AGRICULTURAL ECONOMICS

AND

EXTENSION

Journal of Applied Agricultural Research 2021, 9(1): 2-11
ISSN 2006-750X

CHOICE OF OFF-FARM LIVELIHOOD ACTIVITIES AMONG FEMALE-HEADED HOUSEHOLDS IN RURAL COMMUNITIES OF IMO STATE, NIGERIA

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ABSTRACT

The study analyzed choice of off–farm livelihood activities among female-headed households in rural communities of Imo State, Nigeria. Specifically, it assessed perceived factors influencing respondents in choice of off-farm livelihood activities, examined constraints to choice of off-farm livelihood activities and determined factors influencing choice of off-farm livelihood activities among respondents in the study area. Snow ball and simple random sampling techniques were used to select one hundred and sixty (160) respondents. Data were collected with a structured questionnaire and analyzed using descriptive statistics and inferential statistics (multi Logit regression analysis). The results indicate that respondents had positive perception of off-farm livelihood activities ($\bar{X}$=2.7) and were constrained ($\bar{X}$=2.1) in choosing these livelihood activities. Multi Logit regression analysis result showed that coefficients of income (0.0558**), diversification (- 0.0316**), household food security (0.0795***) and seasonality of product (- 0.0354**) influenced respondents' choice of off-farm activities. Female headed households should engage and diversify to livelihood activities that offer more remuneration activities to supplement agricultural income, has potentials value addition and food security were advocated.

Key words: Choice, Off-farm, Livelihood, Female-headed, Rural Communities

INTRODUCTION

Most of the female headed rural households in developing countries especially rely on incomes from different livelihood sources. Off-farm economic activities are activities established and most popular means of livelihood economies prevalent in rural areas. Female headed households diversify their sources of income owing to the risks and uncertainties that characterize agriculture, in developing countries through non-farm activities (Ibekwe, Eze, Ohajianya, Orebiyi, Onyemauwa and Korie, 2010). The rural economy in Nigeria is characterized by off-farm economic activities which are supplementary or complementary activities that women engage in either off-season or on-season to support themselves such as casual labour, civil service, baking, petty trading, hair dressing, tailoring, fish smoking, fuel wood gathering (Ibidapo, Oso and Ogunsipe.

2017). These activities are means employment options apart from farming intended to curb and reduce rural urban migration, promote income distribution and diversification. These activities assist the farmers tackle the problems that emanate from seasonality of agricultural production as it concerns labour, output and income (Odoh and Nwibo, 2017).

Several authors Nwaobiala and Okeke, 2020a, Nwaobiala and Okeke, 2020b, Tikwe *et al*., 2018, Obinna and Onu, 2017 suggest that the highly diverse and heterogeneous rural non-farm sector offers opportunity for the poor as well as the rich. Poor households frequently seek economic refuge through distress diversification into low skill non-farm employment such as engaging in self-employment activities like weaving/spinning, soap making and selling fire wood (Kagbu and Issa, 2016). Olusola, Idowu, Aihonsu, Olubanjo and Shittu, (2011) averred that livelihood choices can be compromised by gender differences in reproductive responsibilities and access to productive resources (land, capital, labor), as well as gender biases in social systems and infrastructure. Female household heads, in particular, face different constraints based on their unique position in the household including their often sole responsibility for income generation and reproductive work, and higher dependency burden than their male-headed counterparts. Charles and Ahmed (2012) opined that rural women are seeking for diversified opportunities to increase and stabilize their incomes which are determined by their portfolio of assets - social, human, financial natural and physical capital. Rural off-farm economic activities can help absorb surplus labour in rural areas, help farm-based households spread risks, offer more remunerative activities to supplement agricultural income, provide income during the agricultural off-season and serve as coping strategy in an event of uncertainties (Loughrey and Knapp, 2017; Adjognon, Liverpool-Tasie, Benfica and De la Fuente, 2017).

Nwaobiala, (2017) assert that the choice of livelihood activities by women in rural communities is not as assumed by some studies in the literature to be freely made but is subjected to the natural and physical endowments of the family. Development resulting from the change of many rural households to switch over to alternative economic activities is because of the risk minimization strategy motive of income diversification (Briones, 2017). In addition, as asserted by poverty and economic change not only impose unequal costs and burden on household members, but gender identities of household heads also visibly shape the choice of livelihood activities of household members in rural communities Mshelizah, Ajayi, Tsad and Ibrahim, 2018) However, different studies have reported varieties of choices of off-farm livelihood activities available for rural households. Despite these findings, there seems to exist no empirical studies on the determinants of these choices of female-headed households in Imo State Nigeria, hence the need for this study.

Specific Objectives were to:

i. Assess the perceived factors influencing respondents in choosing off-farm livelihood activities
ii. Examine constraints to respondents' choice of off-farm livelihood activities; and
iii. Determine the factors that influence respondents' choice of off-farm livelihood activities among respondents in the study area.

METHODOLOGY

Study Area and Description

The study was carried out in Imo State, Nigeria. The State lies within Latitudes 4^{o} 45'N and 7^{o} 15'N, and Longitude 6^{o} 50'E and 7^{o} 25'E. It occupies the area between the lower River Niger and the upper and middle Imo River. The State is bounded on the east by Abia state, on the west by River Niger and Delta state; and on the north by Anambra State, while Rivers state lies to the south. The state is located within the rainforest belt of Nigeria, and the temperature ranges between 20^{o} C and 30^{o} C. Agriculture is the major occupation of the people. The State has a projected population of 3,934,899 persons (National Population Commission, 2017). The major crops produced includes cassava, yam, cocoyam, maize, and melon. Imo state is made up of 27 Local Government Areas (LGAs) and three Agricultural zones of Okigwe, Owerri and Orlu. The population for this study comprised of all female household heads in rural communities of Imo State.

Sampling Technique and Sample Size

The target population of this study comprised of all female households in rural communities in Imo State. Purposive and multistage stage random sampling techniques were adopted in the selection of Local Government Areas (LGAs,) communities, women groups and respondents. Purposively, the respondents were randomly selected based on widow, absentee husbands and relegation of roles to the more favoured female in the house. First, ten (10) LGAs were randomly selected namely: Aboh Mbaise, Ahiazu Mbaise, Ehime Mbano, Ikeduru, Isiala Mbano, Nkwerre, Obowo, Okigwe, Oguta and Isu out of the twenty-one (21) LGAs that make up the state. From, the selected LGAs, two (2) Rural communities each namely; Nguru-Nweke, Aboh, Oru Ahiara, Afor-Oru, Nsu, Umeze 1, Akabo/Amatta, Abazu, Umuduru, Isiebu, Amaigbo, Obinuhu, Umulogho, Avutu, Ope, Ubaha, Okeichi, Obutu, Umudigo and Umudike were randomly selected to give a total of twenty (20) communities. Also, two (2) active women groups each namely: Aladinma Women Association, Umuada Meeting, Umuamaraulo, Ahiaeke Women Group, St. Peter's Women's Guild, Achara Women Group, Ukoma Wives Forum, St. Joseph's CWO, St. Mark's CWO, Umuamara Village Meeting, Afo di Nkpa Women Association, Umuhu Home/Abroad Women, Atta Home/Abroad Women, Umuna Home/Abroad Meeting, St. Paul's Mother Union, Ezeoke Nsu Cathedral Women Group, Umudim Women Association, Eziobodo Intercessors, Uboma Wailing Women, Ikpa Progressive Mothers Forum, St. John's CWO Añara, Awuchi Home/Abroad Women, Avutu Women Group, Ozimba Meeting, Dorcas Charity Women Organization, Okigwe South Mother Union, Ikeduru Mothers Union, Owerri Nta Women Welfare Group, Obiakpo Home/Abroad Women, Ehume Umuada, Ugwunwanyi Women Association, Obiwuruotu Women Union, Aladinma Women Association, Obichineyere Progressive Front, Umuchiako Women Prayer Group, St. Philip's Avom Women Group, Amaram Umuada Women Organization, Umuchima Women Group, St. Luke's Avom CWO, were randomly selected from the selected communities to give a total of forty (40) women groups. Finally, simple sampling procedure was used to select four (4) female household heads each based on the set criteria to give a total of 160 respondents.

Data Analysis

Descriptive statistics such as frequency counts, percentages and means were used to realize objectives i and ii while objective iii was tested using multinomial logit regression analysis.

Measurement of Variables

a. The perceived factors influencing respondents' choice of off-farm livelihood activities in the study area was measured on a 4-point likert-type rating scale to derive the mean scores. The rating scores were assigned as follows: strongly agree =4, agree =3, disagree =2 and disagree =1. Respondents' mean scores were computed for each of the statements by adding the weight 4=3+2+1=10 and divided by 4 to give a mid-point of 2.5. Mean score greater than or equal to 2.5 implied positive factor and otherwise negative factor.

b. Constraints to choice of Off-farm livelihood activities among female-headed households was measured on a 3 - point likert-type rating scale to derive the mean scores. The rating scores were assigned as follows: Severe = 3, Mild = 2 and No = 1. Respondents' mean scores were computed for each of the statements by adding the weight 3+ 2+1=6 and dividing by 3 to give 2.0. The following decision rule was obtained1.00-1.50 (low), 1.50-1.99 (moderate), 2.0 and above (high).

Model Specification

The multinomial logit regression analysis was used in determining the factors that influence respondents' choice of off-farm livelihood activities. Economic choice theory suggested that individuals are rational and if faced with decision to choose between two or more alternatives, will prefer the option that provides maximum level of utility (Mbaye *et al*., 2014). Therefore, female household heads are expected, given a choice of livelihood activities to choose in order to maximize their utility. Pij is the probability associated with on-farm and off-farm livelihood activities choice of a household 1 with j = I, if the respondent chooses on-farm activity.

The general form of the multinomial Logit is:

$P(yi = j/xi) = \text{explanatory } (\beta jXi\ 1 + \sum^{J}_{j=1} \exp(\beta jXi)$ …… (1)

$P(yi = 0) = 1 + C^{J}_{j=1}\text{explanatory } (\beta jXi)$ …… (2)

Where, for the i^{th} individual,

P(y = j/xi) denotes the probability associated with on-farm activities of a female-headed household I with j = 1 if the respondents participates in off-farm activities; j = 2; yi is observed outcome and Xi is a vector of explanatory variables that affect the response probabilities, P(y=j/x, j=1 &2.

This model for the study is summarized as follows:

Pij= explanatory (yjxi)

$1+ \sum^{2}_{j=1}$explanatory (yixi) for j=1&2

Pij is the probability of being in each of the groups 1 and2

Pi0 is the probability of being in the reference group or group 0.

The coefficient of the reference group is normalized to zero when estimating the model in practice (Sekumade, and Osundare, (2014); Asiga, (2013). This is due to the fact that the probability for both choices must sum up to unity. Hence for the two choices, the estimated equation is given as:

In= (Pij) (Pio) yixi

This denotes that the relative probability of each of the groups 1 and 2 to the probability of the reference group. The estimated coefficients for each choice therefore reflect the effects of Xi's on the likelihood of the female-headed households choosing that alternative relative to the reference group. Hence, for each explanatory variable,

negative of the sum of its parameters for groups 1 and 2 is the parameter for reference group.

The explicit form of the function is specified as follows:

$Pij = \beta_o + \beta_1 + \beta_2 + \beta_3 \ldots\ldots\ldots\ldots \beta_9 + \mu i$

Where,

βo = constant

$\beta_1 - \beta_9$ = Regression Coefficient

Y = choice of livelihood activities (on-farm 1, off-farm 0)

Yi is the observed outcome and Xi is a vector of explanatory variables that affect the response probabilities P(y=1/xi) = 1, 2 ……

Y = choice of livelihood activities (the probability of female-headed households engaging in off-farm activities ranges from 0 - 1)

β_1= income (yes = 1, otherwise = 0)

β_2= value addition (yes = 1, otherwise = 0)

β_3= increased output (yes = 1, otherwise = 0)

β_4= diversification (yes = 1, otherwise = 0)

β_5=household food security (yes=1, otherwise = 0)

β_6=high return on investment (yes = 1, otherwise = 0)

β_7= less capital (yes = 1, otherwise = 0)

β_8= seasonality of product (yes = 1, otherwise = 0)

β_9= access to capital (yes = 1, otherwise = 0)

$e_{i=}$ error term

Perceived factors influencing choice of off-farm livelihood activities

Result in Table 1 shows the mean distribution of respondents according to perceived factors influencing choice of off - farm livelihood activities. The result indicates that respondents perceived that off-farm livelihood activities it serve as avenue to solve family need ($\overline{X}$=3.7), as income generating activity ($\overline{X}$=3.6), as a part time job ($\overline{X}$=3.4) and as a convenient means of livelihood source ($\overline{X}$ =3.1), it does not require drudgery in farming activities ($\overline{X}$=3.2). The respondents also agreed that off-farm livelihood activities are time solving and adds value to business ($\overline{X}$=3.0), because of socio-cultural factors and non-availability of extension services in disseminating information ($\overline{X}$=2.6). The result indicates that all the perceived statements on off-farm livelihood activities had positive perception ($\overline{X}$=2.7). This result is in tandem with the findings of Food and Agricultural Organization (2015) that women account for self-employed jobs as they engage in weaving, knitting non-farm wage labourers, entrepreneurs, traders and providers of services in rural communities. Adesoji, Olanrewaju and Kolawole, (2014), Taiwo, Yekini and Oyediji, (2017), affirmed that the importance of off-farm livelihood activities engaged by female household heads livelihood portfolio is the remittances from non-agricultural activities which serves as an additional income to solve family need

Constraints to choice of off-farm livelihood activities.

