	15.83	33.70
3t/ha	1.26	41.91	16.10	33.68
4t/ha	1.21	41.53	16.94	33.61
5t/ha	1.20	41.93	17.20	33.60
LSD	NS	2.44	2.11	NS

Table 4: Growth Characteristics of Bambara nut as affected by application of different rate of cow dung (combined analysis)

Cow dung	Plant height (cm)	Number of Leaves	Stem Girth (cm)	Leaf Area (cm^2)
0t/ha	21.6	98.4	0.13	2.98
2t/ha	29.3	146.3	0.18	3.32
3t/ha	36.7	162.8	0.22	4.23
4t/ha	38.6	161.0	0.21	4.03
5t/ha	37.2	174.3	0.26	4.31
LSD	2.32	13.4	0.08	0.74

Table 5 : Yield Characteristics of Bambara nut as affected by application of different rate of cow dung (combined analysis)

Cow dung	Pod yield Per plot(kg)	Seed dry weight(t/ha)
0t/ha	0.96	0.83
2t/ha	2.95	2.46
3t/ha	3.71	3.70
4t/ha	4.46	3.72
5t/ha	4.64	3.80
LSD	1.43	0.16

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INFLUENCE OF DIFFERENT FERTILIZER APPLICATION ON PROPERTIES OF CULTIVATED URBAN GARDEN SOILS IN NORTHERN GUINEA SAVANNA OF NIGERIA

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ABSTRACT

Urban cultivation is characterized by intensive vegetable-crop production all year round to meet the demand of burgeoning urban populace and offers ecosystem services of sustainable recycling of municipal waste in food production. In this study, long term effect of three different fertilizer management (treatments) were selected as practiced in the Kubanni area of Zaria, northern guinea savanna of Nigeria, and they include (i) municipal waste (MW) application (ii) mineral fertilization (MF) and (iii) No fertilization (control; NF), to monitor soil quality. Three undisturbed soil cores and three disturbed soil samples were collected from two soil depths (0-15 and 15-30 cm) taken diagonally across the farmland of each fertilizer management. Physical and chemical soil properties were determined by routine analytical procedures. Municipal waste treated soils have the lowest bulk density values compared to the other two treatments with values of 1.34 g cm^{-3} in 0-15 cm and 1.39 g cm^{-3} in 15-30 cm. Total porosity was 47% and 48% in the upper and lower soil layers, respectively, and statistically differ ($p<0.01$) from the other two treatments. Similar trend was observed for water retention, hydraulic conductivity and aggregate stability in both wet and dry sieving methods. Soil pH in $CaCl_2$ and H_2O were close to neutral in MW treated soils, with organic carbon contents of 1.92% in the upper soil depth although, it was not statistically different ($p>0.05$) from MF treated soils with values of 1.74%, and higher exchangeable bases (Na^+, K^+, Ca^{2+}, Mg^{2+}) were obtained in MF soils. These findings have important implications to places where water is a limiting resource, or in the face of climate-related uncertainties not only for urban cultivation but for rain-fed crop production due to enhanced water retention and improved soil structural conditions with the applications of municipal waste.

Keywords: soil quality, nutrient management, urban cultivation, municipal waste, water retention.

INTRODUCTION

The current trend of urbanization in the world and West Africa in particular, necessitates increase in food production to meet the teaming urban population. Urban cultivation entails crop production in open spaces within cities and is often characterized by intensification under continuous year round cultivation (Abdulkadir et al., 2013). Although urban cultivation is an avenue that ensures a steady supply of vegetables and crops to urban markets, intensification of production leads to nutrient depletion characteristic of most African farming systems (Stoorvogel and Smaling, 1990). Integrated nutrient management (INM) which involves complementary use of organic and inorganic fertilizers has been suggested to improve productivity of most depleted soils (De Jager, 2007), which became widespread in the 1990's and 2000's. Integrated nutrient management practices have been shown to have significant influences on physical and chemical status of many agricultural soils. Nigerian savanna Alfisols are characterized with poor structural stability and liable to compact (Ogunwole et al., 2001). However, these properties were shown to improve or change with management practices such as tillage and fertilizer application strategies.

The Kubani area in Zaria, Northern Guinea Savannah of Nigeria is an intensively cultivated fadama-like land located in the urban province. Farmers adopt different fertilizer management practices to sustain productivity among which is the application of organic amendments from municipal waste sources. Emphasis is placed on nutrient supply of this practice with little attention to the role it plays on soil physical status.

The objectives of this work are to access and compare the physical and chemical properties of soils subjected to different fertilizer management under urban cultivation practices in Zaria, northern guinea savanna of Nigeria.

MATERIALS AND METHOD

Site description and management

The study was situated at the Kubani Fadama-like site of Zaria LGA at the Kaduna state, Nigeria, longitude 07^0 41'E and latitude 11^0 10' N with an annual mean rainfall of 1060mm (Oluwasemire and Alabi, 2004). Alfisols are the major soil order in the northern guinea savannah of Nigeria (Jones and Wild, 1975). The Kubanni farmers engage in year-round continuous cultivation with irrigated crop and vegetable production during dry periods.

Three farms were chosen for the study to represent three fertilizer managements i.e. plots or farmlands fertilized mainly with municipal waste (MW), mineral fertilizer (MF) and a control site with no fertilization (NF).

Soil sampling and analysis

Three undisturbed soil cores were taken from each sampling depth (0-15 and 15-30 cm) from three random spots per farm plot (treatment), making a total of 54 (i.e. 3 samples x 3 random points x 2 soil depths x 3 farm plot) soil cores. Disturbed samples were taken from the same spots as the soil cores but were bulked per sample depth i.e. 3 samples per depth per farmland (3 samples x 2 soil depths x 3 farms/plots). Disturbed soil sample taken were analyzed for physical and chemical properties while soil cores were used for determining bulk density by method of Blake and Hartge (1986). Chemical properties determined include soil pH in water and $CaCl_2$with 1:1 soil to solution ratio, organic matter and exchangeable bases. Particle size distribution, total porosity (F), saturated hydraulic conductivity and aggregate stability (wet and dry sieving method) were all determined using standard laboratory procedure.

Data Analysis

Data were subjected to analysis of variance (ANOVA) to assess the effect of the different fertilization on soil properties. Treatment means were separated using the least significant difference (LSD) and Spearman's correlation was also conducted on the data to measure the association of soil organic matter and some selected physical properties. All data was analyzed with SAS Statistical package (SAS Institute, 2001).

RESULTS AND DISCUSSION

Chemical properties

Soil reaction shows the three soils having pH ranges of 5.9 to 7.3 (slightly acidic to neutral) with no significant difference ($p>0.05$) with treatment and soil depth (Table 1). The soils treated with municipal waste had a near neutral pH when compared to the other treatments. This could be attributed to the buffering capacity of organic matter on soil reaction. The MF treatment exhibited a slightly near acidic reaction. Municipal waste applied to the soils was found to have high organic contents of up to 38% (data not shown). This is characteristic of most wastes because it contains high amounts of organic material that is compostable. Soil organic carbon (SOC) in the municipal waste (MW) and mineral fertilization (MF) treatments were not statistically different ($p>0.05$), but both treatment had significantly higher ($p<0.05$) SOC contents than the control (NF) at both soil depth (Table 1). Soil organic matter was higher in MW soils due to addition of municipal waste while as for the MF treatment, it may be due to the wastewater used to irrigate the farms during the dry season as the MF field is located close to the wastewater source. This may be the reason why the some of the farmers do not have to add further organic amendments as their plant nutrient needs are met by the nutrient-rich wastewaters (Abdulkadir et al., 2013). The low soil organic matter in the NF treated soil could simply be attributed to non-incorporation of organic materials to the soil. Across all the treatments, exchangeable bases are moderate in values and optimum for crop production. There was no statistical difference in exchangeable sodium in all the treatments although higher values were obtained in MF treatment. This may be unconnected with slight additions of these bases in mineral fertilizers which contributed to higher values of Ca^{2+} and Mg^{2+} of soils in MF than the other treatments.

Physical properties

Soils were sandy loam in texture and did not differ in the percent clay, sand and silt across all the treatments (data not shown). There was an increase in clay content with depth which as often, is attributed to clay eluviation from the surface as a result of continuous cultivation and tillage (Shirani et al., 2000). Bulk densities of all the treatments ranged from 1.34 – 1.57 Mg m^{-3} (Table 2). Although these values are within the limit of good root penetration, there was a significant difference ($p<0.01$) among the bulk densities of the three farmlands. The MW treatment had low bulk density compared to MF and NF treatment and differ statistically from the two treatments. However, the latter two were statistically at par ($p>0.05$) at both soil depths. Low bulk densities for MW treatments could be as a result of addition of organic amendment which had an influence on the soil structure (Sommerfeldt and Chang, 1987; Arriaga and Lowery, 2003) when compared with MF and NF farmlands. Total porosity (F) of MW varied with that of the other treatments. Soil with municipal waste applied to them had significantly higher ($p<0.05$) porosities than the other two treatments, which were statistically at par (Table 2). This implies that there will be adequate drainage and moisture retention in MW fields as compared to the other fields. Studies have shown an increase in total porosities of soils with organic amendments (Zhang et al., 2006) which is usually has more volume and less weight thus increase the number of and water held in soil pores. The lower porosity of the MF field could be due to non-contribution of organic material towards improving soil porosity which was found to reduce soil porosity of sandy loam soils in the North-eastern part of Nigeria.

High porosity of MW could be attributed to low bulk density and improved soil structure following increased addition of organic materials. Measured saturated hydraulic conductivity (Ks) values across the different treatments are presented on Table 2.

There was a significant difference between the three fields for all soil depths but there is no significant difference within a treatment with depth. There was a slight decrease in Ks with depth for all three fields. Municipal waste treatment had a significantly higher ($p<0.05$) Ks than MF and NF soils. High total porosities of MW from organic amendments would have influenced the transmission properties of the soil vis a vis saturated hydraulic conductivity. Studies have shown a significant increase in Ks and water flow with organic matter additions (Arriaga and Lowery, 2003; Schjonning et al., 2002). Similar trend was observed for dry and water stable aggregates for both soil depths. Similar observation was made by Obi et al. (1995) for soils in southern Nigeria on the influence of organic and inorganic amendments of soil properties.

Relationship between some of the soil properties

Soil properties correlated with organic carbon content (SOM) to explain certain processes taking place in the soil. Saturated hydraulic conductivity had a significant positive correlation ($p=0.001$) signifying that organic matter content has an influence in water movement in the soil (Table 3). The higher the organic matter content, the more rapid the movement of water between the soil pores. The correlation of bulk density showed a negative correlation which was significant ($p=0.001$) signifying that lower bulk density is associated with an increase in organic matter content and vice versa. These results are consistent with findings that indicate the positive impacts of organic additions on soil retention properties that affect soil processes.

CONCLUSION

The Kubanni farms of Zaria practice urban agriculture and are known for intensive crop production with little or land to fallow in order to meet the increasing demand of growing populace. This study showed that municipal waste additions to soils in Kubanni farms increased soil organic matter content at the two soil depths (0-15 and 15-30cm). The soils under municipal waste (MW) application had a lower bulk density, higher total porosity, saturated hydraulic conductivity, water retention and aggregate stability than soils fertilized with mineral fertilizer (MF) or no fertilization at all (NF). Although some of the differences with MF were not statistically significant, values of the soil properties were slightly higher in MW than MF. This was further indicated by the strong correlation between organic carbon and above mentioned soil properties. These findings have important implications for continuous cultivation in dry-land farming, and where water is a limiting factor for crop production. Thus, suggesting that application of organic waste could reduce the amount of water used per irrigation cycle at the same time improve the water retention and transmission properties of the soil.

Table 1: Chemical properties of the study plots under different fertilizer management

Soil Depth (cm)	Plot/ treatment	Organic carbon (%)	Soil pH		Exchangeable bases ($cmol^+kg^{-1}$)			
			H_2O	$CaCl_2$	Na^+	K^+	Ca^{2+}	Mg^{2+}
0-15	MF	1.74^a	5.9	5.3	0.81	0.46	13.51	1.79
	MW	1.92^a	7.3	7.0	0.32	10.5	1.51	1.81
	NF	0.57^b	6.4	6.3	0.23	0.09	12.01	2.50
	SE	0.018	0.13	0.11	0.19	0.02	0.60	0.12
15-30								
	MF	1.73^a	6.0	5.4	0.51	0.17	8.02	1.15
	MW	1.58^a	6.8	6.6	0.57	0.27	8.50	1.26
	NF	0.55^b	6.4	6.3	0.40	0.11	8.02	1.70
	SE	0.020	0.130	0.110	0.100	0.070	0.600	0.120

Means with different letters within the same column are significantly ($p<0.05$) different; MF= mineral fertilizer; MW= municipal waste; NF= no fertilization.

Table 2: Physical properties of the study plots under different fertilizer management

Soil depth (cm)	Plot/ treatment	Bulk density (Mg m^{-3})	Total porosity (%)	Ks (cm sec^{-1})	MWD_{dry} (mm)	MWD_{wet} (mm)
0-15						
	MF	1.54^a	35	0.048^b	1.07^a	0.561^a
	MW	1.34^b	47	0.101^a	0.82^b	0.587^a
	NF	1.48^a	39	0.028^c	0.52^c	0.133^b
	SE	0.013	0.026	0.0001	0.051	0.031
15-30						
	MF	1.47^a	32	0.047^b	1.11^a	0.517^a
	MW	1.39^b	48	0.092^a	0.96^a	0.524^a
	NF	1.90^c	38	0.025^c	0.58^b	0.114^b
	SE	0.013	0.026	0.0001	0.054	0.032

Means with different letters within the same column are significantly ($p<0.05$) different; MF= mineral fertilizer; MW= municipal waste; NF= no fertilization; Ks=saturated hydraulic conductivity; MWD_{dry}=dry mean weight diameter; MWD_{wet}=wet mean weight diameter.

Table 3: Correlation coefficient between selected soil physical properties and soil organic matter (SOM) and coefficient of variability of the properties

Soil property	R	CV (%)
Ks	0.695***	56.7
Bulk density	-0.777***	6.7
MWD_{dry}	0.813***	30.0

***= significant at p=0.0001; SOM= soil organic matter; Ks= saturated hydraulic conductivity; MWD_{dry}=dry mean weight diameter; CV= coefficient of variability of each property.

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PRELIMINARY STUDIES ON THE ASSAY AND QUANTIFICATION OF LEAD IN SOME SOURCES OF POTABLE WATER IN IHIEUTUTU COMMUNITY, ISHIAGU, IVO L.G.A. OF EBONYI STATE, NIGERIA

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ABSTRACT
The eco-toxicological effect of lead pollution is established and enormous. Although there is a lot of awareness on this, mining communities like Ihieututu remain at risk. In Ishiagu and hence Ihietutu, this risk is further heightened by the fact that there is also inadequate water supply. As a result of this, the people of Ihieututu like other communities in Ishiagu depend on surface water to meet their potable water need. Therefore continuous monitoring of lead levels in this critical resource that the people so direly need, to ensure its safety, is imperative. In the light of the above, lead concentration was assayed in three (3) wells and five (5) streams in Ihietutu that serve as sources of potable water using Atomic Absorption Spectrophotometer (AAS). These stream include; Ihukoyi, Okuiyi, Isiovia, Iyiokpu and Akpuadu. Lead concentrations in these streams were found to be 28.528 ± 0.998 mg/l, 0.000 ± 0.000 mg/l, 34.171 ± 2.993 mg/l, 34.244 ± 2.890 mg/l and 34.171 ± 0.998 mg/l for Ihukoyi, Okuiyi, Isiovia, Iyiokpu and Akpuadu respectively. From the result obtained, four (4) of the five (5) streams were found to be contaminated with lead. However, lead was not detected in all well water samples analyzed. This could be attributed to the tendency of lead to adsorb tightly to soil particles.
Keywords: lead, potable water, Ishiagu

INTRODUCTION
The demand for industrial raw materials and the need to earn foreign direct investment (FDI) led to the growth and development of the mining sector. One of the important metals mined is lead. It is the commonest heavy metal, making up 13 mg/kg of the earth's crust (WHO,2011). Archeological research indicates that lead has been used by humans for numerous purposes for more than 5000 years (Hill, 1999). Today lead is still an important metal not only to industrialized nations but also to developing nations who increasingly seek ways of earning more revenue.

However, lead has been found to be highly toxic. This is because lead is an element with no known physiological benefit to living things. Nevertheless, it displaces other elements with very important roles in metabolic processes of living organisms. The harm lead cause to living things is aggravated by the fact that when it gets into the environment, it persists. Its persistent nature is because it is an element. Thus, it cannot be broken down or destroyed. According to (WHO 2010a), when lead finds its way into the system of animals like humans, it is distributed to the brain, liver, kidney and bones and can be stored in the blood, teeth or bones. This is to say that, when lead finds its way into the system of animals including man, it accumulates in these vital organs until certain threshold concentrations are exceeded. At this point, the toxicological effect of lead exposure begins to manifest. Lead accumulation may then result in cardiovascular problem; during pregnancy, lead exposure may cause miscarriage, still birth, low birth weights, premature births and birth defects (Blacksmith Institute, 2007). Lead has also been identified as a possible human carcinogen by the International Agency for Research in Cancer IARC, (2006). Children are even much more vulnerable to lead toxicity. This is because their body can absorb about 4 – 5 times more lead than the adult body; hence even at the lowest level, lead is toxic to children (WHO, 2010b). Put differently, adults absorb only about 5-15% of all the lead they ingest, and generally retain less than 5% of what is absorbed Juberg *et al*., (1997). However, absorption of inhaled lead is much higher, about 50%. On the other hand, children absorb much more of what they ingest. They are able to absorb approximately 30-40% of all ingested lead. The efficiency with which lead is absorbed in children may even get to 50% of all ingested lead. This difference in efficiency of lead absorption has been attributed to physiological and metabolic differences Juberg *et al*., (1997). Furthermore, the brain damage that result from lead exposure in children is irreversible and includes mental retardation, decreased Intelligence Quotient (IQ), shortened attention span, loss of executive function, increased risk of dyslexia and diminished productivity (Blacksmith Institute, 2007). The negative effect of lead exposure on humans may be better revealed by the fact that mild mental retardation and cardiovascular problem alone, caused by lead exposure have been estimated to amount to almost 1% of total global disease burden, with developing countries bearing significant portion of this burden Fewtrell *et al*., (2004). Lead exposure may ultimately culminate to death as observed in the case of lead toxicity in Zamfara State in Northern Nigeria where over one hundred and sixty three (163) people died between March and June 2010. The above causality figures include one hundred and eleven (111) children (BBC News, 4 June 2010).

The detrimental effect of elevated level of lead in the environment is not limited to animals. Plants are also affected negatively. Precisely, lead contamination has been found to cause poor growth, low yield, hinder seed germination, root elongation and seed development in plants Pourrut *et al*., (2011).

Due to the myriad of negative health and environmental effects of exposure to lead and other heavy metals, they should be and are being strictly monitored. However, unlike developing nations, developed nation have become efficient in this regard; thus, they initiated, promoted and implemented the prohibition of the use of lead in house hold utilities and as an additive in gasoline. Precisely legislative measures were gradually introduced to reduce lead exposure by removing lead from paint, food cans, water pipes and gasoline in Europe since 1970s. Leaded petrol was banned from 2000 with exception possible until 2005 (European Food safety Authority, 2012). Although the use of lead as an addictive in gasoline and other household utilities was forbidden by 2005 in most countries, demand for lead have not declined. In 2010, world mine production was estimated to be 4.1 million metric tons while world consumption of refined lead stood at 9.35 million metric tons (Murtala, 2011). Demand for lead worldwide is expected to grow. This is mainly because of increased consumption in China which is being driven by growth in the automobile market (Esteves, 2008).

In Nigeria, the realization of the economic potentials of the solid mineral sector and the decline of crude oil prices, which is the main revenue earner of the country, have made the need to diversity the nations' economy urgent. As a result of this, the Federal Government has undertaken a number of reforms within the sector in order to not only expand the nations non – oil foreign revenue, but to also attract FDI. Because of these reforms, there is significant increase in investments in the sector from not only Government Based Agencies but also from foreign and national private sector organizations. However, it is in the small scale mining category that interests and activities have grown most significantly (Lawal, 2002; Murtala, 2011). This category of Miners have been found to lack necessary capacity to initiate Environmental Protection Measures. Thus, the environmental burden of their mining activities is on the host communities rather than these Small Scale Miners (Lawal, 2002; Okeke, 2008; Murtala, 2011).

Water bodies and soil are often at risk of contamination, due to the nature of lead mining,. When this happens, local populations are invariably affected. Although, whichever the route of exposure, once lead leaks into the environment, the burden of its detrimental effect falls on living organisms, pollution of water bodies have far reaching consequences. This is because both plants and animals depend on water as a critical resource for their survival. Furthermore, lead is much more mobile in water than in soil and as result can reach sites far removed from the site of contamination when suspended in water.

Hence, there is a need for continuous monitoring and assessment to ensure not only the safety of local populations and the agricultural produce from such communities but also environmental sustainability in all mining locations in the country. This is more so as preventive measures have always been found to be better than curative measures. In fact, according to (Gould 2009), the cost-benefit ratio of implementing preventive measures against contamination and associated toxicity is better than for vaccines, which have long been described as the single most efficient global health intervention. Therefore, the aim of this study is to ascertain the presence or otherwise of lead in potable water sources in Ihieututu Community in Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria; and to determine the concentration of lead where present.

MATERIALS AND METHOD

Study Area

Ihietutu is one of the villages in Ishiagu, Ivo Local Government Area of Ebonyi in South Eastern Nigeria. It is the only community in Ishiagu where lead has being mined and is still being mined. Ishiagu is located approximately in latitude 5^o60^oN and longitude 5^o60^oN and experiences wet and dry season climate. The rainy season usually stretches from April till October while the dry season usually lasts from November to March. Maximum temperature in Ishiagu is about 32^o C while minimum temperature is about 24^o C in July.

According to 2006 National Population Census, the population of Ishiagu was 17,250 people (NPC, 2011); and the people of Ishiagu are mainly farmers. There is inadequate water supply in Ishiagu, hence Ihietutu. Therefore, the people of Ihietutu like other communities in Ishiagu depends on surface water. These stream include; Ihukoyi, Okuiyi, Isiovia, Akpuadu and Iyiokpu. There has been not less than 10 years of mining activities in the Study Area.

Sample Collection

Water samples were collected, in August 2015, from three (3) wells and five (5) rivers located in Ihietutu. The samples were collected using 500ml plastic containers. These plastic container and all glass wares used were washed with detergent solution followed by 20% nitric acid and then rinsed with tap water and distilled water. To collect the sample, the plastic containers were submerged in the river at a depth of about 5cm. One (1) sample was collected from each well, while two (2) samples were collected from each stream. One sample was collected upstream while the second sample was collected downstream for each of the streams sampled.

Sample Preservation and Equipment Used

To preserve the sample, 1ml of concentrated nitric acid was added to each 500ml of sample water collected. This was done at the earliest possible time after sample collection. Atomic Absorption Spectrophotometer was used in the assay for lead in the sample waters.

Sample Digestion Procedures

To ensure the removal of organic impurities from the samples and thus prevent interference in analysis, the samples were digested with concentrated Nitric acid. 5 mL of conc. HNO_3 was added to 100 mL of sampling water into the 250 mL conical flask then heated on a hot plate and evaporated till 20 mL was left. After cooling the flask again 5 mL of conc. HNO_3 was added and the flask heated on the hot plate. The digestion was continued till 10 mL was left and finally filtered and diluted with distilled water into 100 mL of volumetric flask and stored in the refrigerator.

Standard Preparation

The stock solution of Lead was prepared by dissolving in a liter volumetric flask 24.62g of Lead nitrate with 68% of nitric acid. The mixture was shaken and the flask made up to the 1 L mark with the nitric acid. Calibration solution of lead ion was prepared from the standard stock by serial dilution.

Sample Analysis

Analytical grade reagents and distilled water were used throughout this study. Chemicals used were obtained from RIEDEL-DE HAEN, Germany. Lead Nitrate was used for preparation of lead standard while nitric acid was used for sample digestion. The digested water samples were analyzed for the presence of lead using Atomic Absorption Spectrophotometer. The calibration plot method was used for analysis. The wave length for the determination of lead was 283.31nm. The digested samples were analyzed in triplicates with the average concentration of the metal displayed in mg/l by the instruments after extrapolation from the standard curve.

RESULTS AND DISCUSSION

Average lead concentrations in the rivers were determined as shown in table 1 above. From the result obtained, all the rivers were found to contain lead except Okuiyi whose lead concentration is below detectable limits. Average lead concentration in the contaminated rivers were 28.528 mg/l, 34.171 mg/l, 34.244mg/l and 34. 171 mg/l for Ihukoyi, Isiovia, Iyiokpu and Akpuadu respectively. From the result for the assay of lead in wells located in Ihietutu as contained in Table 2 above, all the wells tested were found to either contain no lead or lead concentrations below detectable lead range. Therefore, lead was not detected in all the samples collected from the selected wells.

Recent research has shown that some of the negative health effects of lead exposure to living organisms occur at levels of exposure that were previously considered safe (Bolger *et al*., 2000). This discovery brings to question previously accepted safe limits for lead exposure. Nevertheless, one thing is incontrovertible. Lead is harmful and once concentration of lead in the environment exceeds certain threshold, its toxic effect begins to manifest. All life forms, namely, plants, animals and microorganisms in the soil, as well as aquatic organisms, are affected negatively. In this study, lead was assayed in five (5) rivers in Ihieututu as listed in Table 1. These rivers include, Ihikoyi, Okuiyi, Isiovia, Iyiokpu and Akpuadu. Lead was also assayed in three (3) wells located in Ihieututu.

Four of these five rivers, namely; Ihikoyi, Isiovia Iyiokpu and Akpuadu were found to be heavily contaminated with lead. Average lead concentration in these rivers ranged from 28.528, 34.171, 34.244 and 34.171 mg / l for Ihikoyi, Isiovia Iyiokpu and Akpuadu respectively. Lead concentration in these rivers exceeded the minimum acceptable lead concentration in portable water [1]. However, lead was not found in the water sample collected from wells sank in this community. The implication of this is that lead contamination is still limited to the surface waters only. Hence, underground water in the locality is still safe as a source of potable water. Contamination of these rivers are likely a product of mining. This is more so as the community is a rural community with no major highway and low vehicular traffic. There is also no presence of industries except for the mining industry.

Since the people of the community depend on these rivers for agricultural purposes, including fishing; and as sources of potable water, this will have far-reaching impact on the wellbeing of the people and the environment. Precisely, on the micro-environment, it will lead to poor plant yield and decreased animal productivity. Considering the high volume of annual rainfall and the nature of soils in South Eastern Nigeria which is prone to erosion, the poor plant yield and hence poor plant cover that result from lead leakage into the environment will

also lead to increased erosion in the area. This will invariably lead to increased mobility of the contaminant. Lead concentrations were found to exceed minimum acceptable limits. As a result of this, humans within the locality, especially those who depend on these rivers as their means of potable water, may also be exposed to the chronic hazards of lead ingestion.
On the macro-scale, decreased plant yield which may be observed in the micro-environment as a result of lead toxicity may aggravate global warming. This is because; there will be increased escape of greenhouse gases like carbon dioxide into the atmosphere. These gases would have been hitherto trapped by these plants and converted to useful biomass.

CONCLUSION AND RECOMMENDATION

From the result obtained 80% of the surface waters source in Ihietutu was found to be contaminated with lead. However, lead was found not to have percolated to underground waters in the area. This could be attributed to the tendency of lead to adsorb tightly to soil particles. The above view is supported by the assertion of UNEP (2011) that as a result of this tight adsorption of lead to soil, groundwater is not at high risk from lead infiltration through topsoil although heavily contaminated sites may pollute localized groundwater especially in acidified conditions. It is necessary to put measure in place to prevent further contamination while the people should be enlightened on the dangers of continued use of the contaminated rivers as potable water sources. As an alternative, more boreholes and wells should be sank in the community. Again, it is essential that local populations, especially young children, living in the community undergo medical assessment to determine the amount of lead in their blood. This will enable the commencement of treatment and remediation regimes where necessary.

Table 1: Average concentration of lead in samples collected from the five (5) streams located in Ihieututu

	Sample	Lead Concentration (mg / l)		
		Upstream	Downstream	Average ± SEM
1.	Ihikoyi	27.822	29.233	28.528 ± 0.998
2.	Okuiyi	0.000 (ND)	0.000 (ND)	0.000 ± 0.000
3.	Isiovia	32.054	36.287	34.171 ± 2.993
4.	Iyiokpu	32.054	36.287	34.171 ± 2.993
5.	Akpuadu	34.876	33.465	34.171 ± 0.998

ND: Not Detected

Table 2: Result obtained from the assay for lead in water samples collected from three (3) different wells located in Ihietutu

	Sample	Absorbance	SD	RSD	Concentration (mg / l)
1.	Well 1	- 0.156	0.0015	- 0.9349	0.000 (ND)
2.	Well 2	- 0.155	0.0038	- 2.4225	0.000 (ND)
3.	Well 3	- 0.156	0.0024	- 1.5128	0.000 (ND)

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EFFECT OF VEGETATION AGE ON CARBON SEQUESTRATION IN SELECTED SOILS OF SOUTH EASTERN NIGERIA

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ABSTRACT

Changes in agricultural land use patterns influence how much and at what rate carbon is sequestrated in or released from soil. Carbon sequestration was investigated in three soil vegetation ages (7 years vegetation age, 14 years vegetation and 21 years vegetation age. From the results, sand contents ranged from 835.2 – 889.2g/kg, clay content ranged from 92.6 – 122.6g/kg. Organic carbon content was generally low ranging from 3.99 – 5.67g/kg. Carbon sequestration ranged from 1295 – 1611gcm^{-2}. Carbon sequestration result therefore showed that 14 years vegetation sequestered the highest amount of carbon with value of (1611gcm^{-2}) while the least was obtained 7 years vegetation age. It was observed that vegetation age do not have any bad effect on the carbon sequestration. Therefore, I recommend that attention should be given to soils of South Eastern Nigeria on rates at which carbon is sequestered in them for optimum carbon accumulation to be ascertained in Agricultural activities and production.

Keywords: carbon sequestration, soils, vegetation age, effect

INTRODUCTION

Carbon in agricultural soil contributes positively to soil fertility, crop production and overall soil sustainability (Lal, 1999). Carbon is one of the non-mineral elements or nutrient element needed by plants for the completion of their life cycle (Hodges 2002). Carbon is gotten from air by plants during the process of photosynthesis and it is found in all living organisms and also the major building block for life on earth and as well found in vegetation as plants biomass and in soil as soil organic matters (Ecological Society of America 2006). Soils are important reservoirs of active organic components such as carbon and it plays a great role in the global cycle of the element and such, soil can be either as source or sink for atmospheric CO_2 depending on land use and management of soil and vegetation (Lal, 2005). Over 60% of the world's carbon is held in both soils and more than 40% and the atmosphere as carbon dioxide; 20% (Stevenson, 1994).

Carbon sequestration is the active removal of carbon from the atmosphere and depositing it in a reservoir. Carbon sequestration is the long term capture that occurs in biomass, soil, oceans, and underground sinks such as aquifers, saline deposits, and gas reserves (Lal 2004). Carbon can be stored in the soil as soil organic matter and soil organic matter is a complex mixture of carbon compounds consisting of decomposing plants and animal tissue, microbes, protozoa, nematodes, fungi, bacteria, (Ecological Society of America, 2006). Since soils differ in their responses to different land use practices and management system, it is important to investigate more closely the influence of agricultural land use practices on carbon sequestration. Therefore, a good knowledge of carbon sequestration and storage in soils is important for development in soil and reducing its adverse effects. More so, this study tends to determine the effects of vegetation age on carbon sequestration in soil of South Eastern Nigeria. The objective is to determine the effect of vegetation age on carbon sequestration and to determine the physio-chemical properties of the soil of the study area.

MATERIAL AND METHODS

Study Area

The study was carried out at Eziudo in Ezinihitte Mbaise Local Government Area of Imo State, South-Eastern Nigeria. The area lies between latitude $5^0$28' and $5^0$41'N and longitude $7^0$20' and $7^0$48'E with an altitude of 143m. The mean annual temperature range of the study area is 27^0c – 30^0c with the hottest period been between February and April (Ofomata, 1975). The parent material is coastal plain sands (Ofomata, 1975). Farming is the major socio-economic activity of the area.

Pre-field study

Reconnaissance visit was conducted on the study sites and information was gathered from the farmers and land owners through oral interview to find out the number of years the land has remained under its current land use.

Soil sampling and laboratory analysis

A profile pit was dug in each of the three different vegetation ages (7 years, 14 years, 21 years) respectively. Soil samples were collected from the profile pits in each of the three different vegetation age ranging from 0 – 20, 20 – 40, 40 – 60, 60 – 80 and 80 – 100cm. The samples were bulked, taken to the laboratory, air dried sieved using 2mm sieve and used for determination of some physical and chemical properties following procedures outlined by FAO (2002). Carbon sequestration (gCm^{-2}) was calculated using $OCgkg^{-1}$ x $BDgcm^{-3}$ x Horizon thick (Batjes 1996).

Experimental design

The experiment was a factional experiment arrange in randomized complete block. Design (RCBD) with two (2) treatment land use and age.

Data Analysis – Data obtained where subjected to ANOVA. Significant means were separated using LSD at 5% (0.05) probability. Level.

RESULTS AND DISCUSSION

Soil physical properties

The sand content of the varying vegetation ages ranged from 835.2 – 889.2gkg^{-1}. Silt and clay content ranged from 18.2 – 57.2gkg^{-1} and 92.6 – 122.6 gkg^{-1} respectively. However, sand contents of the three vegetation ages differed significantly ($P \leq 0.05$) while no significant differences. were observed in the silt and clay fractions of the three vegetation ages (Table 1). From the results, it was observed that vegetation age had little or no influence on the particle size or fraction of the soil. This observation agrees with the findings of Ahukaemere *et al* (2015).
The Bulk density values ranged from 1.44gcm^{-3} in 7 year old vegetation to 1.64gcm^{-3} in 21 year old vegetation. Significant different or variable was recorded or obtained in the Bulk density values of the soils investigated or studied. In view of this, age of vegetation has significant effect on soil compaction. Generally, the Bulk density values obtained from this study were low compared to the critical limit of 1.75 – 1.80gcm^{-3} of soil survey Staff (2003) where root restriction can occur.

Chemical Properties of the Studied Area

pH and TN

Result of the chemical properties of the studied soil are shown in Table 2, result shows that the P^H ranges from 5.11 – 5.70 respectively. It was observed that the highest value was obtained in 14 years vegetation age and the lowest in 7 years vegetation age and this low value obtained in 7 years vegetation may be as a result of the acidic condition of the soil Silver *et al*, (1994).
Total nitrogen of the soil ranged from 0.356 – 0.494g/km^2 in vegetation ages, significantly ($P < 0.05$) higher value (0.494g/cm^2) was recorded for total nitrogen in 14 years vegetation and 7 years vegetation ages respectively. According to (Landon 1991), these values were rated low (< 0.1%) to medium (0.2 – 0.5%) irrespective of the vegetation ages. Management practices that maintain or slightly increase soil nitrogen such as grazing (Burke *et al*, 1999, Verchot *et al*, 2002), will likely result in limited carbon sequestration, management practice that reduces soil nitrogen will result in net carbon losses from the system as a result of proliferation of microbial population under such condition.

Organic Carbon and Carbon Sequestration

The result of organic carbon and carbon sequestration content of the soils is shown on table 3. From the result, OC ranged between 3.99 and 5.67g/kg^{-1}. From the result, it was observed that the organic carbon content of the studied vegetation ages did not differ significantly and it can be as a result of the mitigating the effects of anthropogenic carbon emissions (Lal, 2004). However, carbon sequestration range from 1295gcm^2 – 1611gcm^2 in 7 years, 14 years, and 21 years vegetation ages respectively. These values of carbon sequestration are not contrary to the findings of Clark *et al*; (2004) who reported that older forest sequester less carbon than younger ones. This trend in reduction in carbon sequestration of the soil profile is consistent with the understanding that the ecosystem will reach a steady state, and a change in management and in inputs would be required to sequester additional carbon (Conant *et al*; 2001, Swift; 2001).

Effect of Vegetation age on Carbon Sequestration

Carbon stored in forest ecosystem depends fundamentally on forest age and management practices (Post and Kwon, 2000; Paul *et al*, 1997; Pregitzer and Euskirchen, 2004). As shown in Table 4 .The highest (5.67gkg^{-1}) organic carbon content was recorded in 14 years vegetation age followed by 7 years (4.19gkg^{-1}) and 21 years. Vegetation (3.99gkg^{-1}) vegetation ages respectively. As expected carbon sequestration followed similar trends with organic carbon. The highest (1611.40gcm^2) was recorded in 14 years vegetation age followed by 21 years (1302gcm^2) and 7 years (1295gcm^2). The findings of this study was in disagreement with the works of Clark *et al* (2003) who recorded higher carbon sequestration in young stands compared to the order stands.

CONCLUSION

This study was done to determine the effects of vegetation age on carbon sequestration in the soils of South Easter, Nigeria. This was done because soil organic carbon plays important roles in soils as good knowledge of carbon sequestration in soils is important for the management and reducing the adverse effects of carbon in the atmosphere.

Table 1: Physical Properties of the Studied Soils

Veg. Age	Sand (g/kg)	Silt (g/kg)	Clay (g/kg)	MC %	BD (g/kg)	TP %	SCR
7	889.2	18.2	92.6	8.29	1.56	40.34	0.19
14	845.2	32.2	122.6	9.95	1.44	43.87	0.14
21	835.2	57.2	107.6	9.91	1.64	31.89	0.57
LSD	53.29	NS	NS	NS	0.10	3.61	0.35

Table 2: Some Chemical Properties of Soil studied soils

	PH (H2O)	TNg/cm2	AVP (PPM)	CN g/cm2
7 years	5.116	0.366	14.3	11.46
14 years	5.704	0.494	12.74	11.46
21 years	5.436	0.356	20.3	11.22
LSD	0.29	NS	NS	NS

Table 3: Organic Carbon and Carbon sequestration

Fallow age	(g/kg)	(Seq. g/cm^{-2})
7 years	4.19	1295
14 years	5.67	1611
21 years	3.99	1302
LSD	NS	NS

Table 4: **Effect of Vegetation age on carbon sequestration**

Fallow Age	Organic Carbon (g/kg)	Carbon sequestration gcm^3
7 years	4.19	1295.00
14 years	5.67	1611.40
21 years	3.99	1302.00
LSD 0.05	0.59	201.09

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FERTILITY EVALUATION OF SOILS OF RUBBER PLANTATIONS IN THE COASTAL PLAINS SAND, IMO STATE

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ABSTRACT
Study evaluated soils of Rubber plantations in the coastal plains sand, Imo State, based on fertility. Plantations were found on Alluvium, Delta and Coastal plains sand. Using physico-chemical properties, the soils generally rated between 39.4% (S_3) and 52.3% (S_2), with most being moderately suitable. The main limiting factors were texture (clay content), OM, ECEC, TN, K. Site on Delta, which soil was classified as Oxyaquic Paleudult or Haplic Ferralsols rated best.
Keywords: fertility, soils, coastal plains sands, rubber

INTRODUCTION
Rubber (*Hevea brasiliensis*) is a tropical crop with high industrial value. Komolafe et al (1979) record that products such as tyres, foam cashions, raincoasts etc are made from it. With the downturn in Nigeria's economy resulting from low prices and production of crude oil, Rubber is one of the cash crops to invest in so as to diversify the economy.
Asawalam and Ugwa (1993) as well as Ugwa et al (2006) evaluated the lands of rubber-growing belt of Nigeria and found low fertility of the soils as the main limitations to the cultivation of rubber plant. These studies were generalized and did not cover local variations of soils.
Rubber plantations are supported by different soils in the coastal plains sand of Imo State. With input requirement being a consideration in land evaluation (FAO, 1976), it is yet to be seen how varying fertility potentials of soils of location of study could influence their suitability ratings for rubber cultivation. The study thus evaluated soils of rubber plantations in the coastal plains sand of Imo State.