The distribution of respondents according to constraint to choice of off-farm livelihood activities is shown in Table 2. The result indicates that poor electricity supply and high cost of raw materials ($\overline{X}$=2.6), poor road network ($\overline{X}$=2.5), inadequate training and retraining of staff ($\overline{X}$ =2.4), poor salary remuneration and poor access to loan facilities ($\overline{X}$ =2.3) were the constraints affecting choice of off-farm livelihood activities in the study area. Also, inadequate incentives ($\overline{X}$=2.1) and non-payment of salaries were other constraints encountered by the respondents in choosing on-farm livelihood activities. The mean constraints of 2.2 indicate that the constraints were severe. This result is in tandem with Adeleke *et al.*, (2019) and Kelechi, (2014), assert that the proportion of women was lower than the men

in both non - agricultural sector and rural non-farm sectors due to cultural factors persistent which impede women involvement in off-farming activities as impediment to off-farm livelihood choices of women in Nigeria.

Factors influencing respondents' choice of off-farm livelihood activities

Result in Table 3 shows the multi logit regression estimates of the determinants of choice of off-farm livelihood activities among farmers in the study area. The results show a Chi^2 value of 18.15 which was significant at 5.0% level of probability indicating goodness of fit of the Logit regression line. The pseudo R^2 value of 0.5312 indicates 53.12% variability in probability of choice of off-farm livelihood activities among the farmers in the study area. The estimated Log -likelihood was 134.70624. The coefficient income (0.0558) was positive and significant at 5.0% level of probability. This implies that any increase in income will lead to a corresponding increase in choice of off-farm activities in the study area. The result is in consonance with the findings of Gimenez *et al*., (2013) that income influences choice of off-farm activities thereby reducing poverty. The coefficient of diversification (- 0.0316) was negative and significant at 5% level of probability. This implies that any increase in diversification will lead to a corresponding decreasing in probability of engagement in off-farm activities among the respondents in the study area. This result is in tandem with Ajani *et al.,* (2016) as they found that diversification influences household livelihood activities. The coefficient of household food security was (0.0795) positive and highly significant at 1.0% level probability. This implies that any increase in household food security will lead to a corresponding increase in probability of engagement in off-farm activities in the study area. The result corroborates with Adepoju and Olabaijelu (2013) as they revealed that livelihood activities have a positive effect on food security status of rural households. The coefficient of seasonality of product (-0.0354) was negative and significant at 5.0% level of probability. This implies any increase in seasonality of product will lead to a corresponding decrease in choice of engagement in off-farm livelihood activities in the study area. This result is in agreement with Eneyew & Bekele (2012) as they found that livelihood strategies assure seasonality of products produced during lean periods.

CONCLUSION AND RECOMMENDATIONS

Female headed households had favourable perception on off - farm livelihood activities and were constrained to choosing these activities. Income, diversification, household food security and seasonality of product were factors that influenced choice of off-farm activities among female household heads. Poor electricity supply, high cost of raw materials and poor road network were the major constraints to choice of off-farm livelihood activities among the respondents in the study area.

Based on the findings of the study, the following recommendations are made;

i. Women engagement in off – farm livelihood activities that has the potential for generating higher income is advocated.
ii. Extension should disseminate value addition technologies to the women in order to for them to be food secure.
iii. Female headed households should diversify by engaging in livelihood

activities that tend to support income from other sources.

iv. Provision of rural infrastructure by Government and rural development

v. Agencies will enhance engagement and choice of female headed households in off-farm livelihood activities in the study area.

Table 1: Mean distribution of respondents according to perceived factors influencing choice of off-farm livelihood activities

Perceived statements	SA	A	D	SD	Total	Mean
The choice of the activities has led to increase in your income	103(412)	48(144)	10(20)	2(2)	578	3.6
Off-farm activities were chosen as part time job	61(244)	37(111)	80(160)	22(22)	537	3.4
The choice is occasioned by the drudgery in farming	79(316)	50(150)	21(42)	10(10)	518	3.2
You considered time factor for the choice	61(244)	47(141)	48(96)	4(4)	485	3.0
Socio-cultural factors made you choose off-farm livelihood activities	42(168)	45(135)	43(86)	30(30)	419	2.6
Ineffective government agricultural policies affects you	58(232)	48(144)	32(63)	20(20)	459	2.9
Off-farm livelihood activities serves as avenue to solve family needs	121(484)	32(96)	5(10)	2(2)	592	3.7
Chosen because extension services not readily available	38(152)	40(120)	61(122)	23(23)	417	2.6
Choice of off-farm livelihood activities has offered you value addition	61(244)	45(135)	44(88)	10(10)	477	3.0
Off-farm livelihood activities is more convenient for you	82(328)	35(105)	18(36)	25(25)	494	3.1
Total						31.1
Grand mean						3.1

Source: *Field survey, 2018*

Table 2: Distribution of respondents according to constraints to off-farm livelihood activities

Constraints	Severe	Mild	No	Total	Mean
Poor salary remuneration	69(207)	75(150)	16(16)	373	2.3*
Poor access to loan facilities	81(243)	49(98)	30(30)	371	2.3*
Non-payment of salary	52(156)	51(102)	57(57)	315	2.0*
High cost of processing equipment	36(108)	25(50)	99(90)	245	1.6
Inadequate training and re-training	45(135)	31(62)	84(84)	281	2.4*
Inadequate incentives	69(207)	44(88)	47(47)	342	2.1*
Poor electricity supply	101(303)	48(96)	11(11)	410	2.6*
High cost of raw materials	95(285)	53(106)	22(22)	413	2.6*
Poor road network	99(297)	43(86)	18(18)	401	2.5*
Perishability of products	12(36)	45(90)	103(103)	229	1.4
Total					21.8
Grand Mean					2.1

Source*: Field survey, 2018*

Table 3: Multinomial logit regression estimates of the determinants of choice of off-farm livelihood activities among farmers in the study area

Variables	Coefficients	Standard Error	T – value
Constant	0.8064	0.0361	22.37***
Increased income	0.0558	0.0214	2.60**
Value addition	- 0.0074	0.0316	- 0.23
Increased output	0.0085	0.0219	0.39
Diversification	- 0.0316	0.0191	-1.96**
Household food security	0.0795	0.0206	3.86***
Higher return in investment	- 0.0020	0.0242	- 0.08
Less capital	- 0.0028	0.0199	- 0.14
Seasonality of product	- 0.0354	0.0209	- 1.99**
Access to capital	0.0187	0.02157	0.87
Chi^2 ($\varkappa^2$)	18.15		
Pseudo R^2	0.5312		
Log –likelihood	134.70624		

Source: *STATA BA Results*

**P≤0.05 and ***P≤ 0.01

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Journal of Applied Agricultural Research 2021, 9(1): 12-20
ISSN 2006-750X

COST-BENEFIT ANALYSIS OF ALTERNATE WEED MANAGEMENT STRATEGIES IN UPLAND RICE

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ABSTRACT

Rice is infested with a wide variety of weeds and the losses due to weeds could go as high as 43%. A range of weed management strategies are being used for the effective control of weeds in upland rice. Economic considerations, particularly profit, are important to farmers in driving the adoption of agricultural innovations. Experiments were conducted in 2016 and 2017 raining seasons at Audu Bako College of Agriculture Dambatta research farm in Kano State of Nigeria to evaluate the efficacy and economic benefits of some pre, post emergence herbicides and hoe weeding on weed control. The experiment consisted of twenty weed control strategies: use of Butachlor at two levels i.e 1.0 and 1.5 kg a.i. ha^{-1} (pre-emergence), Orizo-plus (2,4-D+Propanil) at two levels i.e. 2.8 and 4.5 kg a.i. ha^{-1}, Rainbow-OD (Penoxsulam) at two levels i.e 0.025 and 0.030 kg a.i. ha^{-1} and Solito 320 EC (Pretilachlor+Pyribenzoxim) also at two levels i.e 0.320 and 0.480 kg a.i. ha^{-1} (post-emergence). All the post-emergence herbicides were applied in various combinations with Butachlor and in some cases followed by supplementary hoe weeding (SHW) at 4 weeks after sowing (WAS), or at 8 WAS or at 4 & 8 WAS. Hoe weeded and weedy plots were employed to serve as control. The experiments were laid out using randomized complete block design and replicated four times. The result indicated that use of Butachlor at 1.5 kg a.i. ha^{-1}fb Orizo plus at 4.5 kg a.i. ha^{-1} gave significantly higher paddy yield and cost-benefit.

Key words: Butachlor, Cost-Benefit, Rice, Weed

BACKGROUND INFORMATION

Rice (*Oryza sativa* L.) is a principal source of food for more than half of the world's population, especially in South and Southeast Asia, Latin America and Africa (Rao *et al.*, 2007). In Nigeria rice is a staple food and is consumed by individuals across all levels of incomes. Global land area for paddy production in 2017 was estimated at 163.8 million hectares, yields remained close to that of 2015 at an average of 4.6 tonnes per hectare and the total world production in 2017 was 756.7 million tonnes (FAO, 2017). Nigeria is the second largest producer of rice in Africa with a total of 5.4 million tonnes of paddy rice in 2017 (FAO, 2017). Rainfed upland rice estimated share is 30% of national rice area and the average yield is 1.9 tonnes ha^{-1} (Anonymous, 2014). The Nigerian government is refocusing attention on stimulating domestic rice production through a number of strategies, such as dry season rice production, expansion of land for rice production, developing new agronomic technologies such as aerobic rice production system, provision of incentive to rice farmers, establishment of local rice processing plants, pest and diseases control and ban on rice importation. Nigeria has the potential to be self-sufficient in rice production, both for food and industrial raw material needs and for export.

However, a number of constraints have been identified as limiting to rice production efforts by farmers. Ukungwu and Abo (2004) reported that, weed is the greatest bottleneck to increased yields and quality of rice in Nigeria, particularly in the upland ecology and it ranks only second to drought stress.

Weed managements strategies may have benefits for the control of rice weeds by delaying the development of resistance and/or allowing the control of herbicide-resistant weeds. In most cases, economic considerations, particularly profit, are important to farmers in driving the adoption of agricultural innovations (Pannell *et al*., 2006). Nevertheless, the inherent complexity of decision making in terms of weighting the relative benefits and costs of weed control options makes it difficult to identify economically advantageous actions. One of the important factor that can lead increased rice production is to minimize crop loss which is caused by weed competition because weeds do not only reduce the rice production but also have an adverse effect on rice grain quality. One of the most labour demanding operations in rice production is weed control, and no single weed control method will give satisfactory weed control in all rice ecologies in Nigeria (Ishaya and Dauda, 2010). The aim of the study was to determine the economic advantage of alternate weed management strategies in upland rice production system

Experimental Sites

The experiments were conducted in 2016 and 2017 raining seasons at Audu Bako College of Agriculture Dambatta research farm (110 39'N;08'02E) in Kano State of Nigeria within the Sudan savanna agro-ecological zone of Nigeria. The total amount of rainfall received in the area was 863 mm and 820 mm for 2016 and 2017 respectively. The minimum and maximum temperatures were 24.10^{C} and 32.60^{C} for 2016, and 23.80^{C} and 33.40^{C} for 2017 respectively (Audu Bako College of Agriculture Weather Station 2016 & 2017). The soil is sandy loam with a neutral soil pH. Total nitrogen content and organic matter were generally low; however, available P was high in the soil. The soil also contains moderate potassium and calcium content with low cation exchange capacity (CEC) (Soil science laboratory, Bayero University Kano, 2016)

Treatments and Experimental Design

The treatment consisted of twenty weed control strategies which includes; use of Butachlor at two levels (1 and 1.5 kg a.i. ha^{-1}), Orizo-plus at two levels 2.8 kg a.i. ha^{-1} (1.0 2,4-D +1.8 Propanil) and 4.5 kg a.i. ha^{-1} (1.6 2,4-D + 2.88 Propanil), Penoxsulam (Rainbow-OD) at two levels (0.025g and 0.030g a.i. ha^{-1}) and Pretilachlor + Pyribenzoxim mixture (Solito 320 EC) also at two levels 0.320 g a.i. ha^{-1} and 0.480 g a.i. ha^{-1} all treatments were applied in various combinations with Butachlor as pre-emergence and in some cases followed by supplementary hoe weeding (SHW). Weed free (hoe weeded) and weedy plots were employed to serve as control among the treatments. The experiment was laid out using randomized complete block design and replicated four times. The gross size of the plot was 3x3m while the net plot is 2.4x2.4m. However, a discard of 1m and 50cm was provided between the blocks and individual plots respectively.

Table 1: Total variable cost and inputs of one hectare of upland rice at Dambatta in 2016/2017

S/N	Item/Operation	Quantity/ha	Unit Price (N)	Total Cost (N)
1	Land clearance	10,000	8,000	8,000
2	Land preparation	50,000	50,000	50,000
3	Cost of seed	120 kg	12,000	12,000
4	Planting operation	13,000	13,000	13,000
5	Cost of herbicides (Butachlor PE)	As par treatment	1,500/l	As par treatment
6	Cost of herbicides (Orizo plus POE)	As par treatment	2,500/l	As par treatment
7	Cost of herbicides (Rainbow POE)	As par treatment	9,650/L	As par treatment
8	Cost of herbicides (Solito POE)	As par treatment	3300/L	As par treatment
9	Cost of herbicide application	18 unit	300/16l	5,400
10	Hoe weeding	As par treatment	15,000/ha	As par treatment
11	Cost Fertilizer and application	8 bags	5,500	50,000
12	Cost of insecticides/application	2l	4,000	4,000
13	Harvesting activities per bag	*	750/bag	*
14	Cost of bag	*	100/bag	*
15	Transportation	*	100/bag	*
16	Miscellaneous	5,000	5,000	5,000

*Depend on the total yield per hectare

PE – Pre-emergence POE – post emergence

Data Collection

Weed species composition

Weeds were harvested from a $1m^2$ quadrant placed randomly in each net plot at harvest. The harvested weed samples were identified and classified by species with the help of a Hand Book of West African Weeds by Akobundu and Agyakwa (1998) and in consultation with weed scientists.

Paddy yield (kg ha^{-1})

This was obtained by threshing the panicles from the net plot and winnowed in the air to get a refined grain. The yield obtained from the net plot was converted to per hectare basis in kilogram. The yield was adjusted to 10 % seed moisture content.