MATERIALS AND METHODS
The coastal plains sand of Imo State is within Lat. $5^0 15^| N$ and $5^0 45^| N$, and Long $7^0 30^| E$ and $6^0 45^| E$. It has mean annual temperature of 27^0-28^0C (80^0-82^0F) (Monanu, 1975a); total annual rainfall of 2250-250mm, with three dry months (Monanu, 1975b). The vegetation is rainforest which is dominated by oilpalms (*Elaeis guineensis*) and dominant geology/parent material is coastal plains sand, as shown by table 1.
Sites of rubber plantations in the location of study were identified and located by free survey technique. Soil samples were taken from a quarter of an hectare within each of the six sites as indicated in table 1. Five samples, spread the entire area sampled, were taken from each of 0-20cm and 20-40cm depths and bulked, such that each site had a bulked sample for each depth. A total of twelve (12) bulked samples were thus taken for laboratory analyses.
Samples were air-dried and sieved with a sieve of 2mm mesh size. Using standard routine analyses procedures as documented by Udo et al (2009) the following parameters were determined – particle sizes, pH, Organic Carbon/Organic matter, total nitrogen, Available phosphorus, Exchangeable bases, Exch. Acidity, Effective cation Exchange Capacity (ECEC), Base saturation (BS). The micronutrients (Fe, Cu, Zn, Pb, Mn) were determined using Atomic Absorption Spectrometry.
Soil parameters were rated based on critical values recorded in literature. Productivity/suitability rating indices of parameters and soils were expressed as percentage of their optimal rates using an adaptation of the scheme by Jasbir et al. (1988) given as:

$$\frac{\text{Actual rating}}{\text{Optimal rating}} \text{x} \, 100$$

Suitability rating index values were referred to the rating scale of Dent and Young (1981) to determine the suitability class of parameters and soils.

RESULTS AND DISCUSSION
Rubber plantations were found on different soils (table 1) in the location, namely – Alluvium, Subrecent Alluvium, Colluvium, Coastal plains sand. The classes of soils are as shown on table 1. Physico-chemical properties of the soils are given in tables 2 & 3, while their productivity rating are given in table 4.

Textural classes of soils at topsoil are sand, loamy sand, sandy loam and sandy clay loam; while at the subsoil they are loamy sand, sandy loam, and sandy clay loam. Soils textures are optimal at sites 4, 5 and 6 where they have rated S_1 (highly suitable) and S_2 (moderately suitable) on the basis of clay content taking 35% as optimal (Sys, 1975). The rest of the sites have rated either marginally suitable or not suitable. With drought resistance being low for rubber (Young, 1976), higher clay content for the generally sandy soils will obviously improve moisture content as well as fertility. With OM contents ranging between 0.79-4.88g/kg it is low and generally rates not suitable (N). This is attributed to high rate of decomposition. With soils' pH ranging between 4.2 and 5.7, the soils are generally strongly acidic. Using an optimal pH of 5.3 (Young, 1976), the soils' pH values have rated S_1 (highly suitable) in all cases. This agrees with Watson (1989) who notes Hevea to grow well on acid soils. With ECEC values ranging between 4.6cmol/kg and 9.7cmol/kg, which values are low, they reflect dominance of 1:1 type of clay and low ability to retain nutrients. Both exch. Ca & Mg are generally not deficient in the soils. Of all the bases, only K is limiting as it has rated mainly between S_2 & S_3 using 0.25me/100g as optimal value. With values ranging between 25% and 80%, most of the soils have rated moderately suitable (S_2) in terms of Base saturation (BS). Using the value of 0.15% as optimal, total nitrogen contents of the soils have rated not suitable (N) in all sites. Using 25mg/kg as optimal, av.P has rated moderately suitable in most cases.

The main issues with the micro-nutrient elements are the possibilities of Fe toxicities in sites 1,2,5,6, and those of Mn in sites 3&4.

From table 4, the main factors limiting fertility potentials of the soils and ofcourse their stabilities for rubber cultivation are clay content (texture), OM, ECEC, TN, K. The soils' productivity ratings ranged between 39.4% (S_3) and 52.3% (S_2).

Average ratings of the soils are in the order, site 5>4>1>2=6>3, with most rating moderately suitable (S_2). The higher the rating the less the amount of inputs required.

CONCLUSION

Rubber plantations were found on different soil units of the coastal plains of Imo State namely, Alluvium in the river valleys, colluvium on slopes, subrecent alluvium in the Delta, and the well drained flat coastal plains sand. Most of the soils have rated moderately suitable (S_2) in terms of fertility with the main limitations being texture, OM, ECEC, TN, K. The range of suitability ratings of the soils is narrow.

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Table 1: Descriptions of Sites Sampled

					Soil Classification		
S/N	Site	L.G.A.	Physiography	Parent Material	USDA	FAO	Landuse
1.	Ngbele	Oguta	River Valley	Alluvium	Fluvaquentic Eutrudepts	Gleyic Fluvisol	Rubber Plantation
2.	Ngbele	Oguta	Slope	Colluvium	Typic Paleudult	Haplic Ferralsols	Rubber Plantation
3.	Opuoma	Ohaji/Egbema	Deltaic Plain	Subrecent Alluvium	Oxyaquic Paleudult	Haplic Ferralsols	Rubber Plantation
4.	Ulakwo	Ngor-Okpala	Coastal Plain	Coastal Plains Sand	Typic Kandiudult	Haplic Ferralsols	Rubber Plantation
5.	Oguta	Oguta	Deltaic Plain	Subrecent Alluvium	Oxyaquic Paleudult	Haplic Ferralsols	Rubber Plantation
6.	Emeabiam	Owerri-West	Coastal Plain	Coastal Plains Sand	Fluvaquentic Eutrudepts	Arenic Gleysols	Rubber Plantation

Table 2: Physico-Chemical Properties of Soils

Site	Sampling	Particle Size Distribution (%)			Text.	pH	Exch. Bases													
	Depth	Sand	Silt	Clay	Class	(H_2O)	Ca^{++}	Mg^{++}	K^+	Na^+	Al^{3+}	H^+	Al+H	ECEC	B.S.	ESP	Al-Sat.	OM	TN	Av.P
	(cm)							(cmol/kg)							(%)			(g/kg)	(g/kg)	(mg/kg)
1.	0 – 20	83	9	8	LS	4.6	2.0	4.8	0.32	0.29	1.04	1.2	2.24	9.7	77	2.99	10.72	4.88	0.07	18.0
	20 – 40	84	5	11	LS	4.8	2.0	1.2	0.08	0.16	0.20	1.0	1.2	4.6	74	3.48	4.35	1.14	0.01	15.0
2.	0 – 20	90	4	6	S	4.7	2.4	3.6	0.12	0.13	0.8	1.2	2.0	8.3	76	1.57	9.64	2.16	0.03	15.0
	20 – 40	86	5	9	LS	4.2	2.0	3.2	0.11	0.25	0.48	0.88	1.36	6.9	80	3.62	6.96	1.02	0.03	15.0
3.	0 – 20	80	14	6	LS	5.7	2.4	0.8	0.09	0.14	0.44	1.0	1.44	4.9	70	2.86	8.98	1.02	0.04	16.0
	20 – 40	74	17	9	SL	4.9	2.8	2.0	0.11	0.13	0.84	1.0	1.84	6.9	73	1.88	12.17	0.88	0.01	12.0
4.	0 – 20	78	9	13	SL	4.6	1.2	0.8	0.2	0.08	0.72	2.56	3.28	5.6	41	1.43	12.86	2.19	0.05	17.0
	20 – 40	70	3	27	SCL	4.3	2.8	0.8	0.05	0.21	0.96	0.96	1.92	5.8	67	3.62	16.55	1.12	0.13	35.0
5.	0 – 20	52	27	21	SCL	4.9	2.8	0.4	0.13	0.2	1.12	1.84	2.96	6.4	54	3.13	17.5	2.24	0.03	37.0
	20 – 40	46	25	29	SCL	5.0	2.4	1.2	0.06	0.17	0.56	2.64	3.2	7.0	54	2.43	8.0	0.79	0.07	28.0
6.	0 – 20	73	10	17	SL	5.0	1.2	0.4	0.17	0.09	1.52	4.24	5.76	7.6	24	1.18	20.0	3.07	0.08	24.0
	20 – 40	72	7	21	SCL	4.9	1.2	0.8	0.08	0.03	1.04	2.96	4.0	6.1	35	0.49	17.05	2.0	0.07	6.5

Key: S = Sand; LS = Loamy Sand; SL = Sandy Loam; SCL = Sandy Clay Loam

Table 3: Topsoil contents of some Micronutrient Elements at the sites

Site	Fe	Cu	Zn	Pb	Mn
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1.	90.2	0.6	0.9	0.9	3.0
2.	51.7	0.3	0.5	0	1.7
3.	37.3	0.3	1.0	2.3	118.5
4.	0	0.6	1.5	1.8	52.1
5.	135.3	0.7	0.7	2.6	15.5
6.	90.4	0.4	0.3	1.7	4.5

Table 4: Productivity Rating of Parameters given as percentages of their Optimal Rate and their Suitability Classes

									Average Rating of Soils		
Site	**Depth (cm)**	**Clay**	**OM**	**pH**	**ECEC**	**K**	**BS**	**TN**	**Av.P**	**A**	**B**
1.	0 – 20	22.9(S_3)	4.8(N)	86.8(S_1)	38.8(S_3)	128(S_1)	77(S_2)	4.67(N)	72(S_2)	54.4(S_2)	
	20 - 40	31.4(S_3)	1.14(N)	90.6(S_1)	18.4(N)	32(S_3)	74(S_2)	0.67(N)	60(S_2)	38.5(S_3)	46.5(S_2)
2.	0 – 20	17.1(N)	2.16(N)	88.7(S_1)	33.2(S_3)	48(S_2)	76(S_2)	2.0(N)	60(S_2)	40.9(S_2)	
	20 - 40	25.7(S_3)	1.02(N)	79.3(S_2)	27.6(S_3)	44(S_2)	80(S_2)	2.0(N)	60(S_2)	40.0(S_3)	40.5(S_2)
3.	0 – 20	17.1(N)	1.02(N)	107.5(S_1)	19.6(N)	36(S_3)	70(S_2)	2.67(N)	64(S_2)	39.7(S_3)	
	20 - 40	25.7(S_3)	0.88(N)	92.5(S_1)	27.6(S_3)	44(S_2)	73(S_2)	0.67(N)	48(S_3)	39.0(S_3)	39.4(S_2)
4.	0 – 20	37.1(S_3)	2.19(N)	86.8(S_1)	22.4(S_3)	80(S_2)	41(S_2)	3.33(N)	68(S_2)	42.6(S_2)	
	20 - 40	77.1(S_2)	1.12(N)	81.1(S_1)	23.2(S_3)	20(S_3)	67(S_2)	8.67(N)	140(S_1)	52.3(S_2)	47.5(S_2)
5.	0 – 20	60.0(S_2)	2.24(N)	92.5(S_1)	25.6(S_3)	52(S_2)	54(S_2)	2.0(N)	148(S_1)	54.5(S_2)	
	20 - 40	82.9(S_1)	0.79(N)	94.3(S_1)	28.0(S_3)	24(S_3)	54(S_2)	4.67(N)	112(S_1)	50.1(S_2)	52.3(S_2)
6.	0 – 20	48.6(S_2)	3.07(N)	94.3(S_1)	30.4(S_3)	68(S_2)	25(S_3)	5.33(N)	96(S_1)	46.3(S_2)	
	20 - 40	60.1(S_2)	2.0(N)	92.5(S_1)	24.4(S_3)	32(S_3)	35(S_3)	4.67(N)	26(S_3)	34.6(S_3)	40.5(S_2)

A = Average rating of soils for each of the depths
B = Average rating of soils for both depths.

ECONOMIC DIVERSIFICATION: THE AGRICULTURE ROAD MAP

AGRICULTURAL SOCIETY OF NIGERIA

SUB-THEME XIII:

AGRICULTURAL MECHANIZATION

PERCEIVED SOCIO-ECONOMIC IMPACT OF TIGA DAM BY IRRIGATION FARMERS IN KURA LOCAL GOVERNMENT AREA OF KANO STATE

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ABSTRACT
Tiga Dam was built in an attempt to improve food security through irrigation project. The study therefore investigated the socio-economic impacts of the Dam as perceived by farmers in Kura Local Government area of Kano State. A random sample of One Hundred and Ten (110) irrigation farmers in Kura Local Government Area was used for the study. Findings from the study shows that majority of the farmers are males; 87.3% who are subsistence farmer. More than half of the farmers; 59.1% recorded an improvement in farm yield. Few of the farmers (34.5%) reported reduction in water flow to the tribute while 61.8% claimed it has provided them with social amenities. Involvement of farmers in livestock farming and fish production is rather low among the farmers which might be a contributory factor to the claim of job opportunities by the Dam. The study revealed that construction of Dams has brought displacement of some farmers (70.9%) most of whom were not adequately compensated (68.2%). It is therefore recommended that farmers should be enlightened more on the need to imbibe integrating crop farming with other agricultural enterprises, provided with sufficient farming lands and ensure adequate flow of water in the irrigation channels. Readdressing compensation of the displaced farmers will ensure prosperity and development of the area.
Key words: Irrigation farming, socio-economic Impact, Improved livelihood

INTRODUCTION

The importance of water resources in the socio-economic development of any nation cannot be over emphasized. Water is essential for economic growth, human health and environment with agriculture being the major user in most countries. Increasing need of water upon agricultural development may be met by intensive and extensive use of available water resources. An assumed and regulated supply of agricultural water for ground and surface resource is the basic and essential aspect upon which any future planning of irrigation depends. According to Basak (2009), the main purpose of water resource management includes industrial water supply, irrigation, and flood control among others.

Irrigation has been defined as the application of water to the soil for the purpose of supplying moisture essential for plant growth. It is also undertaken to provide an insurance against droughts, for cooling the soil and atmosphere. It equally provides a more favourable environment for plant growth (Mohammed, 2002). Irrigated agriculture has expanded enormously over the past five decades resulting from a revolution in irrigation development. One of the goals of irrigation farming is the provision of right amount of water at the right time for plant growth and development. Consequently, it ensures sustainable agriculture with its economic benefits. Globally, massive investments have been made in the development of irrigation scheme. In Nigeria, according to NINCID (2009), recent survey suggest that 39% of the land mass is potentially suitable for agriculture and out of this between 4.0 and 4.5 million ha (approximately 4.5 to 5.0%of the land) are judged suitable for irrigated agriculture but only 1.1 million ha can be supported fully by the water available, the remaining 3.4 million ha being Fadama. The benefit of irrigation (which is the artificial supply of water for agricultural crop growth) in Nigeria is not limited to food supply alone but it also serves as a source of income and employment during the slack period of rain-fed agriculture.

Tiga Dam was constructed in an attempt to improve food security through irrigation project schemes. It covers an area of 178 square kilometers with about 2000 cubic meters. Water from the Dam supplies the Kano river irrigation project as well as Kano city (African Research Review, 2008). Despite the significant contribution of irrigated agriculture to increasing food production and to overall socio-economic development, irrigation has come under increasing criticism over the past decade for concerns such as socio-economic inequity, social disruptions and environmental changes that are attributed to irrigation development and reservoir construction. The paper aims at finding out the socio- economic impact of Tiga Dam on the irrigation farmers in Kura Local Government Area of Kano State. Specifically the study aimed to: (i) identify the socio- demographic characteristics of irrigation farmers in the study area; (ii) examine the socio-economic impact of Tiga Dam on the irrigation farmers.

MATERIAL AND METHODS

The study was conducted in Kura Local Government area of Kano state of Nigeria. Kura is bordered by Madobi L.G.A on the west, Garun Malam in the west, Dawakin Kudu in the North and Bunkure in the south. Questionnaire was used in collecting data from three wards in the study area (Karfi, Imawa, Bauren Tanko). A total sample of 110 farmers ware randomly selected. Descriptive statistics (frequency count and percentage count) was used for the analysis.

RESULTS AND DISCUSSION

Table I above shows that majority of the respondent are married (81.8%) and 87.3% are males while few 12.7% of the respondent belong to the female gender. This is consistent with Salisu (2001) and Adeoti (2006) who reported that more men were found in farming than women and that irrigation is majorly a male affair in Northern Nigeria. Most of the farmers; 45.5% are found within the age group of 41 and 50years of age. Farmers in their reproductive age cover 30% (31-40years) of the respondents. About 35% of the respondents have passed through secondary education which is closely followed by 29.1% who claimed quranic education as their maximum exposure of education. The farmers in the study area can be refer to as small scale farmers as more than half of the respondents;54.6% have a farm size of 1-2acres of land while 50.9% claimed to have access to their farmland through inheritance.

Table II shows the impact of the Dam as perceived by the respondents. More than half of the respondents rated their farm yield using the irrigation as having experience an increment as 59.1% of them claimed an improvement in crop yield. Agrarian revolution in Nigeria is incomplete without due recognition of the socio-economic implication of irrigation. It is therefore obvious that socio – economic benefit are important features of Irrigation projects which promotes maximum yield per hectare. A few percentages of the respondents are practicing fish farming (21.8%) while a huge percent; 78.2% are not fish farmers. The same trend was recorded in livestock farming, where farmers who are not involve in livestock farming (70.9%) are too huge compared to those who raise livestock as a result of the presence of the Dam (29.1%).According to the respondents, the Dam has done well in the area of provision of social amenities as claimed by 61.8 percent of the farmers while 38.2 percent said it has made provision for employment in the area. Some of the respondents; 34.5% complained of reduction of water flow to the irrigation channels which resulted in reduction of their farming activities. Majority of the farmers; 70.9% passed through resettlement due to the construction of the Dam, out of which only 31.8% are adequately compensated.

CONCLUSION AND RECOMMENDATIONS

This study revealed that majority of the respondents in the study area is youths whose views and assessment of the irrigation scheme brought about by the existence of Tiga Dam should be reliable. The characteristic gender composition of the respondents describes a typical rural community in northern Nigeria where men are the ones majorly engaged in farming while women are expected to remain at home for the domestic activities.

The revelation made by most of the respondents on their recorded improved yield as result of the irrigation facilities is an indicator of positive impact of the Tiga Dam on their economic and as well as social developments. Another aspect of perceived improvement is the involvement of some farmers in fish farming and livestock husbandry. These enterprises are expected to create diversification of business and thereby making farmers actively engaged in productive activities throughout the year. The few proportion of respondents involved in these mixed farming systems may be linked with inadequate awareness or possibly small size holdings of farm lands in vogue among farmers of the area.

The existence of the Dam is noted to bring about development of social amenities and job creations even though most of the respondents are not satisfied for not been compensated after been displaced from their homes and farm lands to give way for the irrigation scheme.

On the basis of the findings of the findings, the study suggests fostering good relationship between government and the farming communities and make way for real agricultural development in the area .

TABLE 1: **Socio-economic characteristics of Respondents**

Characteristics	Frequency	Percentages (%)
Sex		
Male	96	87.3
Female	14	12.7
Age		
20-30yrs	24	21.8
31-40yrs	33	30.0
41-50yrs	50	45.5
>50yrs	3	2.7
Marital Status		
Single	6	5.5
Married	90	81.8
Divorced	6	5.5
Widow	8	7.2
Educational Level		
Quranic education	32	29.1
Primary Education	24	21.8
Secondary Education	38	34.6
Post secondary	16	14.5
Farm Size		
1-2ha.	60	54.6
3-4ha.	36	32.7
>4ha.	14	12.7
Land Acquisition		
Rent/lease	6	5.5
Inheritance	56	50.9
Purchase	48	43.6

Source: Field Survey 2013

Table II: Socio economic Impact of Tiga Dam on the Farmers.

Perceived Impact	Frequency	Percentage
Assessment rating of farm yield		
Improvement	65	59.1
No Improvement	45	40.9
Total	110	100.0
Involvement in Fish Farming		
Yes	24	21.8
No	86	78.2
Total	110	100.0
Involvement in Livestock farming		
Yes	32	29.1
No	78	70.9
Total	110	100.0
Benefit from the Dam		
Employment Opportunities	42	38.2
Social amenities	68	61.8
Total	110	100.0
Reduction of water- flow in the channels.		
Yes	38	34.5
No	72	65.5
Total	110	100.0
Resettlement due to Dam Construction		
Affected	78	70.9
Not Affected	32	29.1
Total	110	100.0
Compensation after resettlement		
Adequately compensated	35	31.8
Not adequately compensated	75	68.2
Total	110	100.0

Source: Field Survey 2013

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AGRICULTURAL MECHANIZATION: A PANACEA TO NIGERIAN ECONOMIC AND INDUSTRIAL DEVELOPMENT

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ABSTRACT
The need for mechanization of Agriculture in Nigeria and West Africa has become more acute in recent years due to the urgent need to accelerate food and fiber production for the teeming urban and rural population. This study explored empirically the role of Agricultural mechanization in the development of Nigerian economic and industrial development. The problems of Agricultural mechanization were identified and probable solution was discussed. The benefits of agricultural mechanization were highlighted. The level of mechanization in Nigeria was also discussed and its impact analyzed.
Keywords: Mechanization, economic development, Nigeria

INTRODUCTION
Food security is a major concern in many parts of the world including West Africa, and Nigeria in particular. Of the 98.3million hectares of Nigeria's arable land-mass,72% of this has cultivation potential but only 35% of the arable land is under actual cultivation. Despite the high proportion of cultivated landmass relative to the total available space, food production to feed the teeming populace has remained a mirage with the advent of commercial oil exploration in the early 1970s (Adamade and Jackson 2014). Agriculture has the potential to stimulate economic growth through provision of raw materials, food, jobs and increase financial stability. In Nigeria, agriculture remains the most basic part of the economy, since it is the largest sector in terms of share in employment.