Stover yield (kg ha^{-1})

The stover obtained from each of the plots after harvesting the grain were sun dried and weighed, the weight obtained was converted to per hectare basis in kilogram.

Harvest index (HI %)

This was estimated by dividing the paddy yield with the biological yield and multiplied by 100 to get percentage for each of the plots by using the formula below

$$HI = \frac{\text{Paddy yield (kg ha}^{-1})}{\text{Total biological yield (kg ha}^{-1})} \times 100$$

NB:

- Paddy yield - is the weight of the clean paddy yield after harvesting in kilogram per hectare
- Biological yield - is the weight of both the paddy and the stover yield taken after sun drying before threshing in kilogram.

Cost-Benefit Analysis

An economic assessment was done to determine the production cost, revenue and the gross margin that was derived from each of the treatments. The cost of all inputs was recorded along with the price of the produce at the farm gate price. The gross margin (GM) was obtained by subtracting

the total variable cost (TVC) of production from the total revenue (TR) (Olukosi and Erhabor, 1988). The profitability index, also known as cost-benefits analysis measures the rate of return on investment and gives the amount of profit on every Naira invested in each of the weed control methods. It is expressed as GM/ha =TR-TVC, where Cost-Benefit ratio (C:B) = TR/TVC, GM = Gross margin/ha, TR = total revenue/ha and TVC = total variable cost/ha of each of the weed control methods.

Data Analysis

Data collected were subjected to analysis of variance using the general linear model in SAS (SAS, 2004). Where significant, the treatments means were separated by using Student-Newman-Keuls test (SNK).

RESULTS AND DISCUSSION

Weed Species Composition

There were a total of fifteen (15) weed species identified in 2016 (Table 1). Seven were broad leaved; grasses and sedges were four each. *Fimbristylis* ferruginea (L.) Vahl had the highest relative frequency 0f 8.5% while the least figure was recorded by *Oryza longistaminata* (A.) Chev. (2.5%). However, in 2017 a total of sixteen (16) weed species were identified (Table 1). Seven were broad leaved; while four and five grasses and sedges were identified respectively. *Cyperus esculantus* (L.) had the highest relative frequency of 8.5% while the least figure was recorded by *Ageratum conyzoides* (L.) (2.3%)

Paddy yield (kg ha^{-1})

Results on the performance of weed control methods on paddy yield of upland rice in 2016 and 2017 raining seasons is presented in Table 2. Paddy yield was significantly affected ($P \leq 0.05$) by weed control strategies in both growing seasons. Application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo at 4.5 kg a.i.ha^{-1} produced the highest paddy yield. In 2017 raining season however, application of Butachlor at 1.5 kg a.i. ha^{-1} fb Orizo plus at 4.5 kg a.i.ha^{-1} was at par the application of Butachlor at 1.5 kg a.i. ha^{-1} fb Orizo plus at 2.8 kg a.i.ha^{-1}, Butachlor at 1.0 kg a.i. ha^{-1} fb Rainbow at 0.030 kg a.i.ha^{-1}, Butachlor at 1.5 kg a.i. ha^{-1} fb Rainbow at 0.030 kg a.i.ha^{-1}, Butachlor at 1 kg a.i. ha^{-1} fb Solito at 0.320 kg a.i.ha^{-1}, Butachlor at 1.5 kg a.i. ha^{-1} fb Solito at 0.480 kg a.i.ha^{-1}, Butachlor at 1.5 kg a.i.ha^{-1} fb SHW at 4 WAS, Butachlor at 1.0 kg a.i.ha^{-1} fb SHW at 4 & 8 WAS, Butachlor at 1.5 kg a.i.ha^{-1} fb SHW at 4 & 8 WAS and hoe weeded control (at 2, 4, 6, & 8 WAS). The weedy check had the lowest paddy yield in both growing seasons.

Mahajan *et al.* (2009) reported that, herbicides are the most effective means of securing rice yields against weeds. Yawale *et al.* (2015) confirmed that, Application of Butachlor at the rate of 2.25 kg a.i. ha $^{-1}$ followed by Propanil - 2, 4 - D mixture at the rate of 2.52 and 1.44 kg a.i. ha^{-1} respectively, produced higher grain yield in upland rice, and this combination of herbicides corroborate with the one used in this experiment.

Stover yield (kgha^{-1})

Effect of weed control methods on stover yield in kilogram per hectare in 2016 and 2017 raining seasons is presented in Table 2. There were no significant differences in the stover yield of all the treatments evaluated in 2016. However, in 2017 raining season the highest stover yield was recorded by HWC, but this was at par with all the treatments, except Butachlor at 1.0 kg a.i.ha^{-1} fb Orizo at 4.5 kg a.i.ha^{-1}, Butachlor at 1.0 kg a.i.ha^{-1} fb Orizo at 2.8 kg a.i.ha^{-1}, Butachlor at 1.0 kg a.i.ha^{-1} fb Rainbow at 0.025 kg a.i.ha^{-1}, Butachlor at 1.5 kg a.i.ha^{-1} fb Solito at 0.480 kg a.i.ha^{-1}, Butachlor at 1.0 kg a.i.ha^{-1} fb SHW at 4 WAS, Butachlor at 1.5 kg a.i.ha^{-1} fb SHW at 4 & 8 WAS and the weedy check which was the lowest. This result implies that herbicides application does not affect the stover yield in rice to any significant extent, and the result is similar to the findings of Baloch *et al*., (2005) who state that

hoe weeded rice tend to produce more stover yield compared to herbicides use.

Harvest index (%)

The effect of weed control methods on harvest index (HI) in 2016 and 2017 raining seasons is presented in Table 2. The result indicated significant differences ($P \leq 0.05$) in both growing seasons. Application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo at 4.5 kg a.i. ha-^{1} and Butachlor at 1.0 kg a.i.ha^{-1} fb Orizo at 4.5 kg a.i. ha-^{1} produced the highest harvest index in 2016 but was at par with all the treatments except the weedy control. In 2017 however, the highest HI was recorded by the application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo at 4.5 kg a.i. ha-^{1} but was at par with all of the treatments except Butachlor at 1.5 kg a.i.ha^{-1} fb Rainbow at 0.030 kg a.i. ha-^{1}, Butachlor at 1.5 kg a.i. ha^{-1} fb SHW at 4 WAS, Butachlor at 1.5 kg a.i. ha^{-1} fb SHW at 8 WAS and the weedy check. The result indicate that, the net assimilate efficiency is higher in the treatment that produced highest yield and as such harvest index could be used predict yield especially in upland rice (Watson, 2010).

Cost-Benefit Ratio of Weed Control Methods

Analysis of cost-benefit ratio as affected by alternate weed control strategies on growing upland rice is presented in Table 3. It could be observed that in 2016 application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo plus at 4.5 kg a.i.ha^{-1} was more profitable with a cost-benefit ratio of 1.5 per Naira invested but was closely followed by the application of Butachlor at 1.0 kg a.i.ha^{-1} fb Orizo plus at 2.8 kg a.i.ha^{-1} and Butachlor at 1.5 kg a.i.ha^{-1} fb Rainbow at 0.030 kg a.i.ha^{-1}, with cost-benefit of 1.4. The least cost-benefit ratio of -0.9 was observed for Butachlor at 1.0 kg a.i.ha^{-1} fb SHW at 4 & 8 WAS and the weedy check.

In 2017 growing season however, application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo plus at 4.5 kg a.i.ha^{-1} was more profitable with a cost-benefit ratio of 1.5 per Naira invested but was closely followed by the application of Butachlor at 1.5 kg a.i.ha^{-1} fb SHW at 4 WAS with cost- benefit ratio of 1.4. The least cost-benefit ratio of -1.0 was observed for the weedy check.

Total variable cost of production, total revenue and other economic analysis of alternate weed control methods for growing upland rice per hectare had shown higher gross margin and cost-benefit ratio by the use of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo plus at 4.5 kg a.i.ha^{-1}. This is because chemical weed control is cheaper than other ways of weed control and it has good weed control ability which resulted into high yielding which lead to higher return with minimum labor cost. Application of Butachlor at 1.5 kg a.i.ha^{-1} fb Orizo plus at 4.5 kg a.i.ha^{-1} recorded highest net profit and gross margin per Naira invested during both 2016 and 2017 raining seasons. Jabran *et al.* (2012) reported higher productivity and economic returns with penoxsulam in rice production. Mandal *et al.* (2011) also reported that, both the gross return and net return were maximum under herbicides treatment combination. The weed control cost is maximum for hand weeding (two hand weeding at 30 and 45 DAT) and the lowest for chemical weed management (Hasanuzzaman *et al.*, 2007).

CONCLUSION

Base on the findings of this research work on upland rice production in the tropics, weed management strategies influence the productivity and profitability of rice farming particularly direct seeding and it quantify the net profit of about 50 % of the production cost that one can realize by effective use of herbicide especially pre-emergence application of Butachlor at1.5 kg a.i.ha^{-1} and followed by Orizo plus at 4.5 kg a.i.ha^{-1} (Post-emergence).

Table 2: Weed Species Composition and Frequency of the Experimental Site in 2016 and 2017 Rainy Seasons

2016			2017		
Weed species	Common name	Frequency (%)	Weed species	Common name	Frequency (%)
Grasses			Grasses		
P. maximum Jacq	Guinea grass	7.4	*P. maximum* Jacq	Guinea grass	7.4
D. horizontalis Willd	Crab grass	7.7	*D. horizontalis* Willd	Crab grass	5.7
C. dactylon (L) Pers.	Bahama grass	8.1	*C. dactylon* (L) Pers.	Bahama grass	8.1
E. indica (Gaertn.)	Goosegrass	4.0	*E. indica* (Gaertn.)	Goosegrass	6.4
*O. longistminata (*A) Chev.	Wild rice	2.1	*O. longistminata (*A) Chev.		
Broad leaved			Broad leaved		
I. asarifolia (Desr.) Roem.	water spinach	7.2	*I. asarifolia* (Desr.) Roem.	Water spinach	7.2
S. occidentalis (L.) Link	Coffee senna	8.3	*S. occidentalis* (L.) Link	Coffee senna	8.3
*A. spinosus (*L).	spiny amaranth	5.5	*A. spinosus (*L).	Spiny amaranth	3.0
A. hispidum (DC).	Star burr grass	8.3	*A. hispidum* (DC).	Star burr grass	8.1
T. procumbens (L.)	coat buttons	4.9	*T. procumbens* (L.)	Coat buttons	4.9
P. amarus (Schum.&Thon).	——	6.8	*P. amarus* (Schum.&Thon).	——	6.8
C. retusa (L.)	Rattlebox	8.1	*C. retusa* (L.)	Rattlebox	8.1
C. benghalensis (L.)	Tropical spiderwort	-	*C. benghalensis* (L.)	Tropical spiderwort	-
Sedges			Sedges		
L. hexandra (Sw.)	Cut grass	-	*L. hexandra* (Sw.)	Cut grass	-
C. esculentus (L)	Yellow nut sedge	7.9	*C. esculentus* (L)	Yellow nut sedge	8.5
K. squamulata (Thonn.)	——	5.2	*K. squamulata* (Thonn.)	——	6.2
F. ferruginea (L.) Vahl	——	8.5	*F. ferruginea* (L.) Vahl	——	5.5
			L. martinisensis (L)	Wild tea bush	3.5
A. aspera (L)	devil's horsewhip	_	*A. aspera* (L)	Goat weed	2.3

Table 3: Paddy and Stover Yield and Harvest Index of Upland Rice as Affected by Weed Control Strategies at DBT in 2016 and 2017 Rainy Seasons

Treatments	Rate (kg a.i.ha^{-1})	Paddy yield (kg ha^{-1})		Stover yield (kg ha^{-1})		Harvest index (%)	
		2016	2017	2016	2017	2016	2017
Buta fb Orizo	1.0 fb 2.8	1952bcd	1683bcd	448	1463ab	72.9ab	67.0abc
Buta fb Orizo	1.0 fb 4.5	1790bcd	1640bcd	538	792b	77.3a	74.8abc
Buta fb Orizo	1.5 fb 2.8	1599cde	1956abc	734	830b	68.0ab	74.1abc
Buta fb Orizo	1.5 fb 4.5	2470a	2327a	935	1835ab	80.1a	80.3a
Buta fb Rbow	1.0 fb 0.025	1678b-e	1768bc	801	815b	66.8ab	68.2abc
Buta fb Rbow	1.0 fb 0.030	2107ab	1909abc	821	1347ab	72.5ab	72.9abc
Buta fb Rbow	1.5 fb 0.025	1895bcd	1620bcd	826	925ab	70.6ab	70.6abc
Buta fb Rbow	1.5 fb 0.030	2029bc	1840abc	796	1554ab	73.0ab	61.8bc
Buta fb Solito	1.0 fb 0.32	1586cde	1809abc	548	1335ab	74.9ab	71.8abc
Buta fb Solito	1.0 fb 0.48	1558cde	1589bcd	892	1050ab	65.0ab	70.5abc
Buta fb Solito	1.5 fb 0.32	1805bcd	1741bcd	746	949ab	71.0ab	77.2ab
Buta fb Solito	1.5 fb 0.48	1790bcd	1951abc	651	658b	74.7ab	72.6abc
Buta fb SHW @ 4 WAS	1.0	1834bcd	1449cd	865	566b	69.1ab	69.5abc
Buta fb SHW @ 8 WAS	1.0	1526de	1643bcd	840	1450ab	64.6ab	74.0abc
Buta fb SHW @ 4 WAS	1.5	1608cde	2020ab	793	1262ab	67.8ab	62.6bc
Buta fb SHW @ 8 WAS	1.5	1549cde	1648bcd	818	1495ab	64.6ab	61.5bc
Buta fb SHW @ 4 & 8 WAS	1.0	1503bcd	1958abc	660	1380ab	73.2ab	72.2abc
Buta fb SHW @ 4 & 8 WAS	1.5	1972bcd	1912abc	1090	766b	65.3ab	73.6abc
HWC @ 2, 4, 6 & 8 WAS	_	1902bcd	1883abc	739	2167a	73.0ab	66.3abc
Weedy check	_	1214e	1226d	923	750b	59.6b	60.4c
SE ±		290	315	350	600	10.21	9.60

Means with the same letter in the same column are not significantly different P ≤ 0.05 using SNK, WAS – Week after sowing, DBT – Thomas dam Dambatta, SHW – supplementary hoe weeding, HWC= Hoe weeded control, Buta - Butachlor

Table 4: Economic Analysis of Cost and Return of Growing Upland Rice using Alternate Weed Control Strategies at DBT in 2016 and 2017 Rainy Seasons

Treatments	Rate (kg a.i.ha^{-1})	TR (Nha^{-1}) 2016	TVC (Nha^{-1}) 2016	GM (N) = TR-TVC 2016	C:B = TR/TVC 2016	TR (Nha^{-1}) 2017	TVC (Nha^{-1}) 2017	GM (N) = TR -TVC 2017	C:B = TR/TVC 2017
Buta fb orizo	1.0 fb 2.8	244000	178871.1	65128.9	1.4	210350	178871.1	31478.9	1.2
Buta fbE orizo	1.0 fb 4.5	223712.5	187407.4	36305.1	1.2	204975	187407.4	17567.6	1.1
Buta fb orizo	1.5 fb 2.8	199925	185539.9	14385.1	1.1	244537.5	185539.9	58997.6	1.3
Buta fb orizo	1.5 fb 4.5	308750	200461.1	108288.9	1.5	290850	200461.1	90388.9	1.5
Buta fb Rbow	1.0 fb 0.025	209800	174896.6	34903.4	1.2	220950	174896.6	46053.4	1.3
Buta fb Rbow	1.0 fb 0.030	263375	178090	85285	1.5	238625	178090	60535	1.3
Buta fb Rbow	1.5 fb 0.025	236837.5	176283.8	60553.7	1.3	202537.5	176283.8	26253.7	1.1
Buta fb Rbow	1.5 fb 0.030	253650	180375.7	73274.3	1.4	229975	180375.7	49599.3	1.3
Buta fb solito	1.0 fb 0.32	198262.5	178031.6	20230.9	1.1	226075	178031.6	48043.4	1.3
Buta fb solito	1.0 fb 0.48	194787.5	183167.8	11619.7	1.1	198625	183167.8	15457.2	1.1
Buta fb solito	1.5 fb 0.32	225625	182490.7	43134.3	1.2	217625	182490.7	35134.3	1.2
Buta fb solito	1.5 fb 0.48	223712.5	190141.5	33571	1.2	243912.5	190141.5	53771	1.3
Buta fb SHW @ 4 WAS	1.0	229275	185530.3	43744.7	1.2	181162.5	185530.3	-4367.8	-1.0
Buta fb SHW @ 8 WAS	1.0	190800	185920.9	4879.1	1.0	205425	185920.9	19504.1	1.1
Buta fb SHW @ 4 WAS	1.5	200975	184041	16934	1.1	252450	184041	68409	1.4
Buta fb SHW @ 8 WAS	1.5	193650	185730.1	7919.9	1.0	205950	185730.1	20219.9	1.1
Buta fb SHW @ 4 & 8 WAS	1.0	187925	201795	-13870	-0.9	244725	201795	42930	1.2
Buta fb SHW @ 4 & 8 WAS	1.5	246537.5	202929.8	43607.7	1.2	238937.5	202929.8	36007.7	1.2
MHW @2, 4, 6 & 8 WAS	_	237712.5	219796.8	17915.7	1.1	235375	219796.8	15578.2	1.1
Weedy check	_	151775	164350.1	-12575.1	-0.9	153225	164350.1	-11125.1	-0.9

NB: the average weight for a bag of paddy rice is 80kg and the farm gate price is N 10,000 as at 2016 and 2017

*The yield for each treatment is presented in Table 3

TR- total revenue, TVC- total variable cost, GM – gross margin, C:B – cost-benefit ratio

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Journal of Applied Agricultural Research 2021, 9(1): 21-31
ISSN 2006-750X

DETERMINANTS OF CHOICE OF CULTIVAR CHARACTERISTICS INFLUENCING ACCEPTABILITY OF ORANGE-FLESHED SWEET POTATO VARIETIES AMONG FARMERS IN ABIA STATE, NIGERIA

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ABSTRACT

This study analyzed the determinants of cultivar characteristics influencing acceptability of orange-fleshed sweet potato varieties among farmers in Abia State, Nigeria. A total of sixty (80) farmers were randomly selected. Data for the study was analyzed using descriptive statistics such as: frequency counts, mean scores and percentages and probit regression analysis. Result revealed that 68.8% were females, 55.0% were married with mean household size of 6 persons, and 33.8% acquired secondary education with mean farming experience of 3.9 years, while 46.2% had fortnightly contact with extension. The result also showed that most (67.5%) of the farmers cultivated UMUSPO/1 and UMUSPO/3 (58.80%). The farmers sourced OFSP vines from Ministry of Agriculture/Agricultural Development Programmes (91.20%), fellow farmers (90.0%) and research institute (75.0%). Result indicate that the farmers high acceptance ($\bar{X}$ =2.9) of orange-fleshed sweet potato varieties. Probit regression estimates showed that coefficients for culinary taste, good storage potential, dry matter content, colour of the root and texture of flour influenced choice of UMUSPO 1 and UMUSPO 3 orange-fleshed sweet potato varieties. The study therefore recommended promotion of orange-fleshed sweet potato varieties by extension agencies for acceptance by farmers in the study area.

Key words: Determinants, choice, cultivar characteristics, acceptability, orange-fleshed

INTRODUCTION

Sweet Potato (*Ipomea batata L.*) is an important food and feed crop in Sub-Sahara Africa and an an important staple food crop which is generally consumed throughout in Nigeria as an energy giving food (Food and Agricultural Organization (FAO) 2013; Alalade *et al*., 2019). Small holder farmers in Africa value sweet potato because it grows in a variety of climates with few inputs and can withstand drought. It also gives satisfactory yields under unfavourable climatic and soil conditions, as well as under low or non-use of external inputs (Getachew and Jens, 2018).. Sweet potato is rich in carbohydrates and vitamin A, B and C, as well as minerals like phosphorus, iron and calcium. It is also a

good food, security crop and be sold for cash by African women and poor families (Echondu *et al.,* 2018). On dry matter basis, the non-carbohydrate macronutrient composition of the edible tuberous roots includes the following: 1.3 to 8.3% protein, 1.4 to 6.1% ash, 0.4 to 1.8% lipid and 3.4 to 5.9% crude fibre (Monday *et. al.,* 2017).

Technology acceptance or rejection is dependent on farmers' decision whether to adopt or not, hence acceptance of a given technology does not mean adoption. Farmers decision for or against the acceptance of any production technology through mental process consist of several stages that provides firm knowledge on which action could be based, and thus persuade farmers to try a new technology (Nwaobiala, 2018). Ayodele and Akindele, (2016) however asserted that variability in technology characteristics, culture, traditional beliefs and socio-economic factors affects technology acceptance by farmers across Nigeria.

From the year 2005 to 2006, National Root Crops Research Institute (NRCRI), Umudike, Nigeria arranged and acquired some yellow and orange fleshed sweet potato genotypes (OFSP) with improved agronomic traits from International Potato Centre, Lima, Peru (known by its Spanish acronym of CIP) through its sub - station in East Africa. These genotypes, especially those of orange fleshed sweet potato (OFSP), were bred as a tool for the global fight as against vitamin A deficiency in areas that lack vitamin A rich food material (Degras, 2003). It was therefore deemed necessary at NRCRI for Nigeria to evaluate the CIP yellow and orange fleshed sweet potato genotypes (that adapted to the local agronomic conditions) for the production of palatable β-carotene rich in vitamin A that would be acceptable to consumers in combating deficiency ailments (Low *et al*., 2017)

Despite the stated benefits of OFSP, it seems the cultivar characteristics has not led to much acceptance of these varieties which has been identified by key decision makers as major factors for its cultivation (Ndaula *et al*., 2019). However, a dearth of knowledge exists regarding farmers considerations for the acceptance of OFSP in the study area. In the extant literature, studies tend to be descriptive and focus on technology awareness and the channels for effective delivery of planting materials rather than factors influencing its acceptance by farmers (Lukonge *et al.*, 2015). Valuable insights may thus be gained by focusing on farmers regarding acceptance of these bio-fortified staples. In view of these assertions, this paper therefore was undertaken to analyse the determinants of cultivar characteristics influencing acceptability of orange-fleshed sweet potato varieties among farmers in Abia State, Nigeria.

The specific objectives of the study were to;

i. describe the socio-economic characteristics of farmers
ii. identify the orange-fleshed sweet potato varieties mostly cultivated
iii. examine sources of information about these varieties by farmers; and
iv. ascertain levels of acceptability of orange –fleshed sweet potato varieties by farmers;

Research hypothesis

Ho - Cultivar characteristics such as culinary taste, size of tuber, colour of tuber, texture of flour, storage potential, fibre and starch contents do not influence choice of acceptability of orange – fleshed sweet potato varieties.

MATERIALS AND METHODS

Study Area and Description

The study area was Abia State, Nigeria. The state lies between Longitudes 7023' and 802' east of the Equator and Latitudes 4047' and 6012' north of the Greenwich Meridian. The State is located East of Imo State and shares common boundaries with Anambra, Enugu and Ebonyi States on the North West, North and North East respectively. It is bounded by Cross River and Akwa Ibom States on the East and Southeast and Rivers State to the South. The 2017 estimate population of the State is 3,727,300 people (National Population Commission, 2017).

Sample size and data analysis

A multistage sampling technique was used in the selection respondents. First two (2) agricultural zones namely; Umuahia and Aba were randomly selected out of the three agricultural zones that make up the state. Two blocks each were randomly selected from the two agricultural zones (Umuahia zone–Ikwuano block, Umuahia North; Aba zone–Osiisoma block and Isiala Ngwa South) to give a total of 4 blocks. From the selected blocks two (2) circles were randomly selected to give a total of eight (8) circles. Finally, ten (10) orange –fleshed sweet potato farmers each were randomly chosen from the selected circles to give a sample size of 80 farmers. The objectives were realized with descriptive statistics such as frequency counts mean scores and percentages, while the hypothesis was tested using probit regression analysis.

Measurement of variables

The levels of acceptability of orange –fleshed sweet potato varieties were measured by providing them with twelve (12) acceptability statements with the response options of Strongly agree, agree, Disagree and Strongly disagree assigned, respectively The bench mark was obtained thus; 4++2+3+1 = 10 divided by 4 to give 2.5. The mean decision rule implied any mean score of 2.5 and above is high and below is low acceptability.

Model specification

The probit regression analysis was used in testing the hypothesis. Economic choice theory suggested that individuals are rational and if faced with decision to choose between two or more alternatives, preferred the option that provides maximum level of utility (Mahamad *et al*., (2014). Therefore, farmers are expected, given a choice of accepting orange-fleshed sweet potato varieties based on its cultivar characteristics.

The explicit form of the function is specified as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_7 X_7 + \mu_i$$

Where,

β_o = constant

$\beta_1 - \beta_8$ = Regression Coefficient

Y = Probability of farmers choice to accepting orange – fleshed UMUSP01 and UMUSP0/3 sweet potato varieties ranges from 0 – 1

β_1= culinary taste (yes = 1, no = 0)

β_2= size of root (yes = 1, no = 0)

β_3= colour of root (yes = 1, no = 0)

β_4= texture of flour (yes = 1, no = 0)

β_5= storage potential (yes = 1, no = 0)

β_6= flowering ability (yes = 1, no = 0)

β_7=dry matter content (yes = 1, no = 0)

$\mu_{i =}$ error term\

RESULTS AND DISCUSSION

Selected socio-economic characteristics of farmers

The result in Table 1 revealed that 31.2% of the respondents 68.8% were females. This suggests that women were more involved in orange-fleshed sweet potato farming than their male counterparts. This result is in consonance with Ume et al., (2013) as they obtained a similar result among framers in Ebonyi State, Nigeria. The mean household size for the farmers was 6 persons. The larger household sizes are found to be source of cheap labour in farming activities and other remunerative activities thus reducing labour cost (Yusuf *et al*., 2019). The result also showed that 55.0% were married with mean farming experience of the farmers was 3.9 years. The result implied that the cultivation of OFSP by farmers is still new tin the study area. Ukoha and Okonkwo (2019) averred that farming experience enhance participation, adoption and acceptance of improve farming practices. The result reveals that a moderate proportion (42.5%) and 46.2% of the respondents had farming as their major occupation and fortnightly contact with extension respectively. Mbanaso, (2011) asserted that farming is the major occupation and source of income for rural dwellers in developing countries as Nwaobiala, (2018) inferred that extension service remains the major source of knowledge on improved farming practices for farmers in developing countries like Nigeria.