Agriculture is an important occupation in Nigeria with over 70% of her population depending on it directly or indirectly for livelihood. It provides the bulk of employment, income and food for the rapidly growing population as well as supplying raw materials for agro-based industries. World current agricultural production has an average growth rate of 1.8% as compared to the 3% in the 1960s and therefore at a lesser pace than the demographic growth (Asoegwu and Asoegwu, 2007). However, agricultural holdings are generally small and scattered; farming is often of the subsistence variety, characterized by simple tools and shifting cultivation Large-scale agriculture, however, is not common. "The man with the hoe" still remains an apt description of the Nigerian farmer today. The Nigerian agricultural industry, populated as it is by aged and ageing peasants, has progressively developed into a world of drudgery for losers, shunned and despised by Nigerian youths. In spite of decades of immense expenditures and investments into agriculture, in terms of money, men and materials, by national and international governments and agencies, the average Nigerian farmer remains an indigent serf, regarded by today's youths as a dreadful anachronism (Odigboh, 2000).

The need for mechanization of Agriculture in Nigeria and West Africa has become more acute in recent years due to the urgent need to accelerate food and fibre production for the teeming urban and rural population. Pellizzi (1992) summarized the primary objective of agricultural mechanization as: to minimize production cost, optimize protect quality, product the environment and minimize farm production flexibility. In simple terms agricultural mechanization is the process whereby equipment, machineries and implements are utilized to boost agricultural and food production.

Agricultural mechanization is an enterprise that creates wealth and youth empowerment in which one litre of palm oil or groundnut oil is more expensive than one litre of petrol or diesel in Nigeria. It has the potential to stimulate economic growth through provision of raw materials, food, jobs and increase financial stability. Mechanization of agriculture helped transform American agriculture from the situation where one farmer fed 5 people in 1880 to that where one farmer could feed 80 people in 1982 (Ani and Onwualu, 2002). With 90% of Nigeria's agricultural work done with hand tools, 7% with animal-drawn tools and only 3% with engine powered technology, it is understandable that with the over 70% of the population engaged in agriculture, self-sufficiency in food still a mirage (Onwualu and Pawa, 2004). In future, Nigeria would become the third most populous country in the world, and through better understanding of agricultural mechanization, will be able to be self-sufficient in food production, rather than a country, pre-dominantly agricultural, but not able to produce adequate food for its populace (Abimbola,1984). Hence Agricultural mechanization is a panacea for Economical and industrial development.

According to Anyanwu *et al*. (1997), the role of agriculture in transforming both the social and economic framework of an economy cannot be over-emphasized. It is a source of food and raw materials for the industrial sector, it is also essential for expansion of employment opportunity, for reduction of poverty and improvement of income distribution, also for speeding up industrialization and easing the pressure on balance of payment. In effect, it has been the source of gainful employment from which the nation can feed its teeming population, providing the nation's industries with local raw materials and as a reliable source of government revenue. Agricultural development is considered to hold the key to economic development for most Sub-Saharan countries including Nigeria. (Olukunle, 2012)

Agricultural Mechanization will boost productivity and help to maintain low food prices. Mechanization, encompassing the entire scope and usage of animal or motor power, can significantly increase the productivity of human labour and improve the quality of life for large scale, small scale and cooperative holdings. It involves the use of tools, implements and machinery to improve the efficiency of human effort and labour. The most appropriate machinery and power source for any operation depends on the work to be done and the relative desirability, affordability, availability and technical efficiency of the options. Reynolds (1993) revealed that agricultural mechanization can promote the economic development by increasing the supply of food available for domestic consumption and releasing the labour needed for industrial employment. According to him, agricultural mechanization can promote economic development of underdeveloped countries in four distinct ways:

a) By increasing the supply of food available for domestic consumption and releasing labourneeded for industrial employment.
b) By enlarging the size of the domestic market for the manufacturing sector.
c) By increasing the supply of domestic savings and
d) By providing foreign exchange earned by the agricultural exports.

Current mechanized agriculture includes the use of tractors, trucks, combine harvesters, airplanes (crop dusters), helicopters, and other vehicles. Modern farms even sometimes use computers in conjunction with satellite imagery and GPS guidance to increase yields.

Mechanization was one of the large factors responsible for urbanization and industrial economies. Besides improving production efficiency, mechanization encourages large scale production and improves the quality of farm produce. On the other hand, it displaced unskilled farm labor, causes environmental pollution, deforestation and erosion.

Two broad stages of farm mechanization process have been identified viz: Mechanization of power intensive operations e.g. land preparation, threshing etc. which generally precedes the Mechanization of control-intensive operations e.g. weeding, harvesting etc. (Ani and Onwualu, 2002).

Problems of Agricultural Mechanization in Nigeria

The agricultural sector despite many decade of neglect remains the highest employer of labour in Nigeria. The sector employs about 70 percent of the labour force in the country.

Despite this huge number of persons engaged in agriculture, the sector has been unable to meet the food demands of Nigeria. This has led to massive importation of food in to the country. There are many constraints to successful farm mechanization in Nigeria and they include fragmentation of farmlands or small landholdings due to problems of land tenure system, poor capital base (IFPRI, 2010), scarcity of farm machinery and equipment, insufficient farm inputs, poor infrastructural facilities, land degradation, poor social and economic structures. The constraints to mechanization as they apply to large scale farms in Nigeria as a whole are (1) access to credit, (2) non-setting up of manufacturing and repair services by entrepreneurs, (3) no improved infrastructure, (4) non-affordable and secure access to complementary inputs (fuel, electricity, and larger consolidated plots of land), (5) worst legal and regulatory capacity to protect the rights of owners of machinery, and (6) lower efficiency and capacity of public sector for implementing policy. Resolving these constraints should be the policy objectives of the government (IFPRI, 2010).

Benefits of Agricultural Mechanization

The benefits of Agricultural mechanization cannot be over emphasized especially with the drive to achieve food sufficiency. These are as follows:

- Mechanization will boost the food production which will lead to exportation of the excess in the production so as to generate income for the country through foreign exchange earnings.
- Agricultural mechanization had made the level of information dissemination to increase.
- Farmers are aided in improving marketing processes such as packaging, grading and standardizing commodities and reducing losses in the marketing channels, ware housing and storage.
- Farm mechanization encourages multiple cropping which was not possible under traditional farming.

Level of Agricultural Mechanization in Nigeria

The level of mechanization in Nigeria relates to the evolutionary processes that have been influenced by certain socio-economic and natural barriers. By way of classification, the following are the different classes of mechanized farming equipment's and tools in Nigeria: Hand Tools Technology (HTT), Draught Animal Technology (DAT) and Engine Powered Technology (EPT) (Adamade and Jackson, 2014).

Solutions to Problems of Mechanization in Nigeria

According to Anazodo (1975), there are certain pre-requisites for an effective farm power and machinery in traditional farm systems. Some of these factors that aid agricultural mechanization may include:

(a) A growing desire by farmers for better machinery and tools

(b) A government sympathetic to mechanization developments.

(c) Education, Research, and extension programs.

(d) Establishment of agricultural mechanization

There is need for the agricultural engineers to key into the new paradigm shift of value-chain approach where they identify specific points of interventions that are problem solving. Specialization and deeper efforts are indeed expected from the agricultural engineers who are to naturally lead in the mechanization of the Nigerians agriculture.

Farmers should be encouraged to come together and form farming-disposed cooperatives so as to attract incentives for farming and to be able to provide needed financial aids and farm inputs when and where necessary. Such registered cooperative bodies will enjoy government's protection in their businesses. The cooperatives will be able to acquire farm equipment for mechanized farm, which an individual would not be able to achieve. Farm tractors and the accessories should be readily available for farmers to hire at subsidized rates and road constructions by governments are necessary. There should also be awareness campaign for farmers to imbibe the spirit of using findings from research institutes buy innovations in farm mechanization for their farms.

CONCLUSION AND RECOMMENDATIONS

Agriculture holds the key to the future of Nigeria, key to industrialization, key to sustainable fiscal and economic diversification and self-sustainability with the help of mechanization. Since the world is shifting emphasis from the traditional nut and bolt technology in agriculture to a wider spectrum through information technology, Nigerian agricultural engineers and environmentalists should brace up and get involved in the new technologies for the best interest of the farmer and his environment. The low rate of adoption and utilization of appropriate mechanization technologies among others has remained one of the major factors militating against agricultural production in Nigeria.

Based on the foregoing, the paper suggests that proper education and training of the manpower in mechanization technologies should be encouraged and also government should enact decrees and policies that encourage mechanization.

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PARTICIPATORY ON-FARM EVALUATION OF DROUGHT TOLERANT MAIZE VARIETIES AND HYBRIDS IN THE SUDAN SAVANA OF NIGERIA

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ABSTRACT
Maize is an important food crop in the Savanna zones of Nigeria where its productivity is highly influenced by drought and fertility problem especially low nitrogen. Drought mainly occur both at the beginning and during the growing season, which significantly reduces maize productivity. Therefore early-maturing varieties that are tolerant to drought or extra-early maturing varieties that escape drought were desirable in these agro-ecological zones. Several efforts are being made at IITA to develop or identify drought-tolerant maize varieties that are adapted to the Savannas of West Africa. This study evaluated three sets of maize varieties that have been identified either to tolerate or escape drought. The drought-tolerant maize varieties were evaluated on farmers' fields in two LGA of Kano states of Sudan northern Nigeria. Generally, the on-farm yields of the maize varieties evaluated were higher than the average grain yield reported for the local variety in both locations. Among the varieties evaluated, the result shows that 2011 TZE-W DT STR Syn maize variety was significantly higher by 27.66 % and 166.36 % than that of 2013 DTE STR-W SYN and local maize varieties respectively. Since most of these varieties attain their physiological maturity in late September when rainfall intensity is drastically reduce, it therefore, recommended that DTMA seeds should made available for farmers in this zone for agricultural sustainability.
Keywords: Participatory, on-farm evaluation, drought tolerant maize, Sudan Savanna

INTRODUCTION

Maize (*Zea mays* L.), is an important staple crop especially in the savannah ecology of Nigeria. More than 50 % of the maize produced in the country is from the savannas where the best yields are recorded. Despite the immense potential of maize production and productivity in the savannas, its production is greatly constrained by recurrent drought due to climate variability and changes (Bency, 2000). Rainfalls are erratic and native soil nitrogen is low owing to very low organic carbon production and continuous cropping practices prevalent among farmers in the savannah. Maize farmers in the zone reported losses of 90 percent due to drought, 60 % due to striga and about 85 % due to low soil N (Byrne *et al*., 1995). Improving yield levels in the zone require development and adoption of robust maize varieties (OPVs) and hybrids that are tolerant to these stresses especially drought. In order to ensure rapid adoption of such varieties by maize farmers, their participation in the development process is of great value in line with the latest paradigm shift in which technology development is increasingly demand driven.

Recently, maize breeders at IITA developed several early, extra-early, intermediate and late maturing white and yellow-endosperm source populations, OPVs, and hybrids; several of which combine tolerance to drought, low soil nitrogen with resistance to *S. hermonthica* and MSV. Most of these products originate from the DTMA project are yet to be released in partners countries while several other new varieties and hybrids have been developed which need to be tested in on-farm enable their release and promotion. In many instances, several of these varieties produce yields that are higher than the old varieties farmers are using. In addition to the superior grain yields, the new varieties have end-users preferred traits in addition to tolerance to drought. In order to mitigate the incidence of yield reduction caused by stress such as drought that could also lead to food insecurity, poverty and malnutrition as well as poor performance of poor resource small holder farmers. In this project, a participatory on-farm evaluation of drought tolerant varieties of maize is proposed in which farmers should play active role in cultivation.

MATERIALS AND METHODS

Study location

On-farm study was conducted at two locations in Kano state namely: Kura and Rano LGAs in the Sudan Savanna zone of Nigeria. Kano State is located at latitude 11°30^{1}N and longitude 8°30^{1}E with land area of 20,760 km^2. Its vegetation falls mostly within the Sudan Savanna Zone (Kura and Rano LGAs inclusive). The climate of Kano State is the tropical wet and dry type. Annual average rainfall in the area range from 884-1200 mm (from north to south of the state) which is characterized by one peak period (mono-modal), usually attained in August with average temperature of warm to hot throughout the year at about 25±7°C. FAO/UNESCO genetic classification,

classified the soil as leached tropical ferruginous soil developed on deeply weathered pre-Cambrian Basement Complex rock overlain by Aeolian drift of varying thickness (Malgwi *et al.*, 2000).
Selected farmer fields were demarcated into three plots measuring 10 m x 10 m (100 m^2) per plot. The plots were allocated by A, B and C; plots A and C were planted with different improve variety while plot B was as check, planted with farmer variety (local variety). The trials were randomized among the farmers within the selected communities in each location. Each set was replicated three times in each location where a farmer represents a replicate (Table 1).
The fields were sprayed with glyphosate (4 l/ha) at two weeks before land preparation for weeds control. The land was ridged at 0.75 m apart using manual hand plough power as a source of tillage in all the locations and earthed up at 8 weeks after sowing. Maize seeds were planted on 22ndJuly to 8th August, 2015 in all the farmer fields in both locations. The maize seeds were sown manually, two seeds per hole at intra-row spacing of 25 cm and later thinned to one plant per stand at 2 weeks after planting (WAP) to give approximately plant population of 53,333 plants ha^{-1}.

Table 1. List of varieties/hybrids and number of farmers participated in on-farm trials

Set	Hybrid/OPV maize varieties	Number of farmers	Maturity period
1	TZEE-W STR 104 BC2	6	Extra early
1	2013 TZEE-W Pop DT STR	6	Extra early
1	Local variety	6	Late
2	2013 DTE STR-W SYN	6	Early
2	2011 TZE-W DT STR Syn	6	Early
2	Local variety	6	Late
3	(TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25)	6	Intermediate
3	(TZE1 63 x TZE1 108) x TZE1 59 x (TZE1 87)	6	Intermediate
3	Local variety	6	Late

Fertilizer application and weeding

Fertilizer application was at the rates of 120 kg N/ha, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}were the source was urea for N, single supper phosphate (SSP) for P and muriate of potash for K and maintained in all the farmer fields in both locations. Urea (N) fertilizer application was applied in 2 doses; first application was done 10 days after sowing while the remaining part was applied as second dose at 6 week after sowing by opening a hole of 3-4 cm depth at the base of the maize stand and covered with soil (band application). Weed was control by applying pre-emergence herbicide (4 l/ha) at planting and manual weeding using hole was subsequently employed at 4 WAS and also earthing up at 8 WAS before harvesting.

Sampling and processing

Plant sampling was conducted by cutting the maize at ground level, stacked in sheaves, air-dried and manually threshed in accordance with treatments (variety). The following measurements were obtained: Ear and plant heights, cob weight and grain yield for net plot of 7.5 m^2.

Plate 1: Showing harvested varieties of DTMA varieties at right and left hands while local variety at the center *Maize plant height measurement*

Maize plant height and ear height were measured at harvest. This were done from the base of the plant (soil surface) to the apex of the flag leaf with the aid of a 2 m long calibrated wooden pole (plant height). The ear height was obtained by measuring the plant height from the base of the plant to the point of the ear elongation from the stem. Data obtained were recorded in cm.

Data analysis
Data obtained were subjected to analysis of variance (ANOVA) using the mixed linear model of SAS (SAS Institute, 2009).

RESULTS AND DISCUSSION
SET 1: Yield and yield components of maize variety
The results of the yield and yield components of maize variety in set 1 obtained from both study areas are presented in Table 2. The highest grain yield was observed in variety TZEE-W STR 104 BC2, followed by 2013 TZEE-W Pop DT STR variety and least in local variety. The percent differences between the improve varieties and local variety were 70.51 % and 35.74 % respectively. Whereas TZEE-W STR 104 BC2 variety had significantly higher grain yield than 2013 TZEE-W Pop DT STR variety by 25.68 %. Similar observations were obtained in yield components (ear weight and cobs number) while reverse was in the case of growth parameters which were consistently higher in local variety.
The grain yield obtained in accordance with study location is presented in Table 3. Based on location, Kura had a higher grain yield per hectare than Rano, however in all the improve varieties evaluated and as well as local variety. Percentage differences were 40.96 % for TZEE-W STR 104 BC2 maize variety, 16.31 % for 2013 TZEE-W Pop DT STR maize variety and 13.26 % for local variety. The variation in grain yield across the locations may reflect wide variation in the native soil fertility and genotypes differences of these varieties.

SET 2: Yield and yield components of maize variety
The yield and growth components of two maize varieties in set 2 evaluated in the two locations are recorded in Table 4. The result shows that 2011 TZE-W DT STR Syn maize variety was significantly higher by 27.66 % and 166.36 % than that of 2013 DTE STR-W SYN and local maize varieties respectively. However, yield obtained from 2013 DTE STR-W SYN maize variety was significantly higher than the local variety with percent difference of 108.65 %. The same trend of grain yield distribution observed among the varieties evaluated was found in yield components except in growth parameters which were consistently higher in local maize variety than improve varieties. Differences observed between the DTMA varieties and local variety could be attributed to late planting which affected the performance of local variety due to low rain at reproductive stage. This finding is in conformity with that of Amaza *et al*., (2008).
The result of grain yield obtained in accordance with study location is presented in Table 5. Based on location, the grain yield recorded in all the varieties evaluated in set 2 was consistently higher in Kura than ranowith

difference of 1.49 % for 2013 DTE STR-W SYNmaize variety, 1.30 % for 2011 TZE-W DT STR Synmaize variety and 9.21 % for local maize variety. Grain yield differences observed among the DTMA varieties including the local variety might be as a result of earlier planting of varieties at Kura location than Rano farmer fields. This suggest that planting DTMA between second weeks to last day of July would give better grain yield than planting early August irrespective of locations.

SET 3: Yield and yield components of maize variety

The results of the grain yield, yield and growth components of maize variety obtained from both study areas are presented in Table 8. The highest grain yield was observed in (TZE1 63 x TZE1 108) x TZE1 59 x (TZE1 87) maize variety followed by (TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25) maize variety and least in local variety. The percent differences between local maize variety and improve two maize varieties were 68.98 % and 61.52 % respectively. Whereas (TZE1 63 x TZE1 108) x TZE1 59 x (TZE1 87) maize variety was significantly at par (TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25) maize variety in terms of grain yield but with 4.62 % difference. Similar observations were obtained in yield components (ear weight and cobs number) while reverse was in the case of growth parameters which were consistently higher in local maize variety. This could be due to delay in planting these varieties especially local varieties which required good rainfall distribution for optimum production. A study conducted in Northern Savanna by Yusuf et al., (2009) reported that high grain and yield components of maize could be as a result of favourable soil moisture and good distribution of rainfall until harvest. The grain yield obtained from maize varieties evaluated in set 4 is presented in Table 9. Based on location, Kura had a lower grain than Rano in all the maize varieties evaluated except local maize variety which was higher in Kura study location. Percentage difference was 15.87 % for (TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25)maize variety, 26.36 % for (TZE1 63 x TZE1 108) x TZE1 59 x TZE1 87) maize variety and 27.31 % for local variety. Generally, variation in grain yield among the maize varieties across both locations may be as result of difference in soil fertility (soil N), genotypic make up and partly planting date. Maize grain yield obtained in Savanna zones of Nigeria; mainly due to late planting, uneven distribution of rainfall during reproductive stage and short duration of rainfall (Omeke, 2016)

CONCLUSION

The study revealed that DTMA varieties were outstanding in performance with above 10 % higher than local varieties in both locations which is mainly influence by drought and low fertility problem. Therefore, we encourage farmers to cultivate DTMA varieties in these areas prone to late on-set of rainfall and short distribution for food security and improvement of poor resource farmers.