Table 1: Distribution of respondents according to socio-economic characteristics

Variables	Frequency (n=80)	Percentage	Mean
Sex			
Male	25	31.2	
Female	55	68.8	
Marital Status			
Single	9	9.17	
Married	44	55.00	
Widowed	15	3.38	
Separated	12	4.17	
Household Size (numbers)			
2 – 4	21	26.2	
5 – 7	44	55.0	
8 – 10	5	6.3	
11 – 14	10	12.50	6
Farming Experience (years)			
1 – 4	9	12.50	
5 – 8	65	81.20	
9 – 12	3	6.3	3.9
Occupation			
Farming	34	42.50	
Civil service	12	15.10	
Trading	13	16.20	
Artisanry	21	26.20	
Extension Contact (numbers)			
Once a week	19	23.80	
Fortnightly	37	46.20	
Monthly	21	26.20	
None at all	3	3.80	

Source: *Field Survey, 2019*

Orange–fleshed sweet potato varieties mostly cultivated by farmers

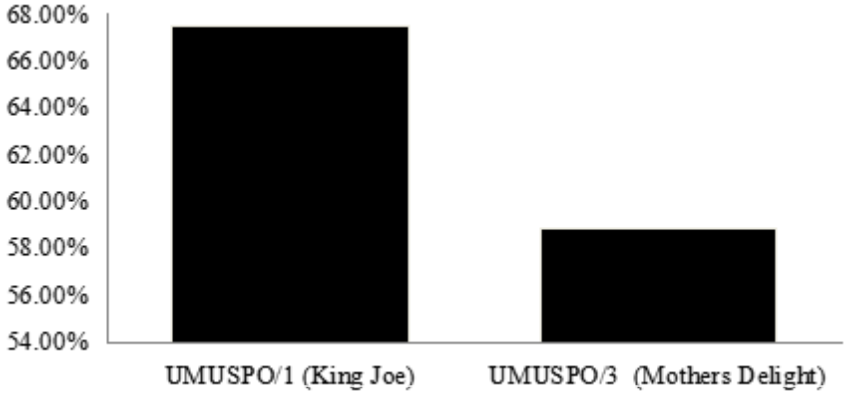

Figure 1: Orange-Fleshed Sweet Potato Varieties Mostly Cultivated by Farmers

Sources of farmers' information on orange-fleshed sweet potato varieties

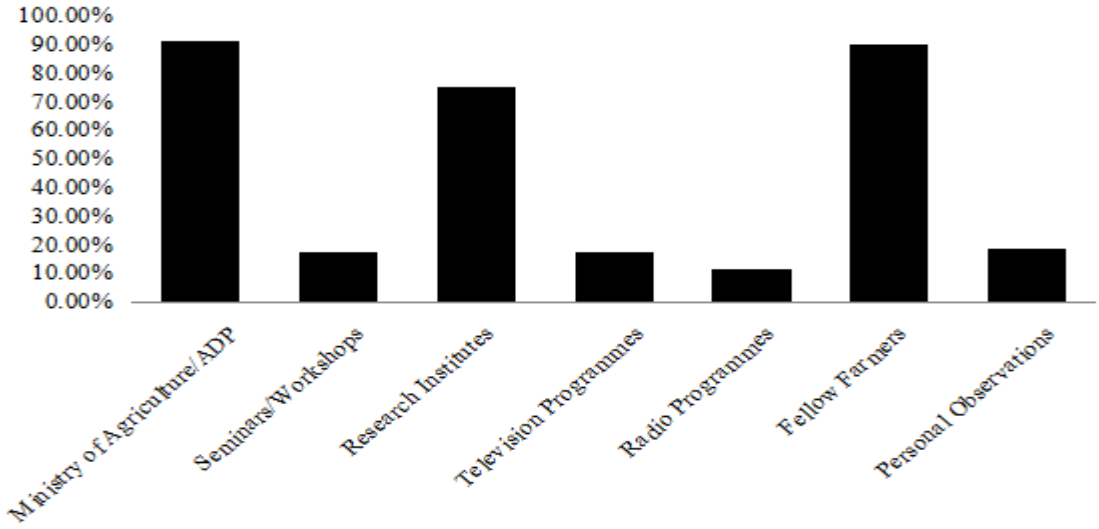

Figure 2: Sources of Orange-Fleshed Sweet Potato Varieties

The distribution of respondents according to orange-fleshed sweet potato mostly cultivated by farmers is shown in Figure 1. The result showed that most (67.5%) of the farmers cultivated UMUSPO/1 while a good proportion (58.80%) cultivated UMUSPO/3. The result may suggest that farmers in the study area cultivated UMUSPO/1 than any other OFSP variety because of its economic potential and attributes it possesses. Nwaobiala and Isaac, (2017) in their study found that technology characteristics of an innovation influences its acceptability, adoption and use

The result in Figure 2 showed that major sources of information on orange-fleshed sweet potato varieties among farmers were from Ministry of Agriculture/Agricultural Development Programmes (91.20%), fellow farmers (90.0%) and research Institute (75.0%). Onuekwusi and Atasie, (2011) opined these sources can assist extension through proper and effective dissemination of information. This result corroborates with

Ikwuakam and Lawal, (2015) as they obtained a similar result among sesame farmers in Katsina state, Nigeria.

Acceptability of Orange–Fleshed Sweet Potato Varieties

The result in Table 2 revealed that the respondents accepted all the acceptability items as perceived of orange-fleshed sweet potato varieties. The farmers agreed that OFSP varieties were high yielding ($\overline{X}$=3.5), they are not prone to pest and disease attack ($\overline{X}$=3.3). Also, the production technologies were easy to practice ($\overline{X}$=3.2), they roots produced high quality flour, easy to market and has high market value ($\overline{X}$=3.1) as against its nutritious value ($\overline{X}$=3.0). However the respondents affirmed that OFSP has good post storage potential and help to combat vitamin A deficiency with mean ratings of 2.9, suppress weeds when intercropped and reduce run off ($\overline{X}$ =2.7), as the vines are readily available ($\overline{X}$=2.2). The mean scores of 2.9 indicate that the farmers had high acceptability of OFSP varietal cultivar characteristics. According to Mica *et al.*, (2018), the introduction of vitamin A-rich varieties (OFSP) with production cycle of 3-4 years has relatively high chance of acceptability and participation of farmers. On dry matter basis, the non-carbohydrate macronutrient composition of the edible tuberous roots increases framers acceptability of the varieties as well as the roots which are rich in β - Carotene (Ukpabi *et al*., 2012). Ndaula, Matsiko and Sseguya, (2019) observed that OFSP has to compete for space and position within the domain defined by the attributes of consumers and the foodstuffs they consume. A major moderator for this process is the acceptance of the OFSP by key decision makers.

Table 2: Distribution of farmers according to acceptability of orange-fleshed sweet potato varieties by farmers

Acceptability Statements	SA	A	D	SD	Total	Mean	Std. Dev.
I cultivate orange-fleshed sweet potato varieties because it is nutritious	37(146)	16(48)	13(26)	14(14)	236	3.0	1.2
The vines tend to suppress weeds when planted sole or intercropped	17(69)	34(102)	16(32)	13(13)	215	2.7	0.9
The vines tend to reduce water run-off	24(96)	22(66)	18(36)	16(16)	214	2.7	0.8
The OFSP varieties are high yielding	30(120)	27(81)	15(30)	8(8)	278	3.5	1.3
I cultivate it because of its good post-harvest storage potential	18(72)	10(30)	31(62)	21(21)	233	2.9	1.2
OFSP varieties are not prone to pest and disease infestation	18(72)	31(93)	9(18)	22(22)	265	3.3	1.2
Colour of the flesh enhances its market value	20(80)	29(87)	10(20)	21(21)	248	3.1	1.2
The production technologies are easy to practice	21(84)	40(120)	10(20)	9(9)	257	3.2	0.9
The tuber produces high quality flour when processed	16(64)	29(87)	20(40)	15(15)	245	3.1	1.3
The vines are readily available at any planting season	10(40)	6(18)	24(48)	40(40)	176	2.2	0.4
The shape and size of roots enhances its marketability	12(48)	41(123)	16(32)	11(11)	244	3.1	1.1
The crop helps to combat vitamin A deficiency in children	6(24)	47(141)	15(30)	12(12)	244	2.9	1.1
Total						35.6	
Grand Mean Scores						2.9	

Source: *Field Survey, 2019*

Figures in parenthesis are nominal likert values multiplied by frequencies

Determinants of cultivar characteristics influencing choice of acceptability of Orange-fleshed sweet potato varieties among Farmers

The empirical results of the Probit regression estimates for determinants of choice of acceptability of UMUSPO1 and UMUSPO 3 orange – fleshed sweet potato varieties are shown in Table 3. The Chi^2 (χ^2) was highly significant at 1.0% level of probability indicating regression of best fit. The likelihood ratio tests indicate that the slope coefficient was significantly different from zero for UMUSPO 1 and UMUSPO 3 varieties. The coefficients for culinary taste were positive and significant at 10.0% and 5.0% levels of probability for UMUSPO 1 and 3 respectively. This indicates that any increase in culinary taste will lead to increase in probability of accepting UMUSPO 1 and UMUSPO 3 sweet potato varieties in the study area. This is expected and in accordance with *a prior expectation* since sweet potato is traditionally prepared by boiling and served as a dish. Cooked varieties of sweet potato are expected to be utilized and accepted by the consumers over other varieties. Following the work of Meenakshi *et al.,* (2017) in Uganda, deep orange sweet potato (containing the highest Pro Vitamin A content) was preferred over yellow, orange, and white sweet potato by 52% of rural and urban consumers due to its different food forms. Chowdhury *et al.,* (2011) also found that the sensory characteristics of orange sweet potato varied widely between cultivars and consumers are functions of different food culinary of these varieties. The coefficient for good storage potential was significant at 5.0% and positively related with choice of acceptability of UMUSPO 1 orange – fleshed sweet potato variety in the study area. This implied that any increase in storage potential of the root will increase the probability of accepting UMUSPO1 over other varieties. In Nigeria, white varieties of sweet potato are more consumed than orange, deep-yellow, or purple varieties in areas where multiple varieties are available following Talsma *et al.,* (2017). This preference is often associated with the inferior storage characteristics of most OFSP varieties. The coefficients for dry matter content were significant for both varieties at 10.0% each but positive for UMUSPO 1 and negative for UMUSPO 3. This implied that increase in dry matter content will increase the probability of accepting UMUSPO1 and decrease for UMUSPO3 Pro-Vitamin A sweet potato variety in the study area. Dry matter has been identified as an important varietal trait when comparing and accepting OFSP to other pale and white fleshed sweet potato varieties, and has been reported as an important attribute for disliking of OFSP by consumers (Laurie *et al.,* 2013). The study also noted that dry matter content had an indirect relationship with the Vitamin A content in the OFSP varieties. This means that as the dry matter content increases, the beta carotene (Vitamin A.) contents will decrease and vice versa. The study by Tomlins *et al.,* (2016) on acceptability of sweet potato varieties in Tanzania showed that mothers liked orange sweet potato better than a purple variety because of the nutritional value, whereas school children liked OFSP similarly as a result of its softness. Although in South Africa, acceptance was more related to sweet flavor, dry mass, and maltose content (as analyzed in the laboratory) than to color; wateriness was associated with the least accepted varieties following Laurie *et al.,* (2013). The coefficient for colour of the root was also positive and significant at 10.0% level of probability. This implied that increase in colour (orange) of the root will

lead to increase in probability of choice of acceptability of UMUSPO 3 orange – fleshed sweet potato variety. This is expected because people tend to try something new and consume orange fleshed sweet potato due to its colour attribute. The study results by Govender *et al.,* (2019) indicated that the sensory attributes taste, texture, aroma, colour and overall acceptability were rated as good by most study participants for OFSP varieties. However, coefficient for texture of flour was negatively signed and significantly related to the choice of accepting of UMUSPO 3 variety at 10.0% level of probability. This revealed that increase in texture of the flour will decrease the probability of choice of acceptability of UMUSPO 3 variety in the study area. This is against a *priori expectation* probably because the respondents may not be interested in processing the variety into flour rather may need sweet potato root for home consumption.

Determination of the marginal effects of choice of accepting orange–fleshed sweet potato varieties among farmers

To augment the interpretation of the estimated results presented in Table 4, the marginal effects of each variable on the predicted probability of determinants of choice of acceptability of orange–fleshed (UMUSPO 1 and 3) sweet potato varieties evaluated at the means of the explanatory variables, are presented in Table 4. The marginal effects report of the Probit regression provides the probability that farmers will choose to accept orange-fleshed sweet potato. The result provides the probability estimation for the likelihood choice of accepting orange-fleshed sweet potato among farmers given the statistically significant variables. The results of the marginal effect of the Probit regression indicates that there is a probability of 26.74% and 8.00% choice of accepting UMUSPO1 and UMUSPO3 respectively if there is an increase in culinary taste among the two varieties. The marginal effect also shows that there is probability of 47.26% and 33.78% that the choice of accepting UMUSPO 3 variety will increase by the respondents if colour of the root increases and texture decreases by one percent. Similarly, there is a probability of 84.39% that the respondents will accept the choice of UMUSPO 1 variety if the storage potential increases by one percent. The probability that the farmers will accept the choice of UMUSPO1 and UMUSPO3 as a result of one percent increase and decrease respectively in dry matter content is given as 2.89% and 20.10% respectively.

CONCLUSION AND RECOMMENDATIONS

In conclusion the study has revealed that the farmers mostly cultivated UMUSPO1 orange fleshed sweet potato and sourced of these vines from Ministry of Agriculture/Agricultural Development Programmes, fellow farmers and research Institute and had high acceptability of these varieties based on their cultivar characteristics. Culinary taste, good storage potential, dry matter content, colour of the root and texture of flour influenced choice of orange-fleshed sweet potato varieties.

Based on the findings of the study, the following recommendations are made;

i. Policies on the promotion of Orange-Fleshed Sweet Potato varieties especially on the aspect of its nutritional value, utilization forms

and consumption pattern to enhance acceptance.

The introduction and development of OFSP varieties with high dry matter content and ensure its availability at any time of the year. Effort should also be made by the authorize agencies to popularize these OFSP sweet potato varieties released which are of orange colour since colour of the root is a criterion for its acceptability. The study calls for breeder to breed for OFSP varieties of high dry matter with deeper orange colour.

Table 3: Probit Regression estimates for acceptability of orange-fleshed sweet potato varieties

	UMUSPO1			UMUSPO3		
Variables	Coefficients	Std. Error	t-value	Coefficients	Std. Error	t-value
Constant (β_0)	1.1078	1.0372	1.07	1.7683	0.9329	1.90*
Culinary taste (β_1)	0.7983	0.4094	1.95*	1.2645	0.4727	2.67**
Size of the root (β_2)	-0.1436	0.5876	-0.24	-0.1905	0.5534	-0.34
Colour of the root (β_3)	-0.0017	0.3063	-0.01	0.2304	0.0932	2.47*
Texture of the flour (β_4)	-0.1073	0.7474	-0.14	-0.5278	0.2282	-2.20*
Storage potential (β_5)	0.5282	0.1919	2.72**	0.0907	0.3408	0.27
Flowering ability (β_6)	0.2166	0.3142	0.69	0.2133	0.3282	0.65
Dry matter content (β_7)	0.0786	0.0337	2.33*	-0.5467	0.2888	-1.89*
Log likelihood	-78.8879			93.8829		
Chi^2 (χ^2)	8.95			18.95		
Pseudo R^2	0.4820			0.5085		

Source: *Field Survey, 2019*

Table 4: Effects for continuous determinants of probit regression on choice of accepting orange–fleshed sweet potato varieties among farmers in the study area

Variables	Marginal effect (UMUSPO 1) dy/dx	Marginal effect (UMUSPO 3) dy/dx
Culinary taste	0.2674	0.0800
Colour of the root		0.4726
Texture of the flour		-0.3378
Storage potential	0.8439	
Dry matter content	0.0289	-0.2010

Source: *Field Survey, 2019*

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Journal of Applied Agricultural Research 2021, 9(1): 32-47
ISSN 2006-750X

LOOKING BEYOND COVID: HOW READY IS NIGERIA FOR A DIGITAL ALTERNATIVE TO ITS AGRICULTURAL PRODUCTION

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ABSTRACT

The COVID-19 pandemic has brought to fore the imperative for digitalization of the Nigerian agricultural and food production system. On the one hand, the current food production system does not have the capacity to feed the current population of Nigeria let alone the projected population of the country in one to three decades from now. And on the hand, Nigeria needs to develop the requisite infrastructural and technological development necessary for the incorporation of digital agricultural technology that will engender its digital agriculture revolution. The paper assessed the prospects of digital agriculture for the developing world especially Nigeria with its massive population and food supply requirements. In the face of the coronavirus pandemic it has become imperative for Nigeria to make a paradigm shift from its current smallholder, low-energy agriculture to digital agriculture driven by automation and data-driven farm management. This would require policy alteration and investment for the incorporation of technologically advanced agricultural systems. It was recommended that beginning with policy and ending in long-term strategic and sustained implementation, Nigeria needs a radical shift into digital agriculture especially with the existing reality of the COVID-19 pandemic. A sustainable digital agriculture plan should not focus on adoption of technology or purchase of same but rather a deliberate localization of technology based on the specific conditions that best fit Nigeria's unique agricultural systems.

Keywords: COVID-19, Nigeria, Digital agriculture, agricultural production.

INTRODUCTION

By 2050 the world's human population is expected to have reached 9.7 billion (United Nations, 2019; UN DESA, 2017). At almost 10 billion people, the world must produce an extra one billion tonnes of cereals and 200 million extra tonnes of livestock products will need to be produced annually (Bruinsma, 2009; Alexandratos and Bruinsma, 2012). But even before the expected population increase, the current estimates of the world's hungry stand at 690 million people (about 8.9% of the world). This is an increase of about one million in just one year and 60 million over just five years. In 2019, about 750 million people suffered from severe levels of food insecurity (FAO, IFAD, UNICEF, WFP and WHO, 2020). With this realization, it is obvious that our current agricultural system cannot sustain the global population going forward. The whole world

must adopt agricultural systems that are capable of producing the right quality and quantity of nutritious food for its populace. The developing world has a greater imperative of achieving food security. Market forecasts for the next decade suggest a 'digital agricultural revolution' will be the newest shift which could help ensure agriculture meets the needs of the global population into the future.

Digitalization will change every part of the agri-food chain. Management of resources throughout the system can become highly optimized, individualized, intelligent and anticipatory. It will function in real time in a hyper-connected way, driven by data. Value chains will become traceable and coordinated at the most detailed level whilst different fields, crops and animals can be accurately managed to their own optimal prescriptions. Digital agriculture will create systems that are highly productive, anticipatory and adaptable to changes such as those caused by climate change. This, in turn, could lead to greater food security, profitability and sustainability (Trendov *et al*. 2019).

Ever since the sudden advent of the global COVID-19 pandemic and the extreme manners with which it affected the economy, agriculture and human activities altogether, policymakers and key stakeholders have pushed for viable alternatives to the current forms of agriculture especially in the developing world. Preliminary assessment puts 83 – 132 million people as the number that will be pushed into the world's undernourished population depending on economic growth scenarios as a result of COVID-19 (FAO, IFAD, UNICEF, WFP and WHO, 2020).

For a country like Nigeria, digitalization of its agriculture is utterly imperative giving that it is neither food secure nor self-sufficient. As a matter of fact, digitalization of agriculture is an opportunity for the West-African Nation to leap-frog other stages of agricultural development and arrive at the most recent. Despite these glorious opportunities, Nigeria must prepare its agriculture for such next level technology. As Kunisch (2016) advanced, big data is only applicable in some forms of agriculture which are primary the farm type and its level of technology adoption. The objective of this paper is to expound on the prospects of Nigeria's digital agricultural revolution and the ways it should position itself to gain significantly from the economic advantages of digital agriculture.

Digital Farming

The new agricultural era is one in which countries need to begin to make deliberate investments in nutrition-sensitive social protection by realigning their agricultural policies and incentives towards more nutrition-sensitive policy actions all along the food supply chain to reduce food losses and enhance efficiencies at all stages (FAO, IFAD, UNICEF, WFP and WHO, 2020). There are more than 570 million smallholder farms around the world (Lowder *et al*., 2016) as a result agriculture and food production account for 28% of the entire global workforce (ILOSTAT, 2019). Smallholders manage 80% of the world's cropland and produce 60% of the world's agricultural output (FAO, 2017).

Digital transformation driven by new technologies holds a lot of promise for the global agricultural sector especially of driving the sector into the next level of productivity and profitability (Himesh, 2018). Digital agriculture (also known as Agriculture 4.0) is based on the principles of precision agriculture where agriculture actors use systems that generate data about their farms, the data is processed such that proper

strategic and operational decisions are made through them; this is distinguished from the traditional method of farming where farmers check farm fields and make decisions based on accumulated experiences (Saiz-Rubio and Rovira-Más, 2020).

Human observation is impossible these days based on the size of fields that are currently under cultivation as well as the new and diverse problems that may be encountered by different segments of the field. The future of agriculture will encapsulate threefold criteria of efficient, sustainability and availability that only advance management systems within the context of smart farming can address (Saiz-Rubio and Rovira-Más, 2020). Digital agriculture sits on the Internet of Things (IoT) as its bedrock, IoT is the reason why such huge quantity of data is generated from agriculture; precision agriculture is also far more profitable and less risk-based than conventional farming (Gralla, 2018).

The Internet of Things (IoT) incorporated with necessary new techniques, is expected to increase productivity by 70% by 2050 (Sarni *et al*., 2016). The efficiency of IoT incorporated into agriculture is auspicious. On the average farms using IoT-based technologies are able to increase yield by 1.75%; using energy that costs 17 – 32 dollars less per hectare and irrigation water of 8% less than average (Gralla, 2018). Digital technologies will also cut down on the wastage associated with our food systems at present. In a world where 795 million people (1/9 of human population) go hungry, there is still an estimated annual wastage or loss of a third of food produced for human consumption (Magnin, 2016). This is the imperative for digital agriculture.

Data retrieved from most commercial agriculture fields may not exactly qualify as 'big data' but it is a path toward that. Big data comprises five dimensions; volume, velocity, variety, veracity and valorisation (Manyika *et al*., 2011; Kunisch, 2016; Kamilaris *et al*., 2017). The next level of agriculture follows precision agriculture and is referred to as *Agriculture 5.0* following its adoption of fifth generation technologies. The global market for agricultural robotics was estimated at $14–18 billion by 2020 (Magnin, 2016). This form of agriculture entails using equipment that have the capabilities of completing unmanned activities and autonomous decision support systems which means incorporation of robotics and artificial intelligence technologies (Zambon *et al*., 2019). These technologies are expensive and not financially feasible for small farms. The cost is expected to decrease with time; the future should see robotic technologies implemented as the best-case alternative for increase in agricultural productivity (Grand View Research, 2019).

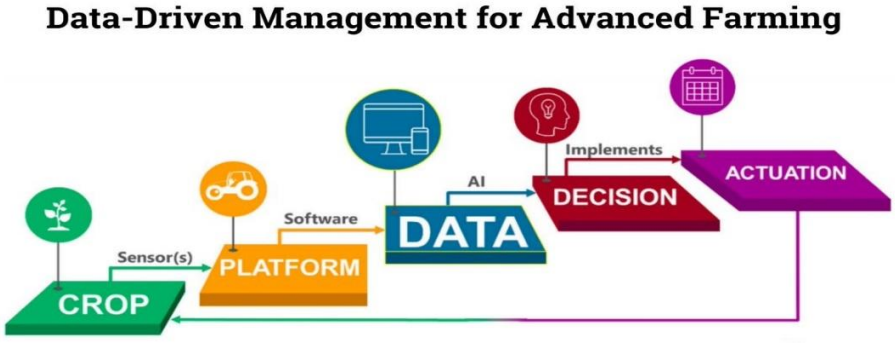

Figure 1: Information-based management cycle for advanced agriculture.
Source: www.WHR.loans

Prospects of Digital and Climate-smart Agriculture for Nigeria

The benefits Nigeria can derive from climate-smart agriculture are enormous. This is because Nigeria is at a stage where the total revolution of its agricultural sector, policies and practice are essential for the country to be able to feed itself and improve on the livelihoods of the agricultural sector which is the chief employer in the nation. Climate-smart agriculture is "agriculture that sustainably increases productivity, resilience (to climate change), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security and development goals" (FAO, 2010). Shifting to healthy diets can contribute to reducing health and climate-change costs by 2030, because the hidden costs of these healthy diets are lower compared to those of current consumption patterns. The adoption of healthy diets is projected to lead to a reduction of up to 97 percent in direct and indirect health costs and 41–74 percent in the social cost of GHG emissions in 2030 (FAO, IFAD, UNICEF, WFP and WHO, 2020).

In late 2020 the National Information Development Agency (NITDA), which is the country's foremost ICT agency of the Nigerian government, developed the "NIGERIA DIGITAL AGRICULTURE STRATEGY (2020-2030)." The objectives of the strategy plan are impressive. They include, increase in research and development (R&D) and deployment of digital technologies and innovations across agriculture value chain with the aim of raising productivity by 50%, reducing food wastage by 50% and reducing the effect of climate change by 40% (in the areas of yield, quality, cost reduction, appropriate use of water, chemicals, farm inputs etc); establishment of business support services with digital capabilities for the creation of sustainable business models and opportunities, develop agriculture to the extent that it can absorb 10 million youth across the production, harvesting, storage, processing, marketing, traceability, and consumption. The plan also covers ensuring that the Nigerian farmer has access to quality farm inputs; grow farm produce that meet international standards as well as have equal access to both local and international markets for farm produce (NITDA, 2020).

CONCLUSION

Nigeria's digital agriculture prospects is tied inextricable to the overall development of the digital economy in Nigeria. It is of profound importance to develop sectors that support each other in an elaborate technological ecosystem that combines technological, human, infrastructural, technical, social and economic systems to act in synchrony for the achievement of alternative economic pathways that will bring Nigeria to economic prosperity and food self-sufficiency.

RECOMMENDATIONS

1. The COVID-19 pandemic despite coming with great economic distress for the Nigerian economy, it is an excellent opportunity as well for reorganization of the Nigerian agricultural sector toward a strong and highly productive sector capable of ensuring food security and self-sufficiency for the ever-increasing Nigerian population.
2. Nigeria needs to start making deliberate and significant investments in renewable energy technologies as well as developing indigenous manpower toward the localization of

these technologies. Renewable energy technologies are the driving force behind digital agriculture.

3. Beginning with policy and ending in long-term strategic and sustained implementation, Nigeria needs a radical shift into digital agriculture especially with the existing reality of the COVID-19 pandemic. A sustainable digital agriculture plan should not focus on adoption of technology or purchase of same but rather a deliberate localization of technology based on the specific conditions that best fit Nigeria's unique agricultural systems.
4. Much of the digital agricultural revolution that will occur in Nigeria will depend on the level of penetration of broadband internet in the hinterlands of Nigeria where the most important agricultural production processes take place. For every 10 additional mobile phones per 100 people, there is an increase of per capita GDP growth by approximately 0.59 percent in low income countries. Additionally, an Ericsson report found that a 10% increase in mobile broadband penetration results in approximately 0.6% to 2.8% rise in gross domestic product (GDP). Therefore, there is great need for concerted and deliberate penetration of broadband internet all over Nigeria to improve mobile and broadband internet to between 70% and 85% by 2025.
5. Addressing the economic situation created by the COVID-19 pandemic entails the realization that the 'new normal' goes beyond the pandemic era to the reengineering of all economic actors of the fragile Nigerian economy. As a matter of urgency, we must completely revolutionize all the areas and sectors that have the greatest impacts and influences on the Nigerian economy. Digitalize all possible areas and create indigenous technology responsible for our prosperity.

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Journal of Applied Agricultural Research 2021, 9(1): 38-47
ISSN 2006-750X

PROFIT ANALYSIS OF MAIZE BASED ENTERPRISES IN JADA AND GANYE AGRICULTURAL ZONES OF ADAMAWA STATE NIGERIA

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ABSTRACT

The study analyzed the profitability of maize based enterprise in Jada and Ganye Agricultural Zone, Adamawa State, Nigeria. Data were collected from 130 randomly selected farmers from 16 farming communities across the two agricultural zones in the State using structured administered questionnaires. The analytical tools used were descriptive statistics (mean, frequency counts, minimum, maximum, and percentage) and Gross Margin (GM) analysis. The result showed that all the eleven maize based enterprise were lucrative with maize/soybean enterprise system having the highest (₦59 760.75) gross margin per hectare. Labour occupied a larger portion of the total variable cost across all the eleven enterprises and a benefit-cost ratio of ₦2.06 was revealed for the study. Major constraint associated with the maize based enterprises system were high cost of labour, high cost of input, pest and diseases, cattle invasion, and low price of maize. The study concludes that maize based enterprise systems in the study area was profitable.