Table 2. Evaluation of yield and growth components of maize in set 1 variety in both locations

Variety	GY (kg/ha)	Ear length (cm)	Ear weight (g/plant)	No. of Cobs	No. of stand	Plant height (cm)	Ear height (cm)
TZEE-W STR 104 BC2	3211.17	32	0.15	201	191	163	80
2013 TZEE-W Pop DT STR	2555.12	25	0.13	187	187	164	75
Local variety	1882.33	38	0.11	110	200	218	110
Mean	2459.54	31.67	0.13	166	198	182	88
SE	179.66	1.19	0.27	6.03	6.59	3.17	9.38

Table 3. Grain yield of set 1 obtained in Kura and Rano LGAs and across both locations

Variety	Grain yield (kg/ha) Kura	Rano	Across	% difference
TZEE-W STR 104 BC2	3888.89	2758.86	3323.88	40.96
2013 TZEE-W Pop DT STR	4444.44	3821.24	3632.84	16.31
Local variety	1988.33	1755.56	1871.95	13.26
Mean	3440.55	2778.55	21942.89	
SE	189.88	78.77	84.44	

Table 4. Yield and growth components of maize varieties in set 2 in both locations

Variety	GY (kg/ha)	Ear length (cm)	Ear weight (g/plant)	No. of Cobs	No. of stand	Plant height (cm)	Ear height (cm)
2013 DTE STR-W SYN	3977.2	28.50	0.15	214	214	163	87
2011 TZE-W DT STR Syn	5077.4	27.50	0.17	224	194	169	74
Local variety	1906.24	32.00	0.09	144	165	211	116
Mean	3653.67	29.30	0.14	184	191	181	92
SE	154.75	1.21	0.08	7.74	7.68	4.06	3.36

Table 5. Grain yield obtained in Kura and Rano LGAs and across both locations

	Grain yield (kg/ha)			%
Variety	**Kura**	**Rano**	**Across**	**Difference**
2013 DTE STR-W SYN	5440.00	5360.00	5400.00	1.49
2011 TZE-W DT STR Syn	6055.56	5977.78	6016.67	1.30
Local variety	2333.33	2136.53	2234.93	9.21
Mean	4069.44	4491.44	4555.53	
SE	184.76	177.16	180.96	

Table 6. Yield and growth components of maize varieties in set 4 in both locations

Variety	Grain Yield (kg/ha)	Ear length (cm)	Ear weight (g plant^{-1})	No. of Cobs	No. of stand	Plant height (cm)	Ear height (cm)
(TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25)	3250.00	27	0.15	173	173	162	93
(TZE1 63 x TZE1 108) x TZE1 59 x (TZE1 87)	3400.00	28	0.18	175	175	155	90
Local variety	2012.13	22	0.12	155	155	206	128
Mean	2887.38	26	0.15	168	168	174	104
SE	122.25	6.35	0.11	3.33	3.33	25.55	18.87

Table 7. Evaluation of maize grain yield in set 3 varieties in Kura and Rano LGAs of Kano state

	(Grain yield (kg/h			%
Variety	**Kura**	**Rano**	**Across**	**Difference**
(TZEQ1 4 x TZEQ1 33) x (TZEQ1 24 x TZEQ1 25)	3500.00	4055.56	3777.78	15.87
(TZE1 63 x TZE1 108) x TZE1 59 x TZE1 87)	3473.33	4388.89	3931.11	26.36
Local variety	3833.33	3011.11	3422.22	27.31
Mean	3602.22	3818.42	3710.37	
SE	87.88	94.98	91.43	

RECOMMENDATION

Based on the findings of the study, it is recommended that; Farmers acknowledge the outstanding performance of most DTMA varieties over the local variety. Training should be conducted on capacity building to enhance farmers' adoption rates and sustainability of production. The project should make the DTMA seeds readily available to the farmers since they are preferred than their local variety.

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ANALYSIS OF THE FRUITS AND VEGETABLE MARKET CHAIN IN SHOMOLU LOCAL GOVERNMENT AREA OF LAGOS STATE, NIGERIA

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ABSTRACT
The study was carried out to analyze the fruit and vegetable market chain in Shomolu Local Government Area of Lagos state. A survey of fifty marketers randomly selected in Bariga and Bajulaye markets in the area formed the sample used. A descriptive research design was used in the study and data were collected using oral interviews and a well-structured questionnaire. Data were analyzed using frequency counts, percentage, market margins, marketing channel analysis and linear regression model to identify existing marketing channels used by vegetable marketers, determine the profitability of fruit and vegetable and isolate factors that affect quantity supplied of fruit and vegetable along the market chain. The study revealed that majority (74%) of the marketers are females. The average age of the fruit and vegetable respondent was (35.5). Local government harassments, lack of support from government, poor market stall, high cost of transportation and inadequate finance were the most perceived problems of marketing by the fruit and vegetable respondents. Channels that included local markets had high total gross margins. The regression analysis showed that quantity of fruit and vegetable supplied, price of fruit and vegetable, access to market information, access to internet service and distance from the market are factors that influenced supply of fruit and vegetable in the markets. Among other things, measures that easy access to credit, reduce multiple taxes and permit on sellers are recommended.
Key Words: Marketing channels, Fruit and vegetable, Shomolu Local Government, Regression analysis

INTRODUCTION
Vegetable constitute the most important and inexpensive component of a balanced diet, which people now realize due to their high nutritive values indispensable for the body. Originally, vegetables were collected from the wild by hunter-gatherers and entered cultivation in several parts of the world, probably during the period 1,000BC to 7,000BC, when new agricultural way of life developed and fruits and vegetables are produced seasonally, but the market requires products throughout the year. As technology improved and consumer incomes increased, it became possible to provide fresh produce year-round. Fresh tropical fruits are on winning ground in world markets as to recent statistical figures (Babatola, 2004.). Its production has risen by 7% annually since 1997 and the bulk of these fruits (98%) are grown in developing countries. The main reason for increase in demand of tropical fruits is the growing familiarity of consumers with tropical fruits; their taste, nutritional value and cooking qualities.
The knowledge of domestic consumers of the benefits of fruits and vegetables is confined to very few varieties of fruits and vegetables. Hence, domestic demand with the exception of few widely known tropical fruits is generally small and various studies show that people generally consume fruits and vegetables on a daily basis without considering them as basic. Abay (2007) stated that the production of fruits and vegetable is seasonal and price is inversely related to supply. During the peak supply period, the prices decline. The situation is worsened by the perishability of the products and poor storage facilities. Along the market channel, 25% of the product is spoiled. According to UNESCO (2005), lack of concerted public support, scanty information, poor understanding of how the market chain works and lack of systematic documented knowledge are main threats that hampered the benefit of the sector. Thus, comprehensive data collection along the chain is a must to envisage the direction of input-output flows. If these jeopardy are not well addressed right onwards, it is obvious the country's competitiveness would trail far behind the existing stage. Even though fruit and vegetable are economically and socially important, fruits and vegetable marketing channel and their characteristics have not yet been studied and analyzed for local markets in Lagos state. Hence, the focus of the study to investigate fruits and vegetable market chains and factors affecting fruit and vegetable supply in Shomolu Local Government Area (SLGA). The outcomes here, hopefully will narrow the information gap on the subject and will contribute to better understanding on improved strategies for reorienting marketing system for the benefit of small farmers and traders. Therefore, the objectives of the study are to: identify the major fruits and vegetable marketing channels; estimate the marketing margins within the fruits and vegetable market chain; determine the factors affecting the quantity of fruits and vegetable supplied to the market.

METHODOLOGY
Shomolu is a Local Government Area in the Ikeja division of Lagos State. It is one of the sixteen LGAs of metropolitan Lagos. It is located in the northern part of Lagos city. According to 2006 population census, it has 402,673 inhabitants. Most of its inhabitants are Yorubas. It is a major nerve center for commercial printing activities in Lagos. Also because of its enormous population, it has attracted huge commercial and industrial

activities. Shomolu local government area harbours several industrial and commercial enterprises. The town is plagued by problems of overcrowding, poor housing and inadequate sanitation. Other articles of trade here is the marketing of agricultural produce such as rice, fruits, beans, garri, meat, vegetables, fish etc.

Survey research design was used. All the fruit and vegetable marketers in the two main markets within the local government area namely, *Bajulaye* and *Bariga* formed the population for the study. The sample for the study comprised 50 fruit and vegetable sellers from the two markets randomly selected using the Simple random sampling. A well-structured questionnaire as well as oral interview was used to collect data. The questionnaire was divided into two sections, Section A was designed to gather information on personal data of respondents, while Section B was designed to gather information on the perceived problems, channels of marketing, favourability of sources of supply, distance from farm of supply, how they get latest information about prices etc., used in analyzing the fruit and vegetable market chain. Where necessary, the questionnaire was read to the respondents in vernacular and responses documented accordingly.

The data collected were summarized using frequency counts and percentages, while the marketing margin analysis was used to determine the profitability of fruit and vegetable along the market chain. A simple linear regression analysis was used to estimate the factors that affect the supply of fruit and vegetable.

Gross Market Margin Analysis:

$$\text{TGMM}= \frac{Cprice - Pdprice}{Cprice} X100$$

$$\text{GMMp} = \frac{Cprice - MGM}{Cprice}$$

$$\text{Pdshare} = \frac{Pdprice}{Rtlprice}$$

Where:
TGMM = Total gross marketing margin
GMMp = Producer's gross marketing margin
MGM = Marketing gross margin
Csprice = Consumer's price
Pdprice = Producer's price
Rtlprice = Retail price
Pdshare = Producer's share

The regression model was specified as follows:

$$Y_i = \alpha_i + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_i X_i + \upsilon_i \text{ ------------------------ (1)}$$

Where: Yi = quantity of fruit and vegetable supplied to market
α_i = Intercept
$ß_i$=Coefficient of the ith explanatory/independent variable
X_i = Vector of explanatory variables
U_i = disturbance term

Hence, the equation for the quantity of fruits and vegetables supplied is: Quantity of fruits and vegetables Supplied = α_i+ $ß_1$Gender + $ß_2$Age+ $ß_3$Household size + $ß_4$Edu + $ß_5$Distance + $ß_6$ Experience + $ß_7$Quantity Supplied + $ß_8$Price + $ß_9$Internet + $ß_{10}$Market Information + $ß_{11}$ credit + Ui

RESULTS AND DISCUSSION

Figure 1 presents channels through which fruit and vegetable move from the production site until they reach the final buyer. According to Teka (2009), a marketing channel involves a series of intermediaries through which fruit and vegetable pass from producers to consumers. As Figure 1 shows, the 2nd channel- Producer-local market-consumer has the highest rank. It also means that the local market will have the largest share from the sales because the goods will be sold at a price that will bring about high income. Four marketing channels were identified for fruit and vegetable in the study area as indicated in Table 3 and figure 1. The results revealed that most of the fruit and vegetable goes through channel-2, followed by channel-3 and channel-4. Channel-1 accounted for the least of the fruit and vegetable in the market. The possibility here is that the producer does not make enough profit from channel-1.

In this section the factors that influence the supply of fruits and vegetable are presented and discussed. A simple linear regression models were employed to analyze the factors that affect the supply of fruit and vegetable.

Table 4 presents the determinants of the supply of fruit and vegetable. The result shows that among the eleven hypothesized determinants of market supply of fruit and vegetable, five variables were found significant. These are quantity of fruit and vegetable produced, price of fruit and vegetable, access to market information, access to internet service and distance from the market. The coefficient of multiple determinations (R^2) was estimated (0.876) and adjusted R^2 value was 0.846. This means that 87.6% of the variation in the dependent variable is explained by the explanatory variables included in the model. Furthermore, the adjusted R^2 of 84.6% which is significant further consolidated the goodness of the model. The result in table 4 shows that the quantity produced is significantly and positively related to marketed supply of fruit and vegetable at 1% significance level. The value of the coefficient for production of fruit and vegetable implies that an increase in production of fruit and vegetable by one unit per hectare resulted in an increase in farm level marketable supply of fruit and vegetable. Similarly, the result shows that the price of fruit and vegetable is significantly and positively related to marketed supply of fruit and vegetable at 10% significance level. This complied with the law of supply that price and quantity supplied are directly related. Thus as the price fruit and vegetable increase in the market, farmers will supply more quantity of fruit and vegetable to the market to get better returns for the products. A priori, access to market information is positively related to market supply of fruit and vegetable at 10% significance level. As hypothesised access to internet service affected the marketed supply of fruit and vegetable positively and significantly at 5% significance level. This might be because internet service enables the traders to have better knowledge about how to get better production and productivity, and creates awareness about new technologies. Distance from the market is significantly and negatively related with the marketed supply of fruit and vegetable at 1% significance level. As the distance from the production area to market place become farther and farther, the producers supply lesser quantity of fruit and vegetable to the market. This is might not be unconnected with the nature of the product (i.e. perishability) and the costs which are related with transportation and handling.

RECOMMENDATION AND CONCLUSION

This study investigated the fruit and vegetable marketing chains in Shomolu Local Government area of Lagos with the aim of unravelling the routes through which fruit and vegetable reached consumers in this area. Based on this study, it is recommended as follows: One, as revealed by this study, marketing channel affects profit margin thus, Fruit and Vegetable marketers should be assisted in identifying the best channel. Two, marketers should form cooperatives in order to arrest price volatility within the fruit and vegetable supply chain. Three, since rents and permits are charged on each sellers, Government should provide adequate market stall for the marketers to store and display their goods. Excess taxes are spread on price thus escalating prices and reducing demand/ sales, government should help streamline multiple permits and taxes imposed on fruit and vegetable sellers. Finally, Policies that ease access to loan and financial support to agribusiness should be promoted.

Table 3: Market channels and marketing margin analysis for fruit and vegetable

Market Actors	Marketing Measures	Fruit and Vegetable market channels			
		CHA-1	**CHA-2**	**CHA-3**	**CHA-4**
Producer	Price	**13,750.00**	**13,750.00**	**13,750.00**	**13,750.00**
Local market	Price		**62,750.00**	**62,750.00**	**62,750.00**
	Gross margin		**3,202.82**	**3,202.82**	**3,202.82**
Wholesaler	Price			**42,000.00**	
	Gross margin			**3,440.21**	
Retailer	Price				**22,000.00**
	Gross margin				**3,019.91**
Total Gross Marketing Margin		**14,405.17**	**73,664.92**	**48,162.95**	**24,159.28**

Source: Field Survey, 2015; Note: CHA=channel

Ranks of channels by producer's share

Channel-1 Producer→consumer; Channel-2 Producer→localmarket→consumer

Channel-3 Producer→wholesaler local market→consumer

Channel-4 Producer→retailer→localmarket→consumer

Table 4: Factors affecting the supply of fruit and vegetable

Variables	Coefficient	SE	t-vlues
Constant)	-0.267	0.981	-
0.273			
Gender	0.100	0.185	0.543
Age (in years)	0.001	0.009	0.098
Education	0.011	0.078	0.134
Quantity produced	0.732***	0.024	30.825
Price of F & V	0.003*	0.002	1.756
Household size	0.054	0.042	1.286
Years of experience	0.002	0.027	0.091
Access to market information	0.125*	0.069	1.81
Access to internet service	0.522**	0.199	2.620
Distance from the market	-0.170***	0.060	-2.820
Access to credit service	0.033	0.186	0.178
$R^2$0.876			
Adjusted R^2 0.84			

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EVALUATION OF THE EFFECT OF PROCESSING ON THE FOOD QUALITY OF AERIAL YAM (*D.BULBIFERA*): IMPLICATIONS FOR IMPROVED NUTRITION AND FOOD SUFFICIENCY IN NIGERIA

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ABSTRACT
Fresh aerial yam was processed into high quality aerial yam flour (HQAYF), whole-meal high quality aerial yam flour (WHQAYF), aerial yam fufu flour (AYFF) and whole-meal aerial yam fufu flour (WAYFF). The flours and the raw aerial yam were subjected to chemical analyses to determine their proximate, total carotenoid, minerals and phytochemical compositions. This was to evaluate the effect of processing on the food quality of aerial yam. The result of the proximate compositions indicated that there were losses in moisture and starch contents while dry matter, crude protein, crude fibre, fats, ash and carbohydrates appreciated with processing. The result in total carotenoid composition showed that there were 27.5% to 40.3% losses in WHQAYF and HQAYF respectively while the losses recorded for AYFF and WAYFF were 89.3% and 92.9% respectively. The only mineral that that indicated losses was potassium (K), calcium (Ca), sodium (Na), phosphorus (P) and magnesium (Mg) increased with processing. The result in phytochemicals showed that there losses of all the phytochemicals with processing, thereby bringing them down to the level where they are harmless for both human and animals.
Keywords: Aerial yam, processing, proximate, carotenoid, minerals, phytochemicals, chemical analyses.

INTRODUCTION
Yam is one of the oldest food crops of tropical origin which belongs to the family of Dioscoreaceae and one of the oldest groups among the angiosperm (Onwueme, 1978). The report of IITA, (1992) stated that there were about six (6) economically important species of yam grown as staple food in Africa. They were; *D. rotundata* (white yam), *D. cayenensis* (Yellow yam), *D. alata* (water yam), *D. esculentum* (Chinese yam), *D. dumentorum* (bitter yam) and *D. bulbifera (*aerial yam). Orkwor, (1992) contended that the preferred yam cultivar in eastern banks of River Niger was *D. rotundata.* Observation has shown that there is a growing demand of *D.alata* in Cross River state, Akwa Ibom state and environs. Also, the work of Aniedu & Oti, (2011) showed a number of recipes and delicacies which can be made from *D.alata.* However, evidence has shown that some of these 6 yam species are becoming extinct as they are rarely seen in the market and hence feature rarely in daily meals of people in Nigeria. One particular yam specie of interest, is the aerial yam (*D.bulbifera* – aerial yam*)*. The observance of this fact, led Nwosu, (2014) to state that *D.bulbifera* was traditionally eaten when boiled, fried, roasted or cooked with vegetables in time past and because *D. bulbifera* tend to darken during cooking made consumers regard it as being inferior to other types of yam and this has led to the crop going extinct. Hence, Aniedu, *at al*, (2016) investigated into the food quality of this crop and reported that the aerial yam was rich in food nutrients and had high naturally occurring carotenoid composition which needed to be exploited for improved rural nutrition and food sufficiency in Nigeria. Consequently, this study aims at evaluating the effects of some processing methods on the food quality of this crop in order to explore other uses to which the crop can be put so as to ensure that the crop does not go into extinction but rather there will be need to increase its cultivation for its increased contribution towards improved nutrition and food sufficiency in Nigeria. The main aim of the study was to evaluate the effects of processing aerial yam into unfermented and fermented flours on its food quality. The specific objectives were to evaluate: i. the effects of processing aerial yam into unfermented flours (high quality aerial yam flours) on its proximate, total carotenoid, minerals and phytochemical compositions; ii. the effects of processing aerial yam into fermented flours (aerial yam *fufu* flours) on its proximate, total carotenoid, mineral and phytochemical compositions.

MATERIALS AND METHODS
The aerial yam landrace was procured from yam farmers in Bende area, Abia state, Nigeria. The aerial was processed as follows:

Chemical Analysis
The four (4) processed aerial yam flour samples of high quality aerial yam flour (HQAYF), whole-meal high quality aerial yam flour (WHQAYF), aerial yam *fufu* flour (AYFF) and whole-meal aerial yam *fufu* flour (WAYFF) and raw aerial yam were analyzed for the following; proximate compositions, minerals (calcium, sodium, phosphorus, potassium and magnesium) and phytochemical compositions, using the methods described by AOAC (1995).

Carotenoid analysis
The total carotenoid composition of the flour samples and the raw aerial yam were analyzed, using the method of Harvest-plus protocol (2004) as follows; 5g of each of the samples was grinded with the aid of hyflosupercel in 50ml of cold acetone and filtered with suction through a Buchner funnel with filter paper. The filtrate was extracted with 40ml of petroleum ether (P.E.) using separating funnel while saturated sodium chloride was used to prevent emulsion formation. The lower phase being water was discarded while the upper phase was collected into a 50ml volumetric flask, making the solution pass through a small funnel containing anhydrous sodium sulfate to remove residual water. Then, the separating funnel was washed with P.E. and the standard flask made up to 50ml mark. The absorbance at 45ml of the solution was taken using specifophometer and the total carotenoid contents were calculated thus;

$$\text{Total carotenoid } (\mu/g) = \frac{A \times \text{volume} \times 10}{A1\%_{1cm} \times \text{sample weight (g)}}$$

Where A = Absorbance, Volume = total volume of extract (50ml), A1%1cm = absorption coefficient of carotenoid in P.E. (2592)

Statistical analysis
The ANOVA and mean separation by Least Significant Difference (LSD) at 5% probability levels of proximate, total carotenoid, vitamins, minerals and phytochemical composition scores were carried out using SAS version 8, 2000.