Key words. Profit, Cost, Maize, Enterprise

INTRODUCTION

One of the major challenges confronting most developing countries, Nigeria inclusive is food security and one important food crop that guarantees a nation's food security is Maize (*Zea mays L*). Maize is a staple food of great socio-economic importance and has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become an important crop which has now risen to a commercial crop on which many agro-based industries depend on as raw materials (Iken and Amusa, 2004). According to Owoeye (2017) maize is not only important as food crop that guarantees food security but also as a major source of income for many maize farmers. Eighty percent of maize produce in Nigeria is consumed by humans and animals while the residual 20% is utilized in a variety of industrial processes for the production of starch, ethanol and alkaline (Ibrahim et al., 2019).

Maize also accounts for about 43% of calorie intake and it is one of the major cereals consumed by nearly all Nigerians either fresh or processed (Maurice et al., 2014). With

regards to food, it is generally accepted as a good source of energy for man and livestock because of its great dietary and economic importance. Maize is rich in carbohydrate, starch, protein, fats among other food nutrients which make it an important good and reliable source of food, energy, and industrial raw materials (Olowa and Olowa, 2010).

The worldwide maize production for year 2018 was 785 million tons with the United States of America being the largest producer (42%) and Africa produces 6.5% (Kelani et al., 2020). The largest African producer is Nigeria with nearly 11 million tons, followed by South Africa.Nigeria produces 43% of the total maize grown in West African countries (Usman, 2016).

Despite the importance of maize as a key means of food security in Nigeria, there is dearth of empirically documented data on the profitability of various maize based enterprises in the study area which necessitated this study. It is in the view of the foregoing that the following specific objectives were investigated:

i. The socio-economic characteristics of the maize farmers in the study area;
ii. The maize based enterprises system practice in the study area;
iii. The profitability of maize based enterprise in Jada and Ganye Agricultural Zones;
iv. The constraints to maize based enterprises in the study area.

MATERIAL AND METHODS

The Study Area

Jada and Ganye Agricultural Zones are located in Adamawa State. They are among the 21 Agricultural Zones in Adamawa State. Adamawa State is located between latitude 7^0N and 11^0 N of the equator, and longitude 11.0^0E, and 14^0E of the Greenwich Meridian (Njodi et al., 2019). Jada and Ganye Agricultural Zone is predominantly inhabited by the Chambas, Fulfulde, Hausa, Koma, and Mumuye.

The climate of the study area is similar to what is obtained in the other Agricultural Zones of the State. The rainy season commences from April to early October, with the highest rainfall mostly being recorded in August and September. The area has a good rainfall pattern with some area having as high as 1,400mm (Adebayo, 1999). The daytime temperature is as high as 40^0C and nighttime temperature estimated at about 12^0C. The study area is well noted for its agricultural potential which earned her the name food basket of Adamawa State due to the varieties of food and cash crops being cultivated and marketed in the area (Maurice, 2012).

Jada and Ganye Agricultural Zones have rich agricultural land suitable for growing maize, cowpea, groundnut, soybean, bambara nuts, sugarcane, cashew among other crops (Timon *et al.*, 2020). Domestic animals such as cattle, goat, and sheep are also been reared to supplement the farmers income.

Sampling Procedure and Sample Size

The target population for this study are maize farmers in Ganye and Jada Agricultural Zone of Adamawa State, Nigeria. A multistage sampling technique was adopted for the study. At the first stage, eight (8) districts (4 districts each from Ganye and Jada Agricultural Zones) were purposively selected. Their selection was based on their maize production level (Maurice et al., 2015). The eight (8) purposive selected districts are: Bakari-Guso, Jaggu, Timdore, Sugu. Danaba, Mbulo, Mapeo, and Kojoli.

The Second stage involved a random selection of 16 farming communities from the eight districts, namely: Bakari-Gusso (Bakri-gusso, and Garga), Jaggu (Jaggu, and Wadore), Timdore (Timdore,andYelwa), Sugu (Sugu, andGamu), Danaba (Nawai, and Nadeu), Mbulo (Gangsanji, and Boro) Mapeo (Babidi, and Sitim), and Kojoli (Sandasini, and Dabora).

Table 1 shows the selection of the respondent for the study. The third and final stage involved simple random sampling technique using balloting to select 130 samples from the sample frame of 1,336 maize based enterprise farmers.

Table 1: Selection of respondents for the study

LGA	District	Farming Communities	Sample Frame	Random Selection
Ganye	Bakari-Gusso	Bakari-Gusso	90	9
Ganye	Jaggu	Garga	40	4
		Jaggu	100	10
Ganye	Timdore	Wadore	50	5
		Timdore	100	10
Ganye	Sugu	Yelwa	140	14
		Sugu	120	12
Jada	Danaba	Gamu	110	11
		Nawai	90	9
Jada	Mbulo	Nadeu	62	6
		Gansanii	73	7
Jada	Kojoli	Boro	85	8
		Sandasini	68	7
Jada	Mapeo	Dabora	39	4
		Babidi	84	8
		Sitim	85	8
Total			1,336	130

Source: Field survey 2018

Primary data used for the study were collected by means of a structured questionnaire administered to 130 maize farmers engage in maize based enterprise in Jada and Ganye Agricultural Zone. Table 2 shows the farming communities, questionnaire distributed and retrieved. The data comprised of socio-economic characteristics, cost of inputs, revenue earned, and constraint faced by the maize farmers.

Table 2: Distribution of sample in 16 farming communities

Farming Communities	Questionnaire Distributed	Questionnaire Retrieved
Bakari-Gusso	9	9
Garga	4	4
Jaggu	10	10
Wadore	5	5
Timdore	10	10
Yelwa	14	14
Sugu	12	12
Gamu	11	11
Nawai	9	9
Nadeu	6	6
Gansanii	7	7
Boro	8	8
Sandasini	7	7
Dabora	4	4
Babidi	8	8
Sitim	8	8
Total	**130**	**130**

Source: Field survey 2018

Methods of Data Analysis

The descriptive statistics which employed the use of mean, frequency counts, minimum, maximum, and percentage were used to achieve objectives i, ii, and iv.

Gross Margin was used to analyzethe profitability among the maize farmers (objective iii). According to Giroh et al. (2018), gross margin involves accurate collection of total variable cost and total revenue data obtained from a farm enterprise. Essentially, gross margin is a budgeting tool used to estimate gross margin.

The model used for the estimation of the gross margin according to Labaga et al. (2020) is stated as:

GM = TR – TVC

Where, GM (Gross Margin) = TR(Total Revenue) – TVC (Total Variable Cost)

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The gender distribution in Jada and Ganye Agricultural Zones showed that the male maize based enterprise farmers (76.2%) were more involved in the maize-based enterprises than their female (23.8%) counterpart. This finding agrees with the findings of Solomon (2017), that farming activities in northern Nigeria is being carried out mostly by males while the females involve in light farm operations such as harvesting and marketing. The result in Table 3 further shows the mean

age of the respondents as 39 years and majority (36.9%) of the respondents are between the ages of 31 – 40 years of age. The result further reveals the respondents as well educated. Most of the respondents (87.7%) have various forms of formal education and 12.3% had no any form of formal education. Majority (46.9%) of the respondents had primary education. The mean household size of the study was 10. The study showed the majority (34.6%) of the respondents are in the household size of between1-5 persons per household. The minim household size of the study is 1 person and the maximum is 21 persons.Majority (41.5%) of the respondents'farmland size was found to be less than 2 hectares and the mean is 1.8 hectares. The minimum farmland size for the study is 0.5 hectares while the maximum is 2.7 hectares

Table 3: Socio-economic characteristics of the maize farmers

Variable	Frequency	Percentage	Mean	Minimum	Maximum
Gender					
Male	99	76.2			
Female	31	23.8			
Total	130	100.0			
Age (years)					
20–30	28	21.5	39	20	65
31–40	48	36.9			
41–50	30	23.1			
51–60	16	12.3			
61 and Above	8	6.2			
Total	130	100.0			
Education					
Informal	16	12.3			
Primary	61	46.9			
Secondary	36	27.7			
Tertiary	17	13.1			
Total	130	100.0			
Household Size					
1–5	45	34.6	10	1	21
6–10	41	31.5			
11–15	15	11.5			
16–20	21	16.2			
21 and Above	8	6.2			
Total	130	100.0			
Farmland Size (hectare)					
≤ 2.0	54	41.5	1.8	0.5	2.7
2.1–3.0	40	30.8			
3.1–4.0	31	23.8			
4.1 and Above	5	3.8			
Total	130	100.0			

Source: Field Survey, 2018.

Distribution of Respondents on the Basis of Maize Based Enterprise

The results in Table 4 shows that the majority (60%) of the respondents were involved in only one of the forms of maize based enterprises. While those solely on maize cultivation constituted 40%. Table 4 also shows that sole maize cropping predominates any other form of maize based cropping system in the study area. The dominance (40%) of sole maize enterprises over any other form of maize enterprises may be attributed to the small-scale nature of the maize farmers. This finding gives credence to the findings of Babatunde *et al.* (2008), who found in their study that the majority of maize farmers in Kwara State were involved in sole maize cultivation

Cost of inputs associated with the maize based enterprise system

Table 5 shows labour occupied a larger portion of the variable cost across all the eleven enterprises. This shows that labour was used by maize farmers than any other input (Seed, Agrochemical and Fertilizer) in Jada and Ganye Agricultural Zone. This finding contradicts the findings of Bello, et. al. (2020), who found fertilizer to be the most dominant input of production in Bichi Local Government (Kano State).

Profit Analysis of Maize Based Enterprises in the Study Area

Table 6 shows that the total revenue earned for the eleven maize based enterprises was ₦895868.49, the total variable cost was ₦436488.32, and the total gross margin was estimated to be ₦44 593 80.17 per hectare. The Table shows the total revenue, total variable and gross margin of maize/rice as 74 813.16, 35 040.27 and 39 772.89. This reveals that maize based enterprise systems were profit able in Jada and Ganye Agricultural Zone of Adamawa State which is in support of the findings of Maikasuwa et al. (2013), who reported a positive gross margin for all the yam based enterprises in Bosso Local Government Area of Niger State. Maize/soybean occupied a larger portion (13.0%) of the total gross margin with a gross margin of ₦ 59 760.75.

Table 4. Distribution of respondents

Enterprise	No of Respondents	%
Sole maize	52	40.0
maize/cowpea	22	16.9
maize/yam	8	6.2
maize/groundnut	19	14.6
maize/beniseed	2	1.5
maize/millet	6	4.6
maize/rice	6	4.6
maize/sugarcane	3	2.3
maize/soybean	6	4.6
maize/sorghum	3	2.3
maize/bambaranut	3	2.3
Total	130	100.0

Source: Field Survey, 2018

Table 5: Cost of inputs associated with maize based enterprise system in the study area

Enterprise	Item	Quantity Used	Price/unit (₦)	Cost (₦)	Total Cost (%)
Maize/Rice	Seed	43.78	56.32	2 466.57	7.0
	Agrochemical	20.21	267.18	5 400.00	15.4
	Fertilizer	72.10	102.18	7 368.42	21.0
	Labour	18.71	1 058.54	19 810.53	56.5
Maize/Cowpea	Seed	34.12	70.42	2 402.67	5.4
	Agrochemical	14.73	317.54	4 678.40	10.5
	Fertilizer	70.66	105.66	7 466.67	16.8
	Labour	27.00	1 123.00	29 970.00	67.3
Maize/Groundnut	Seed	65.31	42.83	2 797.51	6.2
	Agrochemical	19.20	280.64	5 388.33	11.9
	Fertilizer	68.58	102.20	7 009.17	15.5
	Labour	29.83	1 007.00	30 040.00	66.4
Maize/Sorghum	Seed	45.00	98.27	4 422.22	9.4
	Agrochemical	16.56	202.25	3 348.33	7.1
	Fertilizer	136.11	104.08	14 166.67	30.2
	Labour	20.14	1 237.51	24 927.78	53.2
Maize/Soybean	Seed	49.28	56.53	2 785.55	10.6
	Agrochemical	21.89	295.25	6 462.78	24.6
	Fertilizer	51.94	120.59	6 263.89	23.8
	Labour	13.81	782.23	10 802.59	41.1
Maize/Sugarcane	Seed	49.00	122.04	5 980.00	13.4
	Agrochemical	23.70	222.15	5 265.00	11.8
	Fertilizer	68.00	100.15	6 810.00	15.2
	Labour	34.45	772.95	26 625.00	59.6
Maize/Yam	Seed	44.23	68.16	3 014.53	7.2
	Agrochemical	17.55	344.62	6 047.17	14.5
	Fertilizer	68.87	101.10	6 962.26	16.6
	Labour	18.32	1 408.74	25 811.32	61.7
Maize/Benniseed	Seed	35.00	50.00	1 750.00	6.9
	Agrochemical	14.63	196.15	2 868.75	11.4
	Fertilizer	35.63	100.00	3 562.50	14.1
	Labour	12.30	1 385.44	17 043.75	67.6
Maize/Bambaranut	Seed	36.64	62.32	2 283.18	5.8
	Agrochemical	17.64	259.79	4 581.82	11.6
	Fertilizer	54.55	106.67	5 818.18	14.7
	Labour	19.57	1 369.11	26 790.91	67.9
Maize/Millet	Seed	39.38	64.33	2 532.81	6.3
	Agrochemical	14.06	335.56	4 718.75	11.8
	Fertilizer	64.06	99.51	6 375.00	15.9
	Labour	24.20	1 092.82	26 446.88	66.0
Sole Maize	Seed	41.26	70.52	2 909.66	6.2
	Agrochemical	16.75	335.33	5 615.86	11.9
	Fertilizer	70.46	103.49	7 291.95	15.4
	Labour	26.46	1 187.06	31 408.21	66.5

Source: Analyzed from field Survey data 2018

Table 6: Profit analysis of maize based enterprise system

Enterprise	Total Revenue (TR)	Total Variable Cost (TVC)	Gross Margin (GM)	Gross Margin (%)
Maize/Rice	74 813.16	35 040.27	39 772.89	8.7
Maize/Cowpea	78 240.00	44 517.74	33 722.26	7.3
Maize/Groundnut	93 247.73	45 237.01	48 010.72	10.5
Maize/Sorghum	95 805.56	46 865.00	48 940.56	10.7
Maize/Soybean	86 075.56	26 314.81	59 760.75	13.0
Maize/Sugarcane	95 635.00	44 680.00	50 955.00	11.1
Maize/Yam	94 791.51	41 835.28	52 956.23	11.5
Maize/Benniseed	56 287.50	25 225.00	31 062.50	6.8
Maize/Bambaranut	68 000.00	39 474.09	28 525.91	6.2
Maize/Millet	68 203.13	40 073.44	28 129.69	6.1
Sole Maize	84 769.34	47 225.68	37 543.66	8.2
TOTAL	895 868.49	436 488.32	459 380.17	100

Source: Analyzed from field Survey data 2018

Benefit Cost Ratio of Maize Based Enterprise System in the Study Area

The Benefit- Cost Ratio (BCR) of ₦2.06 in Table 7 indicates that for ₦1.00spent, ₦2.06 will be realized as revenue. This cost-benefit ratio follows the findings of Abdulaleem et al. (2017), who reported a BCR of ₦1.74 for small-scale maize farmers in Osun State, Nigeria.