RESULTS AND DISCUSSION
The results of the proximate compositions of the samples in Table 1 showed that the moisture and starch contents were highest (71% and 28.6% respectively) in the raw aerial yam sample while about 90% moisture loss was observed in the processed samples (which ranged from 7.2% - 7.7% in WHQAYF and AYFF respectively), the starch loss in processed aerial yam ranged from 8.4% to about 30% in WHQAYF and WAYFF respectively. The result in Table 1 also showed a significant increase in dry matter, crude protein, fats, ash and carbohydrates contents in the processed samples. The unfermented samples of WHQAYF and HQAYF were significantly (P=0.05) higher in crude protein than the fermented samples of AYFF and WAYFF while carbohydrates and starch were significantly (P=0.05) higher in AYFF and WAYFF than in WHQAYF and HQAYF. The result did not show obvious significant (P=0.05) differences among processed samples in crude fibre and fats.

The result in Table 2 indicated that there were great depletions of carotenoid with fermentation which were 89.3% and 92.9% in AYFF and WAYFF respectively while the rate of carotenoid losses was 27.5% and 40.3% in HQAYF and WHQAYF respectively (unfermented flours).

The picture is clearer in Fig.5 which showed that total carotenoid of raw aerial yam reduced from 8.44μg/g to 5.041μg/g and 6.12μg/g in WAYF and HQAYF respectively. It was observed that fermentation further depleted total carotenoid contents from 8.44μg/g in raw aerial yam to 0.90μg/g and 0.60μg/g AYFF and WAYFF respectively. This confirmed the report of Aniedu and Omodamiro (2012) which observed that there were high losses of carotenoid when pro-vitamin A cassava was processed into flour. The work further stated that when fermentation and drying process were involved in processing pro-vitamin A cassava into flours, there was almost a complete loss of carotenoids.

The result in Table 3 revealed that calcium, sodium, phosphorus and magnesium contents of aerial yam increased with the processing of the raw bulbs into flours. These minerals were significantly (P=0.05) higher in unfermented flours (WHQAYF and HQAYF) than in the fermented flours (AYFF and WAYFF). The potassium was the only mineral that showed some losses with processing with the losses in fermented flours being significantly (P=0.05) higher than the unfermented flours.

The phytochemicals as are regarded as anti-nutrients but latest findings by Liu (2004), Higdon (2007) and Rao, *et al* (2010) have shown that phytochemicals are useful in numerous ways particularly when they are found at low levels in foods e.g.

- 1. Saponin – checks replication of cells in the body.
- 2. Tanin – acts as pesticides and helps in poultry production at 0.15 -0.2% levels inclusion in feeds.
- Phenol – precursor of aspirin, used as analgesic and antiseptic. Its lethal to human at 300 -500μg/kg food.
- Alkaloids – antimalarial, anti-asthma, anti-cancer, etc.
- Flavonoids – anti-viral, anti-cancer, anti-inflammation, anti- allergy.

In Table 4, the results revealed that there were sizable losses of all the phytochemicals with processing of aerial yam into the various flours. However, the levels at which the phytochemical occurred in raw aerial yam were seen to be beneficial both for human consumption and for compounding feeds for animals. Hence, whether aerial yam is used raw or processed, the level of its phytochemical composition would not constitute any danger to health.

CONCLUSION

The aerial yam is a crop to be examined critically for its use as health food for humans, in compounding animal feeds and for pharmaceutical purposes due to its high carotenoid contents and phytochemical compositions. As processing into unfermented flour retained high level of carotenoid, there is need to explore the possibility of producing new food forms of the crop from the unfermented flours and the raw crop.

Table 1: Effects of Processing on Proximate Compositions of the Samples

Sample	% Moisture	% Dry Matter	% CP	% CF	% Starch	% Fats	% Ash	% CHO
Raw aerial yam	71.0	29.0	3.1	2.1	28.6	0.2	1.6	21.9
WHQAYF	7.2	92.6	7.3	2.6	20.1	1.2	3.9	77.5
HQAYF	7.4	92.6	7.6	2.3	20.5	1.1	4.0	77.7
AYFF	7.7	92.3	6.4	2.1	26.1	1.0	3.8	80.0
WAYFF	7.3	92.0	6.1	2.5	26.2	1.0	5.5	79.3
LSD(0.05)	**0.9**	**1.2**	**0.4**	**0.3**	**0.4**	**0.2**	**0.8**	**1.6**

***CP = Crude protein, CF = Crude fibre, CHO= carbohydrate**

Table 2: The effects of Processing on Total Carotenoid Composition of the Samples.

SAMPLES	T. CAROT. (µg/g)
Raw aerial yam	8.44
WHQAYF	5.04
HQAYF	6.12
AYFF	0.90
WAYFF	0.60
LSD(0.05)	**0.09**

Table 3: Effects of Processing on mineral Compositions of the Samples

Samples	µg/g				
	Ca	Na	P	K	Mg
Raw aerial yam	1.85	4.02	4.21	5.03	1.01
WAYF	2.26	5.72	7.11	4.99	2.83
HQAYF	2.29	5.70	7.07	4.94	2.81
AYFF	2.07	5.60	6.67	4.88	2.48
WAYFF	2.21	5.65	6.90	4.90	2.38
LSD(0.05)	**1.63**	**0.17**	**0.17**	**0.05**	**0.33**

***Ca= calcium, Na=sodium, P=phosphorus, K=potassium, Mg=magnesium**

Table 4: Effects of processing on Phytochemical Composition of the |Samples

	µg/g				
Samples	Saponin	Tanin	Phenol	Alkaloids	Flavonoids
Raw aerial yam	0.170	0.042	0.017	0.024	0.028
WHQAEF	0.010	0.004	0.001	0.012	0.016
HQAYF	0.010	0.002	0.001	0.008	0.010
AYFF	0.060	0.002	0.012	0.012	0.011
WAYFF	0.140	0.003	0.011	0.013	0.012
LSD(0.05)	**0.004**	**0.003**	**0.002**	**0.009**	**0.009**

Fresh Aerial Yam
↓
Sort
↓
Peel
↓
Wash
↓
Chip
↓
Sun-dry or oven dry at 50°C
↓
Mill into powder
↓
High quality aerial yam flour (HQAYF)

Fig. 1: Flow Chart of High Quality Aerial Yam Flour(HQAYF)

Fresh Aerial Yam
↓
Sort
↓
Wash
↓
Chip
↓
Sun-dry or oven dry at 50°C
↓
Mill into powder
↓
Whole-meal high quality aerial yam flour (WHQAYF)

Fig. 2: Flow Chart of Whole-meal High Quality Aerial Yam Flour (WHQAYF)

Fresh Aerial Yam
↓
Sort
↓
Peel
↓
Wash
↓
Chip
↓
Soak in water to Ferment for 10hrs
↓
Sun-dry or oven dry at 50°C
↓
Mill into powder
↓
Aerial Yam *Fufu* Flour (AYFF)

Fig. 3: Flow Chart for the Production of Aerial Yam *Fufu* Flour(AYFF)

Fresh Aerial Yam
↓
Sort
↓
Wash
↓
Chip
↓
Soak in water to Ferment for 10hrs
↓
Sun-dry or oven dry at 50°C
↓
Mill into powder
↓
Whole-meal Aerial Yam *Fufu* Flour (WAYFF)

Fig. 4: Flow Chart for the Production of Whole-meal Aerial Yam *Fufu* Flour (WAYFF)

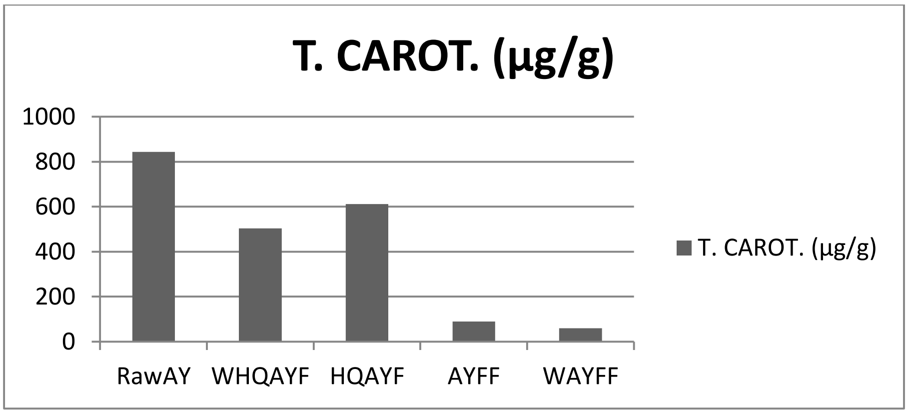

Fig 5: Level of depletion of Total Carotenoid Composition in the Samples

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FINANCING VALUE ADDITION OF ROOT AND TUBER CROPS AMONG PRODUCING HOUSEHOLDS IN ABIA STATE, NIGERIA

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ABSTRACT
Financing value addition via processing of root and tuber crops into other foods and industrial products have several social and economic implications on rural economic development. This study focused on the empirical investigation of financing value addition of root and tuber crops among producing households in Abia state, Nigeria. The specific objectives were to ascertain the various sources of finance available for value addition and determine the respondents' reasons for value addition. Multistage sampling technique was employed in the selection of 250 respondents across 5 Local Government Areas of Abia state. Structured questionnaire was used to obtain data from the respondents and the data collected were analyzed using descriptive statistics. The results of the descriptive statistics showed that most of the respondents were: between 40 – 59 years, married, with household size of 6 - 10 persons, and farm size of 1 - 3 hectares. Most respondents' major source of financing value addition was personal savings and their major reasons for financing value addition were to increase farm income; satisfy consumers and prevent spoilage. The study thus recommends that farmers should join cooperatives to have easy access to finance and other agricultural incentives from government while government on its part should address through policies bureaucratic bottlenecks involved in accessing agricultural loans.
Key words: financing, value addition, root and tuber crops

INTRODUCTION
Root and tuber crops have been the major sources of carbohydrate and other food nutrients to a vast majority of people living in sub-Saharan Africa. Root and Tuber crops are frequently grouped together because they are bulky, perishable and vegetatively propagated. Root crops are the edible energy-rich underground plant structures developed from modified roots, for example, cassava and sweet potato; while tuber crops are those crops in which the edible energy-rich storage organs develop wholly or partly from underground stems such as yam, cocoyam and ginger (Eke-Okoro *et al.*, 2014). A study by Gregory, Mark and Claudia (2000) on "Root and Tubers for the 21st Century; Trends, Projection and Policy Options" has shown that root and tuber will continue to play a significant role in developing-country food systems because they contribute to the energy and nutrition requirements of over 2 billion people and will continue to do so over the next two decades.
In Nigeria, root and tuber crops such as cassava, sweet potato, yam, cocoyam, and ginger play vital roles in the food security of Nigerians (Eke-Okoro *et al*., 2014). However, root and tuber crops just like other agricultural produce are perishable in nature, thus most rural farmers do not get the desired reward for their effort as most of their products perish few days after harvest hence, the need for value addition. Value addition which involves the the process of transforming these roots and tuber crops into other food, feed and industrial products will help to increase demand, ensure attractive prices and lead to sustainable agriculture, poverty alleviation and rural economic development. However, engaging in meaningful value addition requires financial capital which may be beyond the purview of rural households. Inadequate finance has been identified by researchers as one of the major challenges facing the adoption of value added processing technologies (Aniedu *et al*., 2012; Onubuogu and Onyeneke, 2012; Omoare *et al.*, 2014). Given the expanding market potentials of value added root and tuber products, coupled with the fact that successive governments over the years have allotted funds for agricultural purposes through different agencies and financial intermediaries, there is a compelling need to empirically investigate how root and tuber crops producing households in Abia state finance the production of value added root and tuber products. This study is gerared towards facilitating the realization of sustainable agriculture and rural economic development in Nigeria.

METHODOLOGY
The study was carried out in Abia State, Nigeria. It is one of the 36 states in the country created in 1991 from part of Imo State. It is located in the South-East geopolitical zone of the country. The State lies between longitudes 04^0 45' and 06^0 07' North and Latitude 07^0 00' and 08^0 10' East. It is bounded by Imo State to the West, Ebonyi and Enugu States to the North, Cross Rivers and Akwa Ibom States to the East and Rivers State to the South. The State covers an area of about 5,243.7 square kilometers which is approximately 5.8 percent of the total land area of Nigeria (Independent National Electoral Commission, 2008). It has a population density of 580 persons per square kilometer and a projected population of 3,395,414 persons growing at an annual rate of 2.83 percent (National Bureau of Statistics, 2014). Administratively, it has 17 Local Government Areas (LGAs), three

Senatorial districts and 3 Agricultural Zones with Umuahia as the State capital. The climate of the State is tropical with two seasons namely, rainy season which starts from March to October; and dry season which commences from November and ends in February of each year. The inhabitants are predominantly Igbos, and practice Christianity and African Traditional Religions. Agriculture is the major occupation of the people and subsistent agriculture is prevalent (Agwu *et al.*, 2014). They produce crops like cassava, yam, cocoyam, sweet potato, ginger, rice, maize, oil palm, rubber, cocoa, banana, and various types of fruits. For the purposes of this study, five root and tuber crops namely, cassava, sweet potato, yam, cocoyam and ginger were selected for empirical investigation, as they constituted the main root and tuber crops produced by rural households in the State.

The study employed multistage sampling technique in the selection of respondents. First, 5 LGAs namely: Ikwuano, Isiala Ngwa North, Isiala Ngwa South, Bende and Ohafia were purposively selected out of the 17 LGAs in the State based on the reponderance of root and tuber crops producing households in the areas. Secondly, 1 autonomous community was randomly selected from each of the LGA making a total of 5 autonomous communities. Thirdly, 2 villages were randomly selected from each of the autonomous community making a total of 10 villages. Finally, 250 respondents comprising 50 households engaged in the production of each of the root and tuber crop studied namely: cassava, sweet potato, yam, cocoyam and ginger were purposively selected across the 10 villages in the study area.

Data were sourced using questionnaire and oral interview to elicit information from the respondents. Data collected were analyzed using descriptive statistics such as frequency distribution tables, percentages, and likert scale. In order to address the objective on reasons for financing value addition, 5 point likert scale rating technique was employed. The rating was in this order: Strongly Agree (SA) = 5, Agree (A) = 4, Undecided (U) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The mean score was calculated thus: $5 + 4 + 3 + 2 + 1 = 15/5 = 3$. Using the interval of 0.05, the upper limit cut-off point was $3.00 + 0.05 = 3.05$, while the lower limit was $3.00 - 0.05 = 2.95$. **Decision Rule:** Mean scores less than 2.95 (i.e. MS < 2.95) were regarded as not important; those between 2.95 and 3.05 (i.e. 2.95 < MS < 3.05) were regarded as important; while those greater than 3.05 (i.e. MS > 3.05) were regarded as very important.

RESULTS AND DISCUSSION

Sources of financing value addition of root and tuber crops employed by the respondents

The result of the sources of financing value addition among root and tuber crops producing households as depicted in Table 1 indicated that majority of the respondents financed value addition with equity finance from their personal savings. Cocoyam producing households recorded the highest percentage whereby, all the respondents financed their value adding activities from personal savings. This was followed by ginger producing households where majority (96%) of the respondents financed their value addition activities with personal savings and the remaining 4% obtained finance by borrowing from family and friends. Then yam producing households, where majority (90%) of the respondents financed value addition with personal savings, while about 10 percent utilized funds from friends and Cooperative Societies. Thereafter, sweet potato producing households which had majority (86%) of the respondents financing value addition with personal savings while about 14 percent obtained finance from family and friends. Lastly, cassava producing households where most (58%) of the respondents financed value addition with personal savings while about 40 percent obtained finance from informal financial sources and the remaining 2 percent utilized finance from Microfinance Banks. The probable reason for this result is that most of the respondents were small-scale farmers, cultivating between 1 to 3 hectares of land with low investment. This result is in line with the findings of Okereke, (2013) and Ikwuakam, (2013) who found that most farmers finance their productive activities with their personal savings and funds borrowed from informal credit sources. The informal credit sources have some attractive features such as: collateral free lending, proximity, timely delivery and flexibility in loan transaction. According to Asogwa *et al.*, (2014), low patronage of banks may be due to the concentration of banks in the urban areas and inability of small scale farmers to present the needed collateral for bank loans, as well as the bureaucratic bottlenecks associated with sourcing loans from banks.

Reasons for value addition among the respondents

The major reasons for value addition among root and tuber crops producing households in descending order of importance as shown in Table 2 were to: increase farm income satisfy consumers, prevent spoilage, enhance the nutritional content, reduce bulkiness and increase the shelf life. These findings on reasons for value addition among the respondents concurs with Ememwa *et al.,* (2008) who observed that processing perishable farm produce reduces bulkiness, diversifies consumption, enhances acceptability and marketability, increases shelf life and contributes significantly to household food security and income generation since wastage is minimized.

CONCLUSION

This study had shown that root and tuber crops producing households in the study area mainly employed eqiuty finance in the form of personal savings in carrying out their activities.This hinders them from engaging in meaningful value addition and adversely affect their monthly farm income. Also, most of them are non members of agricultural cooperatives. Thus, root and tuber producing households are advised to join cooperative societies in order to have easy access to cooperative finance and other agricultural incentives from government.

Table 1: Distribution of the respondents based on their sources of capital for financing value addition (n =250)

Sources	Frequency	Percentage(%)
Cassava Producing Households		
Equity Finance		
Personal Savings	29	58
Debt Finance		
Friends and relatives	10	20
Cooperative societies	7	14
Money Lenders	3	6
Microfinance Banks	1	2
Total	**50**	**100**
Sweet Potato Producing Households		
Equity Finance		
Personal Savings	43	86
Debt Finance		
Friends and relatives	7	14
Total	**50**	**100**
Yam Producing Households		
Equity Finance		
Personal Savings	45	90
Debt Finance		
Friends and relatives	2	4
Cooperative societies	3	6
Total	**50**	**100**
Cocoyam Producing Households		
Equity Finance		
Personal Savings	50	100
Total	**50**	**100**
Ginger Producing Households		
Equity Finance		
Personal Savings	48	96
Debt Finance		
Friends and relatives	2	4
Total	**50**	**100**

Source: Field survey data, 2015.

Table 2: Reasons for value addition among the respondents (n = 250)

Reasons	Mean	Rank	Remark
(i) Prevent spoilage	4.48	3rd	very important
(ii) Reduce bulkiness	3.05	5th	important
(iii) Reduce transportation cost	2.38	7th	not important
(iv) Increase the shelf life	2.95	6th	important
(v) Enhance the nutritional content	4.36	4th	very important
(vi) Satisfy consumers	4.54	2nd	very important
(vii) Increase farm income	4.70	1st	very important

Source: Field survey data, 2015.

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EVALUATION OF PRE- EMERGENCE HERBICIDE FORMULATION FOR THE MANAGEMENT OF WEEDS IN POTATO

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ABSTRACT
An experiment was carried out to evaluate a newly introduced pre-emergence herbicide in the management of weeds in potato production during 2011 cropping season. The herbicide was Pendilin with Pendimethalin 500gm/l. EC as active ingredient a pre - emergent herbicide formulated for the control of broad leaved weeds and grasses with a recommended application rates of 2.5-4.0 L./ha. The experiment was carried out at Potato Research Programme experimental field Kuru (09^0 44^{1}N 08^{0}44E and altitude 1351m) during 2011 cropping season. Experimental design was Randomized Complete Block Design replicated three times. Potato variety used as test crop was Nicola a popular variety with the farmers. Result of the effect of the pre emergence herbicides on plant vigour, weed density, weed biomass and yield of potato was significant ($p<0.05$). Pendalin at the rate of 4 liter/ha and atrazine at the rate of 4 liters/ha gave weed densities of 2.11 and 2.67/0.25m^2 compared to the control with a density of 7.00/0.25m^2. Both fresh and dry weed biomass was significantly higher in the control (2.33 and 0.271kg/plot respectively). For the rates, result showed that application of the herbicides at high concentration significantly ($p<0.05$) suppressed the weeds than lower rates and the control irrespective of the herbicides. It is recommended that in addition to pre emergence herbicides, post emergence herbicides be use followed by at least one manual weeding for effective weed management in potato as from the 4-6 weeks after planting. Pendilin is therefore strongly recommended as a pre-emergent herbicide to be use in potato production.
Keywords: Herbicide formulation, management, weeds, potato

INTRODUCTION

It has been established severally that weeds are a major problem in crop production generally. Weeds compete with the crops for space, light, moisture and soil nutrients. Weeds can also serve as alternative host for pests and diseases (Agpad, 1987). Weeds are also known to lower human efficiency and cause drudgery (Melifonwu, 1999). Akobundu, (1987) reported that weeds are the most underestimated pests in tropical agriculture that are often been associated with the drudgery that characterized peasant agriculture. Akobundu (1987) stated that weed results in 65% reduction in the yield of root and tuber crops and takes 25% of the total labour use in the production. Nwokocha (1987) had shown that yield reduction of about 50% is possible in potato production as a result of weeds infestation. All these calls for concerted effort at weed control in crop production.

Weeds can be managed either culturally, mechanically, biologically, chemically and through an integrated approach. There are two major ways is which weeds are controlled in Nigeria today, these are manual and chemical. The use of cover crops to suppress weed had also been shown to be effective (Chikoye *et al*., 2001) Manual weeding is capital intensive, time consuming and full of drudgery which had made it unattractive.

New improved agricultural inputs are getting into the market on a daily basis. Herbicides are essential in the management of weeds in potato production. Several herbicides and their rates had been screened and found effective in the control of weeds in potato and other crops production.

There are approximately 140 herbicides active ingredients (Vencill, 2002; Mallory-Smith and Retzinger, 2003). Most of these basic forms of herbicides are further refined and formulated, creating several hundred commercial products. It is natural to evaluate them viz a viz the existing ones in the management of weeds in potato production. The objectives of the study were; to evaluate the new herbicide formulation in the management of weeds in potato and to compare its efficacy viz a viz the existing ones being used in the management of weeds in potato. Lastly to determined the best rate for optimum weed control.

MATERIALS AND METHODS

An experiment was carried out to evaluate a newly introduced pre-emergence herbicide by an agrochemical company (African Agro) based in Kano state in the management of weeds in potato production. The herbicide brought was Pendilin with Pendimethalin 500gm/l. EC as active ingredient a pre - emergent herbicide formulated for the control of broad leaved weeds and grasses with a recommended application rates of 2.5-4.0 L./ha. The experiment was carried out at Potato Research Programme experimental field Kuru (09^0 44^{1}N 08^{0}44E and altitude 1351m) during 2011 cropping season. Experimental design was Randomized Complete Block Design replicated three times. Potato variety used as test crop was Nicola a popular variety with the farmers. Potato was planted at a spacing of 30cm inter and 100cm intra row given a gross plot size of 24m^2. Fertilizer NPK was applied at planting at the rate of 100kg/ha each of N, P_2O_5 and 40kg/ha K_2O as band application. Atrazine (ai =Atrazine

500SC) a pre-emergent herbicide with a recommended application rates of 2.5 – 4L. /ha was used as a check herbicide. The herbicides were applied after planting (0WAP) using a CP3 knapsack sprayer at the following rates; Pendilin applied at 4, 3.25 and 2.5 liter/ha, Atrazine applied at 4, 3.2 and 2.4 liters/ha and absolute control (No herbicide application). Weed biomass was taken using a quadrat of 0.5x0.5m (0.25m^2) at 6 weeks after planting (WAP). Thereafter the potatoes were weeded manually. Harvesting was done at 12WAP. Data collected were; plant establishment at four weeks after planting (4WAP), a score of weed density and plant vigour, fresh and dry weed biomass at 6WAP, final stand count and tuber yield at 12WAP. Data collected were subjected to analysis of variance and means separated by LSD at 5% level of probability,

RESULTS AND DISCUSSION

Results of the effect of the pre emergence herbicides on establishment count, weed density, plant vigour, weed biomass and yield of potato are presented in Table 1. The result revealed a significant ($p<0.05$) effect in all the parameters measured with exception to plant establishment. Higher rates of the herbicides led to vigorous growing plants as the result shows. Pendilin applied at the rate of 4 liters/ ha and atrazine (check) at 4 liters/ha gave the most vigorous growing plants compared to the absolute control. The effect of herbicides on weed density and biomass shows that they suppressed the weeds. Higher rates irrespective of the herbicides gave significantly low weed densities than the control. Pendalin at the rate of 4 liter/ha and atrazine at the rate of 4 liters/ha gave weed densities of 2.11 and 2.67/0.25m^2 compared to the control with a density of 7.00/0.25m$^{2.}$ Both fresh and dry weed biomass was significantly higher in the control (2.33 and 0.271kg/plot respectively)

Effect of pre – emergence herbicides and rates on fresh and dry biomass of weeds (kg) /0.25m^2 are presented in table 2. Result shows significant ($p<0.05$) effect in the herbicides and rates on fresh and dry weed biomass. Interaction between herbicides and rates was not significant ($p<0.05$). There was no significant difference in the fresh and dry weed biomass between the new herbicide pendalin (1.71kg and 0,155kg/0.25m^2) and the check herbicide atrazine (1.81 and 0.113/0.25m^2) in terms of weeds management though pendalin was numerically better. For the rates, result showed that application of the herbicides at high concentration significantly ($p<0.05$) suppressed the weeds than lower rates and the control irrespective of the herbicides

Herbicides had been known to control weeds if applied effectively without phytotoxic effect on the crops. The low weed densities and biomass mass can be attributed to the herbicides applied as the result shows. As the rate increases, the densities and biomass reduces. This has further been ascertained with higher weed density and biomass recorded in the control. Balthazar and Barium (1986) and Olofintoye (1997) reported that pendimethalin (pendilin) a pre emergent herbicide as for grass – weed control. Yield and yield attribute of the potatoes were also significantly affected. Result shows that there is a positive relationship between herbicides application and yield performance as seen on final stand count, tuber number and weight. Weeds have been known to interfere with normal crop growth and yield leading to low yield. This fact is corroborated by the findings of Akobundu, (1987) who stated that weeds are the most underestimated pests in tropical agriculture and can results in 65% reduction in the yield of root and tuber crops. Nwokocha (1987) had shown that yield reduction of about 50% is possible in potato production as a result of weeds infestation. This shows that weed management translate to high yield.

CONCLUSION

It has being established that weeds adversely affect potato production resulting in low yields. Result of the study revealed that the herbicide Pendilin applied at 4 liters/ha did suppressed weeds infestation in the first six weeks of potato production though not significantly different from the check herbicide (atrazine) applied at 4liters/ha. It is therefore deduced from the finding of this work that pendilin is a credible alternative to atrazine or any other pre emergence herbicide in potato production. For the desire result recommended rates of the herbicide be use for effective management of weeds in potato. It was observed that the potency of the herbicides is shot lived for the period of crop growth.

It is recommended that in addition to pre emergence herbicides, post emergence herbicides be use followed by at least one manual weeding for effective weed management in potato as from the 4-6 weeks after planting. Pendilin is therefore strongly recommended as a pre emergent herbicide to be use in potato production.

Table 1: Effect of pre emergence herbicides on some potato attributes, weed biomass and yield

Treatment	Est. Count (4WAP)	Plant Vigour Score	Weed Density Score	Fresh weed biomass	Dry weed biomass	Final Stand Count	Tuber No.	Tuber yield (kg/std)
Pen.(4L./ha)	36.00	2.33	2.11	1.23	0.096	16.67	6.10	6.00
Pen.(3.25L./ha)	38.00	1.67	3.89	1.87	0.119	15.33	6.07	5.67
Pen.(2.5L./ha)	37.33	1.44	5.00	2.03	0.124	9.67	4.39	3.33
Atraz. (4L./ha)	38.00	2.33	2.67	1.77	0.108	16.33	6.48	6.33
Atraz.(3.2L./ha)	38.33	1.67	5.45	1.83	0.174	15.33	4.93	4.67
Atraz.(2.4L./ha)	37.00	1.67	5.67	2.00	0.182	13.00	4.92	4.00
Control	37.67	1.00	7.00	2.33	0.271	12.00	4.88	1.67
Mean	**37.48**	**1.73**	**4.60**	**1.87**	**0.153**	**14.05**	**5.4**	**4.52**
LSD0.05	NS	0.74*	0.68*	0.58*	0.01*	5.49*	1.09*	1.92*

Weed Density Score (on a scale of 1-7) where; 1 = weeds free, 3 = slightly weedy, 5 = weedy and 7 = very weedy
Plant Vigour Score (on a scale 1-5) where; 1 = low vigour, 3 = moderately vigorous and 5 = highly vigorous
WAP = Weeks After Planting

Table 2: Effect of pre – emergence herbicides and rates on weeds biomass (kg) / 0.25m^2

	Biomass of fresh weeds (kg) /0.25m^2				Biomass of dry weeds (kg) /0.25m^2			
Rate	**Pendilin**	**Atrazine**	**Control**	**Mean**	**Pendilin**	**Atrazine**	**Control**	**Mean**
1 (higher)	1.87	1.77	2.33	**1.80**	0.096	0.108	0.271	**0.158**
2(medium)	1.23	1.83	2.33	**1.99**	0.119	0.174	0.271	**0.188**
3 (lower)	2.03	2.00	2.33	**2.12**	0.124	0.182	0.271	**0.192**
Mean	**1.71**	**1.87**	**2.33**		**0.113**	**0.155**	**0.271**	**0.158**
	LSD(0.05)Herbicides = 0.38*				LSD(0.05)Herbicides = 0.093*			
	LSD(0.05)Rates = 0.15*				LSD(0.05)Rates = 0.031*			
	LSD (0.05) Herb. x Rates = 1.195 ns				LSD (0.05) Herb. x Rates = 0.123ns			

Where: Pendlin 1= 4L./ha, Pendlin 2= 3.25L./ha and Pendlin 3=2.5L./ha,
Atrazine 1= 4L./ha, Atrazine 2=3.2L./ha and Atrazine 3= 2.4L./ha Control (No herb. Application)

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AN UPDATE ON PROFITABILITY OF COCOYAM PRODUCTION AT NRCRI UMUDIKE IN 2015 PLANTING SEASON

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ABSTRACT
A gross margin analysis of cocoyam production at National Root Crops Research Institute Umudike done in 2015 planting season was carried. The experimental study showed that the enterprise is profitable. Labour constituted about 42.90% of total variable cost of production, which is the most important resource in cocoyam enterprise. One-hectare cost of cocoyam production was N573,480 while total revenue was N936,400 and gross margin was N362,920. The study showed that the result of profitability analysis of cocoyam production is profitable by returning N1.63 to every N1.00 spent. There is need therefore to encourage farmers to go into rapid production of cocoyam to enhance their revenue, food security and livelihoods.

INTRODUCTION
Cocoyam (Colocasia esculenta and Xanthosoma mafia) is an important carbohydrate staple food particularly in the southern and middle belt areas of the Nigeria (Asumugha and Mbanaso, 2002). Cocoyam is a stem tuber that is widely cultivated in the tropical regions of the world and is a well – known food plant which has a long history of cultivation with Nigeria being the largest producer of cocoyam (3.45mt) in the world (9.97mt) and accounting for about 34.57% of the total output (FAOSTAT, 2013). In the last decade, attention has been focused on means of eliminating food insecurity and hunger worldwide. The targets of the first Millennium Development Goal (MDG) between 1990 and 2015 are to halve, the proportion of people who suffer from extreme hunger and people, whose income is less than $1 a day (FAO, 2005).
Expansion in cocoyam production has therefore the potential of bridging the wide demand and supply gap, and enhancing the income (thereby reducing poverty) of the rural farmers, particularly the vulnerable group. Opata and Nwaeze (2009) reported that many rural people, particularly women have gained interest in the production, processing and marketing of cocoyam, essentially because of the rapid increase in its share of the urban market in Nigeria.
Resource allocation to cocoyam is significantly low when compared to crops such as yam and cassava (Okorji and Obiechina,1995; Okoye,2006). Production has not been given priority attention probably because of cocoyam's inability to earn foreign exchange and its unacceptability to the high income groups for both consumption and other purposes (Nweke, 1987; Onyenweaku and Eze,1987). The need for increased food production to meet the demand of ever-increasing population in Africa, where population growth rate is higher than the rate of increase in agriculture production had been long emphasized (World Bank, 1992).
The production is labor intensive with most operations carried out manually at the traditional level (Okoye, 2006). Zuhair and Hunter, (2000) reported that the cultivation of cocoyam is declining. To meet the demand for cocoyam, there is need to increase its production (Eze and Okorji, 2003).The study will therefore serve as a basis for information to the farmers on cocoyam profitability which is expected to drive increased cultivation of the crop.

MATERIALS AND METHODS
Six cocoyam cultivars NCe 001, NCe 002, NCe 003, NCe 004, NCe 011, NCe 012 of the *Colocasia* spp were used for the study which was carried out at NRCRI, Umudike in 2015 planting season. Data, such as resource allocation which includes; labour in mandays, inputs, cost items as well as output (yield) and value of produce were taken. Data was analyzed using the Cost and Returns analysis procedure on per hectare basis.

RESULTS AND DISCUSSION
Table 1 show that output per hectare was 4,682kg. The total value of production was N936, 400 at the cost of N200/kg for cormels and corms respectively. Total variable cost of production was N573,480. Labour constituted about 42.90% of total variable cost of production. This implies that production is labour intensive because most operations were carried out manually. This followed the findings of Okoye, (2006) and Okoye *et al*., (2004). The results show a gross margin of N362,920, indicating that cocoyam is profitable by returning N1.63 for every N1.00 spent. This excludes the fixed costs which most times are minimal and not significant due to depreciation.

CONCLUSION
The study estimated the gross margin for cocoyam production per ha in NRCRI Umudike. The results of the gross margin analysis showed that cocoyam production is profitable by returning N1.63 to every N1.00 spent. Farmers should be encouraged to go into cocoyam production since it is a highly profitable venture. Given that cocoyam

is an important staple food in Nigeria, any attempt to increase its productivity would be a right step towards the resolution of the food crisis especially in Nigeria. Farmers are therefore encouraged to go into rapid production of cocoyam since it is highly profitable. This will enhance their revenue, improve food security and livelihoods among cocoyam farmers.

Table 1: Gross Margin Analyses for Cocoyam Production at NRCRI Umudike

	Output	**Unit Quantity (kg)**	**Price**	**Total**
A	**Revenue**	4682	200	936,400
B	Variable Cost			
	Cocoyam setts (corns and cornel)	902	200	180,400
	Fertilizer	400	120	48,000
	Bags	20	100	2,000
	Baskets	10	150	1,500
	Total			**231,900**
C	Labour input (mandays)			
	Land preparation (Tractorization)			15,000
	Setts preparation	17	1000	17,000
	Planting	15	1000	15,000
	Weeding	$61^{\times 2}$	1000	122,000
	Fertilizer Application	13	1000	13,000
	Spraying	9	1000	9000
	Roughing	5	1000	5000
	Slashing	18	1000	18,000
	Earthening up	15	1000	15,000
	Harvesting	47	1000	47,000
	Carriage/Expenses			3,000
	Total			**246,,000**
D	Opportunity cost of variable cost at 20%			95,580.00
E	Total variable cost (B+C+D)			573,480.00
	Gross Margin (A-E)			362,920.00
	BCR=A/E			N1.63:1.00

Source: Field survey, 2015

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EFFECTS OF SPACING AND PHOSPHORUS FERTILIZATION ON THE PERFORMANCE OF COWPEA IN CALABAR

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ABSTRACT
This study was conducted during the 2014 cropping season to investigate the effects of plant spacing and phosphorus fertilizer application on the performance of cowpea. The treatments consisted of factorial combinations of three row spacing including 75 cm x15cm, 75cm x25cm and 75cm x35 cm as well as four levels of phosphorus fertilizer of 0, 25, 50 and 75 kg/ha. The treatments were laid in a Randomized Complete Block Design (RCBD) replicated three times. The result of the study showed that wider spacing significantly (P<0.05) increased number of leaves, number of branches and pod length whereas narrow spacing significantly improved most of the yield parameters measured. However, plant height was not significantly influenced by plant spacing. Result also showed significant response to applied phosphorus fertilizer on pods per plant, number of seeds, 100-seed weight, pod dry weight and grain yield. Phosphorus fertilizer significantly ($P \leq 0.05$) enhanced growth characteristics of cowpea: plant height, number of leaves, number of branches and pod length in all the weeks of measurement. From the results, it was observed that interaction between spacing and phosphorus fertilizer application was significant with the best result for 100-seed weight obtained at 35cm x 75 cm alongside application of 50 – 75kg/ha P whereas pod dry weight, and grain yield were higher at spacing of 15cm x 75 cm at the rate of 75 kg/ha of phosphorus fertilizer application.
Keywords: Effects, phosphorus fertilization, performance, cowpea

INTRODUCTION:

Cowpea (*Vigna unguiculata* (L) Walp) is an important grain legume and the most diverse of the cultivated species. In most traditional African Societies, farmers sow cowpea in a wide space which eventually affects the total production of cowpea. Decrease in plant spacing means increasing the plant population in a given area of land, and this leads to an increased competition among plants for soil moisture, nutrients, light and space. Hamad (2002) and Asiwe and Kutu (2009) all reported that cowpea plants produced at the lowest densities, set good number of pods than those at the higher densities. Webber *et al.* (1966) found that soybean plants produced at highest densities were taller and more sparsely branched. Abdelrhim (2010) observed that optimum spacing not only utilize soil moisture and nutrients move effectively but also avoid excessive competition among the plants. Ndor *et al.* (2012), it reported that spacing had significant response on almost the entire growth and yield parameters assessed. Malami and Samai'la (2012) reported that intra-row spacing affected stand establishment count, plant height, leaf width, number of leaves and leaf canopy while both inter and intra-row spacing of 100 and 25 cm respectively recorded the highest yield.

Tropical soils are inherently low in nutrients particularly nitrogen and phosphorus (Haruna *et al*., 2011). The deficiency of phosphorus in some of these soils is so acute in some cases that the symptom manifest in the plant. Application of phosphorus fertilizer therefore has great impact on crop yield (Alaam *et al.,* 2003). This is more so on highly weathered and leached soils in tropical and temperate regions of the world where soil acidity causes infertility and is a general limitation to crop production (Von Uexkull and Mutert, 1995). Despite its importance in plants growth and metabolism, phosphorus is the least accessible macro-nutrient and hence most frequently deficient nutrient in most agricultural soils because of its low availability and its poor recovery from the applied fertilizers (Balemi and Negisho, 2012). The low availability and poor recovery of phosphorus is due to the fact that it readily forms insoluble complexes with cation such as aluminum and iron under acidic soil condition Phosphorus is critical to cowpea yield because it stimulates growth, initiates nodule formation as well as influence the efficiency of the rhizobium legume symbiosis (Haruna and Aliyu, 2011). Accordingly phosphorus is required in young cells such as shoot and root tips where metabolism is high and cell division is rapid. Ndakemi and Dakora (2007) reported that phosphorus aids in flower initiation, seed and fruit development. El-Habbasha *et al.,* (2005) reported that increasing phosphorus levels increased number of leaves, stem weight, number of pods, weight of pods and seeds per plant, 100-seed weight and seed yield of groundnut. Abdel-ati (2000); Haruna and Usman (2013) showed that number of pods per plant, pod yield per plant, seed yield per plant, number of seeds per pod, 100 seed weight and seed yield per hectare were significantly increased by the application of 30 kg P ha^{-1}. FAO (2005) recommended about 30kg of phosphorus per hectares in the form of single super phosphate. Singh et al, (2011) reported highest yield of 60kg/ha of P and suggested that, that may be the optimum as further application may or may not increase yield. Yakubu *et al.* (2010) and Uzoma *et al.* (2006) reported that phosphorus application at 20 and 40 kg/ha P improved the performances of cowpea significantly but the best performance was obtained with 40 kg Pha^{-1}

MATERIALS AND METHOD

The study was conducted at the Teaching and Research Farm, University of Calabar, during the 2015 late cropping season. Calabar is in the humid forest zone of Nigeria and lies within latitude 05^0 29'N and Longitude 08^0 44'E. Annual rainfall of Calabar ranges from 1200mm to 2500mm and are bimodal in distribution with peaks in July and September.

Random soil samples were taken from 0-15cm depth of the study site at the beginning of the experiment and composited. This was then taken to the laboratory for physico-chemical analysis using suitable laboratory procedures as described by IITA (1979). The experiment was a 3 x 4 factorial experiment laid out in a randomized complete block design with three replications. Treatments included three row spacing (75cm x 15cm, 75 cm x 25cm, 75 cm x35cm) and four rates of phosphorus fertilizer (0, 25, 50, 75kg/ha). There were a total of 12 treatment combinations each of which was replicated thrice. The total field size 13m x 40.8m (530.4m^2) while each experimental plot measured 3m x 2.5m (7.5m^2). Two seeds of Cowpea variety- Sampea 7 (obtained from the Institute of Agricultural Research, Samaru, Zaria) were planted per hole at a planting depth of 2.5cm and later thinned to one plant per hole two weeks after planting. Single superphosphate fertilizer was incorporated into the soil one week before sowing, manual weeding was done 2 and 5 week after planting (WAP). Data were collected on plant height, number of leaves and number of branches, each taken from 10 plants randomly sampled from the two inner rows of each plot at 3, 5 and 7 weeks after planting (WAP). Other data collected included; pod length (cm), number of pods per plant, number of seeds per pod, 100-seed weight (g), dry pod yield (tonnes/ha) and grain yield (tonnes/ha. Data collected were subjected to statistical analysis using analysis of variance (ANOVA) according to Gomez and Gomez (1984) and significant means compared using the Fishers' least significance difference (FLSD) at the 5% level of probability.

RESULTS AND DISCUSSION

The soil texture at the experimental site was classified as loamy sand (10.7, 9.0 and 80.3% clay, silt and sand respectively). The pH (4.9) was very low and exchangeable acidity (3.2cmol/kg) was high. The Nitrogen (0.10%), potassium (0.09cmol/kg), calcium (1.4cmol/kg) and magnesium (0.07cmol/kg)) contents as well as base saturation (44.44%) and organic carbon (1.20%) were low whereas, phosphorus content (39.89mg/kg) was high. The effects of plant spacing and phosphorus fertilizer application on vegetative growth of cowpea at different growth stages are presented in Table 1. Plant spacing did not significantly ($P \geq 0.05$) influence the height of cowpea at 3, 5 and 7 WAP. However, planting cowpea at a spacing of 25 x 75cm had the tallest plants in all the sampling periods. The number of leaves were significantly ($P \leq 0.05$) influenced by spacing at 3, 5 and 7 weeks after planting. Cowpea planted at 15 cm x 75 cm produced significantly ($P \leq 0.05$) more leaves compared to those planted at 25 cm x 75 cm which in turn produced significantly ($P \leq 0.05$) more leaves than those planted at 35 cm x 75 cm. On the other hand, cowpea planted at 35cm x 75 cm had significantly the highest mean of number of branches per plant compared to other plant spacing. Application of phosphorus fertilizer had significant ($P \leq 0.05$) effect on plant height and number of leaves at 3, 5 and 7 WAP. At 3, 5 and 7 WAP respectively, application of 50 kg P_2O_5/ha produced significantly ($P \leq 0.05$) taller plants when compared to those that received 75kg/ha P_2O_5 and 25kg/ha P_2O_5 respectively. Conversely, 75kg/ha P_2O_5 produced significantly ($P \leq 0.05$) more leaves compared to application of 50 kg/ha P_2O_5 which in turn produced significantly ($P \leq 0.05$) more leaves than the 25kg/ha P_2O_5 application at 3 and 7 WAP but At 5 WAP, application of 50kg/ha P_2O_5 produced the highest number of leaves but this was not significantly ($P>0.05$) different from the number of leaves produced at 75kg/ha P_2O_5. At 3 WAP, there was no significant difference between the number of branches produced when P was applied at the rate of 50 and 75 kg/ha respectively but at 5 and 7 WAP, application of 50kg/ha P_2O_5 produced significantly higher number of branches per plants when compared to application of 75kg/ha P_2O_5. Plants in the control plot were significantly the least in terms of growth.

Both spacing and P application significantly ($P \leq 0.05$) influenced yield components of cowpea (Table 2). Cowpea planted at widest plant spacing (35cm cm x75 cm) produced significantly more pods and longer pods compared to those planted at 25cm x 75 cm and 15 cm x 75 cm respectively. However, cowpea planted at a spacing 25cm x75 cm produced significantly more seeds per pod compared to those planted at 35cm x 75 cm which in turn had significantly more number of seeds per pod than those planted at 15 cm x 75 cm whereas, cowpea planted at 35cm cm x75 cm had significantly higher 100-seed weight compared to those planted at 25cm x 75 cm and 15 cm x 75 cm respectively. Pod dry weights at spacing of 15 x 75 cm and 25 x 75 cm were not significantly ($P \geq 0.05$) different although they were significantly when compared to those planted at 35 cm x 75 cm but cowpea planted at 15cm x 75cm had significantly higher grain yield compared those planted at 25cm x 75cm and 35 cm x 75 cm which had significantly the least grain yield. P fertilizer significantly ($P \leq 0.05$) influenced the pod length, number of pods per cowpea plant as well as number of seeds per pod. Application of 50 kg/ha P_2O_5 produced significantly the longest and highest number pods per plant/ number of seeds per pod when compared to 75kg/ha P_2O_5 and 25kg/ha P_2O_5 respectively. However, both 50 and 75kg/ha P_2O_5 had statistically similar 100-seed weight and pod dry weights which were higher than those at 25kg/ha P_2O_5 whereas, 75kg/ha P_2O_5 produced significantly higher grain yield of cowpea when compared to that at 50 and 25kg/ha P_2O_5 respectively.

Spacing and phosphorus fertilizer had significant ($P \leq 0.05$) interaction effects on the height of cowpea at 5 WAP, number of leaves produced by cowpea at 3, 5 and 7 WAP and number of branches at 5 and 7 WAP. Cowpea planted at 25 cm x 75 cm and application of 50kg/ha P_2O_5 produced taller cowpea plants with more number of branches though at 5 WAP, planting cowpea at 25cm x 75 cm and 50 kg/ha P_2O_5 had the highest number of branches per plant but this was not significantly different from the number of branches produced when cowpea was planted at a spacing of 35cm x75 cm with 25kg/ha P_2O_5 application, 35cm x 75 cm with 50kg/ha P_2O_5 and 35cm x75 cm with 75kg/ha P_2O_5 application respectively. Also, planting cowpea at 15cm x 75 cm with 50kg/ha P_2O_5 produced the highest number of leaves but this was not significantly ($P \leq 0.05$) different from those produced when cowpea was planted at a spacing of 15cm x 75 cm but 75kg/ha P_2O_5 was applied. Also, cowpea at a spacing of 25cm x 75 cm which received 50kg/ha P_2O_5 produced significantly longer pods, more pods seeds per pods when compared to those produced in other treatment combinations. Pod dry weights obtained at 25 cm x 75 cm alongside the application of 50 kg/ha P_2O_5, 35 cm x 75 cm with 75 kg/ha P_2O_5 as well as 15 cm x 75 cm with 75 kg/ha P_2O_5 did not differ significantly from each other. There were no interaction effects of spacing and phosphorus fertilizer application on grain yield. The very low soil pH coupled with low nitrogen, potassium, calcium, magnesium, organic carbon contents and base saturation but with high phosphorus content was observed from the soil analysis. These properties are typical of highly leached ultisols as observed by Agbede (2009).

The study revealed that wider plant spacing enhanced growth as observed in number of leaves as well as number of branches. This may be due to less competition among plants for space, soil moisture, nutrients, light and carbon dioxide. The results also revealed that narrow spacing tends to favor most yield attributes such as number of pods per plant, pod dry weight and grain yield. This agrees with the results earlier obtained by Haruna et al. (2011), Haruna and Usman (2013), Asiwe and Kutu (2009) and Hamad (2004) who indicated that cowpea plants produced at the lower plant densities set good number of pods than those at the higher densities.

Growth attributes such as plant height, number of branches and numbers of leaves were significantly increased by the application of phosphorus fertilizer. Thus, an indication that the cowpea variety utilized the phosphorus fertilizer applied judiciously in growth and development processes. These could be attributed to the fact that phosphorus is required in large quantities in shoot and root tips where metabolism is high and cell division is rapid (Ndakidemi and Dakora, 2007). It also stimulates root and stem growth, initiate nodule formation by enhancing the general efficiency of the rhizobium – legume symbiosis leading to enhanced nitrogen fixation as observed by Haruna and Aliyu, 2011). However, Singh *et al*., (2011) had suggested that application beyond 60kg/ha P may or may not influence the growth of cowpea. It was observed that application of P generally improved the yield of cowpea. The significant yield response of cowpea to phosphorus application could be attributed to the role of phosphorus in seed formation and grain filling (Haruna and Aliyu, 2011), in flower initiation, seed and fruit development (Ndakidemi and Dakora, 2007), improvement in the pod length, number of pods per plant, pod yield per plant, seed yield per plant, number of seeds per pod, 100 seed weight and seed yield per hectare (Abdel-ati, (2000) Krasilnikoff *et al*., (2003), El-Habbasha *et al*., (2005), Nyoki *et al*., (2013) and Haruna and Usman (2013). Additionally, P has been reported to stimulate growth, initiate nodule formation as well as influence the efficiency of the rhizobium legume symbiosis (Haruna and Aliyu, 2011). The result also showed that the highest number of pods per plant, highest pod yield as well as grain yield were recorded at 50 or 75kg/ha P_2O_5. This agrees with the observation of Singh *et al*., (2011) who obtained the highest cowpea yield when 60kgha-1 of P was applied and suggested that that may be the optimum as further application of phosphorus may or may not increase yield of cowpea.

CONCLUSION

Narrower plant spacing out yielded wider spacing but the latter performed better in terms of vegetative character. Also, increasing levels of P improved both growth and yield characteristics however 50kg/ha P_2O_5 is as good as 75kg/ha P_2O_5

Table 1: Effects of spacing and phosphorus fertilizer on the vegetative growth of cowpea

Treatments	Plant height			Number of leaves			Number of branches		
	3WAP	5WAP	7WAP	3WAP	5WAP	7WAP	3WAP	5WAP	7WAP
Spacing (S) in cm									
15 x75	8.88	12.99	17. 67	4.39	10.10	19.68	1.48	2.34	3.63
25x 75	12.09	16.96	20. 69	4.27	9.53	19.05	2.04	3.20	3.73
35x25	11.38	16.11	19.83	3.47	6.57	14.46	1.92	3.40	3.58
$LSD_{(0.05)}$	NS	NS	NS	0.06	0.21	0.24	NS	0.13	NS
Phosphorus (P) in kg									
0	5.33	8.34	10.43	2.43	4.93	9.94	0.86	1.62	2.51
25	10.67	14.34	18.06	4.17	9.43	19.19	1.94	3.31	3.84
50	15.00	21.79	26.42	4.71	10.36	20.98	2.22	3.67	4.20
75	12.12	16.93	22.67	4.86	10.20	20.82	2.23	3.32	4.04
$LSD_{(0.05)}$	1.96	1.42	1.58	0.08	0.28	0.32	0.23	0.17	0.12

Legend: S_1 = 15cm x75cm, S_2 = 25cm x 75cm, S_3 = 35 cm x 75cm, P_1= 0kg Phosphorus, P_2= 25kg Phosphorus, P_3= 50kg Phosphorus, P_4= 70kg Phosphorus

Table 2: Effects of spacing and phosphorus fertilizer on the yield components of cowpea

Treatments	Pod length(cm)	Pods/plant	Seeds/pod	100-seedwt (g)	Pod dry wt (t/ha)	Grain yield (t/ha)
Spacing						
15x75	4.12	4.95	3.97	28.06	0.30	0.29
25x75	6.82	9.67	5.40	28.60	0.30	0.27
35x75	7.22	10.87	5.33	29.15	0.24	0.22
$LSD_{(0.05)}$	0.16	0.18	0.04	0.17	0.01	0.01
Phosphorus						
0				26.99	0.14	0.15
25	3.20	3.80	3.44	28.78	0.28	0.28
50	5.99	7.98	5.01	29.42	0.35	0.29
75	7.91	11.38	5.63	29.22	0.35	0.31
$LSD_{(0.05)}$	7.10	10.82	5.50	0.23	0.01	0.01

Legend: S_1 = 15cm x75cm, S_2 = 25cm x 75cm, S_3 = 35 cm x 75cm, P_1= 0kg Phosphorus, P_2= 25kg Phosphorus, P_3= 50kg Phosphorus, P_4= 70kg Phosphorus

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IMPACT OF NEEM (*AZADIRACHTA INDICA*) SEED EXTRACT ON THE GROWTH, HAEMATOLOGICAL PARAMETERS AND SERUM CHOLESTEROL OF BROILER CHICKS

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ABSTRACT
The impact of Neem (Azadiradita indica) seed extract (NSE) on the growth performance, haematology and serum cholesterol of broiler chicks was evaluated in a study that lasted 35 days. 225, 7 day old broiler chicks were randomly assigned to five treatment which contained 0, 15, 30, 45 and 60ml NSE per litre of water representing $T_{1,}$ T_2, T_3, T_4, and T_5 respectively in a completely Randomized Design. Each treatment was replicated three times with 15 birds in each replicate. Feed and water were given ad libitum. There was no significant (P>0.05) differences in weight gain, feed and water intakes, feed conversion and protein efficiency ratios of the birds among the treatments. NSE had significant influence (P< 0.05) on the packed cell volume, red blood and white blood cells. There was no significant (P>0.05) difference in the haemoglobin, serum protein, albumin, globulin, triglyceride and cholesterol level of the birds. There were marked (P>0.05) variations in the glucose, HDL and LDL of the blood. In conclusion, results of this study indicate that NSE could therefore be used in broiler production without any deleterious effect on the growth, haematology and serum biochemical parameters of broiler chicks.
***Keywords*: Azadiradita indica, broilers, growth, haematology, serum cholesterol**

INTRODUCTION
In Nigeria, many herbal products have been used as growth promoters and preventive remedies for several infections in poultry birds because of their availability, suitability, lower cost of production, reduced risks of toxicity and minimum health hazards. Researchers have identified several beneficial chemical compounds in medicinal plants, which play an important role in improving production and immune system of birds against different diseases and have strong medicinal value and could be effectively utilized as natural growth promoters to replace antibiotics and other synthetic feed additives (Durrani et al., 2007). Neem tree as one of the most researched tree in the world has attracted world-wide prominence due to its vast range of medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, hepatoprotective and various other properties without showing any adverse effects (Kale et al., 2003). Although the beneficial effects of incorporating neem leaf and seed meal into poultry feeds on the performance have been reported, data on the effects of neem seed extract on the health status and growth performance of birds are still scanty. The study therefore is to determine the effect of neem seed extract on the performance, haematology and serum biochemistry broiler chicks.

MATERIALS AND METHODS
The experimental protocol was approved by the Animal Care Committee of the Ebonyi State University, Abakaliki, Ebonyi State, Nigeria. 225, 7 day old broiler chicks were randomly assigned to five treatment which contained 0, 15, 30, 45 and 60ml NSE per litre of water representing $T_{1,}$ T_2, T_3, T_4, and T_5 respectively in a completely Randomized Design. Each treatment was replicated three times with 15 birds in each replicate. Feed and water were given *ad libitum*. Data on weight gain, feed intake and feed conversion ratio
At the end of the feeding trial, 2mls of blood sample were collected from 4 birds that were randomly selected from each replicate and put into sample bottles containing ethylene diamine-tetra acetic acid (EDTA) which served as anticoagulant for haematological analysis (Jain, 1986). Another 2mls of blood sample were collected for serum biochemical indices such as triglyceride, total cholesterol, total glucose, high density lipid, low density lipid, total protein, albumin and globulin were evaluated.
Data were analyzed according to the ANOVA model, using the GLM procedure of the Statistical Package for the Social Sciences (SPSS, 1999). When significant treatment effects were observed, differences between treatment means were tested by Duncan's multiple range test (SPSS, 1999).

RESULTS AND DISCUSSION

The result on the effect of *A. indica* seed extract on the growth performance of starter broilers are presented in the Table 1. There was no significant (P>0.05) difference in weight gain, feed and water intakes, feed conversion and protein efficiency ratios of the birds among the treatments.

Table 1: Effect of *A. indica* seed extract on the growth performance of starter broilers

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial body weight (g)	125.75	124.82	125.74	126.14	125.91	83.68
Final body weight (g)	1303.88	1249.44	1145.90	1202.91	1291.79	55.25
Bodyweight gain (g)	1178.13	1121.62	1020.16	1076.77	1165.88	55.68
Daily weight gain (g)	42.07	40.06	36.46	38.45	41.62	1.97
Total feed intake (g)	2338.16	2328.79	2221.13	2370.30	2363.72	134.51
Daily feed intake (g)	83.50	83.17	79.32	84.64	84.41	4.80
Total water intake (ml)	4785.89	4953.75	4517.93	4724.59	4858.40	292.60
Daily water intake (ml)	170.92	176.91	167.27	175.87	173.50	11.31
Feed water ratio	1:2.03	1:2.12	1:2.10	1:2.08	1:207	0.09
Feed conversion ratio	1.97	2.07	2.17	2.20	2.03	0.09
Daily protein intake	17.53	17.46	16.65	17.77	17.72	1.00
Protein efficiency ratio	2.40	2.29	2.18	2.17	2.19	0.28

The comparable weight gain of the birds fed neem seed extract and the control is an indication that quantity of toxicants (terpenes and limonoids) (Ogbuewu et al., 2001; Kabeh and Jalingo, 2007) was negligible to have depressed the growth of the birds served the treated water. The lack of variation in feed and water consumption of the birds is an indication that the concentration of active principles salanolide meliacin (Garg, 1989) and tignic acid (Lale, 2002) were within the tolerable limits of the birds fed neem seed extract. Significant (P>0.05) differences did not exist in feed conversion and protein efficiency ratios among the treatment groups This is an indication that the Neem leaf extract did not impair nutrient availability, digestion, absorption and utilization. This is evident in the comparable weight gain of the birds (Onu and Aniebo, 2011).

The effects of neem seed extract on the haematology indices of broiler starter as presented in Table 2. There were significant (P< 0.05) differences in the PCV, RBC, WBC and MCH of the birds among the treatment. NSE significantly decreased the PCV and WBC of the birds as the level increases (Gowda et al., 1998; Biu et al., 2009). There was no significant difference in the HB, MCV and MCHC of the birds among the treatment. The haematological values were still within the moral range for healthy broiler chicken reported Anon (1980).

Table 2: Haemogical parameters of starters broilers served *A. indica* seed Extract supplement

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Packed cell volume (%)	27.67^a	27.00^b	26.67^c	26.33^d	24.26^e	0.3
Haemoglobin (g/dl)	9.20	9.00	8.81	8.33	8.23	0.33
Red blood cell (x10^6/L)	2.02^b	2.30^b	2.18^b	2.82^b	2.36^b	0.09
White blood cell (x10^6/L)	23.06^a	21.86^b	20.86^c	20.50^d	19.33^e	0.79
Mean cell volume (FL)	120.43	125 07	119.33	118.33	112.43	16.29
Mean.corpusular Haemoglobin (pg)	45.43^a	39.27^a	40.73^a	29.53^a	35.10^a	1.84
Mean corpuscular Haemoglobin Conc.(g/dl)	33.23	33.33	33.23	31.73	33.40	0.70
Triglycerde (mg/dl)	127.33^b	146.27^b	137.00^b	152.13^b	130.23^a	3.48
Total cholesterol (mg/dl)	96.67	90.20	113.77	114.70	103.77	16.02
Total glucose	57.43	59.87	63.27	64.23	74.47	3.48
High density lipid (mg/dl)	33.43^{ab}	36.70^b	38.37^b	40.07^b	43.33^a	0.74
Low density lipid(mg/dl)	56.23^a	49.33^b	49.50^b	43.20^{bc}	36.40^c	1.68
Total protein (g/dl)	7.83	7.87	7.13	7.93	7.53	0.15
Albumin (g/dl)	4.67	4.63	4.50	4.67	4.33	0.17

a, b, c.d means with different superscript differ significantly.

The treatment did not significantly (P>0.05) influence the protein, albumin, globulin, triglyceride and cholesterol level of the blood. There were marked (P>0.05) variations in the glucose, HDL and LDL of the blood. The non-significant (p>0.05) effect of NSE on total protein, cholesterol, glucose and albumin obtained suggests nutritional adequacy of the NSE for starter broilers. In conclusion, results of this study indicate that NSE could therefore be used in broiler production without any deleterious effect on the growth, haematology and serum biochemical parameters of broiler chicks.

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