Constraints Facing the Maize Farmers in the Study Area

Table 8 shows that high cost of labour, high cost of input, pest and diseases, cattle invasion and low price of maize were the first five most prominent constraints affected maize farmers in Jada and Ganye Agricultural Zone. The constraint table shows that the main constraint is high cost of labour (72.3%). This may be due to high rate of kidnapping and banditry been faced in the study area. The table also shows that the second constraint is high cost of input (65.4%). The high cost of input reveals that the price of inputs like improve seeds, fertilizer and agrochemical are too expensive for the maize farmers to buy and which will negatively affect the profitability of the farmer. 57.7% was pest and diseases, and 53.9% had cattle invasion as a problem. 51.5% had low price of maize as a constraint.

Table 7: Benefit cost ratio of maize based enterprise system

Total Revenue (TR)	Total Variable Cost (TVC)	Benefit Cost Ratio (TR/TVC)
₦895 868.49	₦436 488.32	₦2.06

Source: Analyzed from field Survey data 2018

Table 8: Distribution of maize farmers according to constraint

Constraint	Frequency	Percentage	Ranking
High cost of labour	94	72.3	1st
High cost of input	85	65.4	2nd
Pest and diseases	75	57.7	3rd
Cattle invasion	70	53.9	4th
Low price of maize	67	51.5	5th

CONCLUSION AND RECOMMENDATION

Based on the outcome of the study, it was concluded thatmaize based enterprise system production in the study area was lucrative, despite the series of identified constraints.The benefit-cost ratio of ₦2.06 estimated from this study indicates that for every one naira spent, ₦2.06 will be realized as revenue. It is therefore recommended that more farmers should be encouraged to go into maize based enterprise system farming since it is profitable and since the maize based enterprises system is lucrative; there is need for government to attract more unemployed youths into this business.

ACKNOWLEDGEMENTS

The authors wish to thank Staff of Adamawa State Ministry of Agriculture and Rural Development and maize based enterprises farmers in the study area for their great assistance in providing information and data for this research.

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Journal of Applied Agricultural Research 2021, 9(1): 48-57
ISSN 2006-750X

DYNAMICS OF PRICE TRANSMISSION AND MARKET INTEGRATION OF CASSAVA IN RURAL AND URBAN MARKETS OF OYO STATE, NIGERIA

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ABSTRACT

The study analyzed the dynamics of price transmission and market integration of cassava in rural and urban markets of Oyo State, Nigeria. The specific objectives were to examine the trend of cassava price series in the rural and urban markets, determine the long run and short run influences of cassava prices in the rural and urban markets, determine the market integration of cassava price series in the rural and urban markets and ascertain the market that causes integration and the direction of causality in the rural and urban markets of Oyo State, Nigeria. Average monthly price (₦/kg) of cassava spanning from January, 2008 to December, 2018 were collected and analyzed using ADF test, Johansen co-integration test, Error Correction Model (ECM), Index of Market Concentration (IMC) and Granger causality test. The result of ADF test showed that the price series were stationary at levels with the co-integration test revealing the presence of long run relationship between the rural and urban market price of cassava in the study area while the ECM revealed that the speed of price transmission between the rural and urban markets was weak and the adjustment towards the long run equilibrium in the short run was slow. Also, the Index of Market Concentration (IMC) was less than one (IMC < 1) and statistically significant at 1% probability level (P < 0.01); which implies the existence of high short-run market integration between rural and urban markets while the results of granger causality shows both uni-directional and bi-directional causality in the study area. Based on these findings, it was recommended that, there is need for efficient transmission of price information among the various market actors in the urban and rural markets through the establishment of market information centers to facilitate adequate communication and flow of information.

Keywords: Cassava, Integration, Market, Price, Stationarity.

INTRODUCTION

Cassava (*Manihot esculenta*) is one of the important sources of carbohydrate and primary product for food especially in the form of Garri, tapioca and fufu for human consumption in Nigeria. It is a perennial vegetatively propagated shrub and is one of the most important food crops grown in Africa (Oyegbami *et al*, 2010). 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. Nigeria is the world's largest producer of cassava with other top producers being Indonesia, Thailand, the Democratic republic of Congo and Angola (FAOSTAT, 2012). Cassava prices are highly unstable between seasons in different part of Nigeria. Consumers pay different amounts for the

same product in different markets separated by few kilometers. Price instability of agricultural commodity would be considered a normal phenomenon, if it does not significantly differ from one market to another. On the contrary, if products prices are significantly different among markets it will distort resources flow, which might have adverse effect on the food security goal of the nation (Akpan *et al*., 2014).

Nigeria is a vast country with clear distinct regions, rural and urban areas. Prices of agricultural commodities in each of this region, rural and urban areas differ depending on the availability of infrastructures among others (Akpan *et al*., 2014). Spatial price linkages are often interpreted as providing insight into the efficiency of infrastructures of markets. This is especially true in developing economy or society, where infrastructure issues such as roads, market links and development, transportation, communication among others may be especially pertinent (Godwin, 2005).

Market integration is a central issue in many contemporary debates concerning market liberalization (Adenegan and Anifat, 2014). It is perceived as a pre-condition for effective market reform in developing countries: "Without spatial integration of markets, price signals will not be transmitted from urban food deficit to rural food surplus areas, prices will be more volatile, agricultural producers will fail to specialize according to the long term comparative advantage and gains from trade will not be realized" (Adenegan and Anifat, 2014). In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost; the arbitrage activities will be activated. The arbitrageur purchases commodities from lower-price markets and resell in higher-price markets. This is a situation where spatial markets are not integrated but on the other hand, two markets are integrated when there is a significant long-run relationship between prices of homogenous goods due to the smooth transmission of price signals and information across the two markets (Akpan *et al*., 2014). Market integration could be perfect if price changes in one market are fully and instantaneously reflected in the alternative markets.

Hence, understanding the direction and magnitude of cassava price transmission between the rural and urban markets in Oyo state will provide indispensable input to policy makers to formulate workable policies for the agricultural sector in the state. It will also, promote the achievement of the food self-sufficiency goal and help in minimization of the poverty menace among the citizens in the state and the nation at large. Therefore, such information can help government at all tiers to decide the extent to which price transmission can be considered as efficient across different geo-political zones in their domains (Akpan *et al*., 2014).

In recent years, the empirical research on agricultural price transmission has gathered considerable attention. Interest in this topic unquestionably increased after the so-called food crisis of 2007 – 2008 in which international agricultural markets were shocked by increased volatility, which is a rapid rise and fall of the "price bubbles" as well as a possible change in the long-term downward trend of agricultural prices (Guilia and Roberto, 2012). The boom and subsequent decrease in food prices that took place around 2008 raised numerous questions about the impact of such variations on populations' welfare and on the economic sector which directly concerns the agricultural sector. In this matter, if governments are to take adequate measures to ensure food security, they need to have

good knowledge of the functioning of their markets. This implies, among others, knowing the state of price transmission along the marketing chain within the country and between international and domestic markets (Sadiq *et al*., 2017).

In the light of the aforementioned, this study therefore seeks to provide answers to the following research questions: What is the trend of cassava price series in the rural and urban markets? What is the long run and short run influences of cassava prices in the rural and urban markets? What is the market integration of cassava price series in the rural and urban markets? and which market causes integration and what is the direction of causality?

Objectives of the Study

The aim of this study was to analyze the dynamics of price transmission and market integration of cassava in the rural and urban markets of Oyo State, Nigeria. The specific objectives were to: (i) examine the trend of cassava price series in the rural and urban markets, (ii) analyze the long run and short run influences of cassava prices in the rural and urban markets, (iii) determine the market integration of cassava price series in the rural and urban markets, and (iv) ascertain the market that causes integration and the direction of causality in the study area.

MATERIAL AND METHODS

The Study Area

The study was conducted in Oyo State, Nigeria. It is located in the South-Western part of Nigeria and lies between latitude 7^0 and 9.3^0N and longitude 2^0 and 4^0E. The state is made up of 33 local government areas with a total population of 5,591,585 (National Population Commission (NPC), 2006) which is projected to be about 7,408,850 in 2019 at 2.5% growth rate according to the National Bureau of Statistics (NBS), (2016). The Oyo state rural markets represented different communities and villages in the rural areas while the urban markets represented different towns and cities in the urban areas. The major ethnic group comprises of the Oyos, the Oke-Oguns, the Ibadans and the Ibarapas, all belonging to the Yoruba family. Both annual and perennial crops are grown in the region and this includes but not limited to maize, cassava, yam, oranges, cocoa, tobacco, cashew and sugar cane.

Data Collection and Analytical Techniques

Secondary data were used for this study. Time series data for average monthly price of cassava (₦/kg) spanning from January 2008 to December 2018 was collected from the National Bureau of Statistics and the Oyo State Agricultural Development Programme. The study applied series of statistical and econometric techniques to analyze the data collected in line with the stated objectives of the study. These includes: Augmented Dickey Fuller (ADF) test, Johansen Co-integration test, Error Correction Model (ECM), Index of Market Concentration (IMC) and Granger causality test.

Augmented Dickey Fuller (ADF) Unit Root Test

As first step in the analysis involving time-series data, the investigation of the presence of unit root in the data is very important for the reason that it helps to ensure that the variables used for the analysis do not result in spurious regression. The ADF unit root test was carried out on the data in order to test for the stationarity of each time series data set. The test also enables the determination of the

order of integration of the series, which is the number of times a series has to be differenced for it to become stationary.

$$\Delta P_{Bt} = \beta_0 + \beta_t P_{Bt-i} + \sum C_j \Delta P_{Bt-I} + \varepsilon_i \quad 1$$

$$\Delta P_{At} = \gamma_0 + \gamma_t P_{At-i} + \sum d_j \Delta P_{At-I} + \varepsilon_i \quad 2$$

Where; Δ = first difference operator and ε_t= stochastic error term that follows the classical assumptions. The decision rule is that, if the value of the ADF statistic is less than the critical value at a specified significance level then the series (P_t) is said to be non-stationary and vice versa.

Johansen Co-integration Test

The next logical step was to test for co-integration using Johansen co-integration techniques (Trace and Eigen-value Test). It was used to test the hypothesis: **H_0**: The time series variables are not co integrated (r=0).

If two series are individually stationary at same order, the theories of Johansen and Juselius (1990) and Juselius (2006) can be used to estimate the long run co-integrating vector from a Vector Auto Regression (VAR) model of the form:

$$\Delta_{pt} = \propto + \sum_{i=1}^{k-1} \tau_i \Delta P_{t-1} + \pi P_{t-1} + \mu_t \quad 3$$

Where: P_t is a (n x 1) vector containing the price series at time (t), Δ is the first difference operator. Γ_I and Π are (m x n) matrix of parameters on the i[th] and k[th] lag of p_t,$\tau_i = (\sum_{i=1}^{k} A) - I_g$, $\pi_i = (\sum_{i=1}^{k} Ai) - I_g$, I_g is the identity matrix of dimension g, α is constant term, μ_t is (n x 1) white noise vector. Throughout, p is restricted to be (at most) integrated of order one, denoted by 1(1), where 1(j) variable requires j[th] differencing to make it stationary.

Error Correction Model (ECM)

This involved estimating the Error Correction Model (ECM). ECM captures the short-run disequilibrium situations as well as the long-run equilibrium adjustments between prices. Even if one demonstrates market integration through co-integration, there could be disequilibrium in the short-run i.e price adjustments may not happen instantaneously. It may take some time for the spatial price adjustments to take place. ECM can incorporate such short-run and long-run changes in the price movement.

An ECM formulation, which describes both the short-run and long-run behaviours of prices, is expressed as follows:

$$\Delta P_{Bt} = \gamma_1 + \gamma_2 \Delta P_{At} + \pi \vartheta_{Bt-I} + V_{it} \quad 4$$

In this model,

γ_2 = the impact multiplier (the short-run effect) that measure the immediate impact that a change in P_{At} will have on a change in P_{Bt}.

π = the feedback effect or the adjustment effect that shows how much of the disequilibrium is being corrected, that is the extent to which any disequilibrium in the previous affects any adjustment in the P_{Bt} period. Note that, $\vartheta_{t-I} = P_{Bt-1} - \rho_1 - \rho_2 P_{At-1}$ therefore from this equation we also have ρ_2 being the long-run response.

Index of Market Concentration (IMC)

The index of market concentration was used to measure the price relationship between integrated markets.

$$P_t = \beta_0 \ \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_{t-1} + \varepsilon_t \quad 5$$

Where: R_t = urban, P_t= rural price, R_{t-1} = lagged price for urban markets, R_t-R_{t-1} = difference between urban price and its lag, $\in_t$ = error term or unexplained term, β_0= constant price, β_1 = coefficient of rural lagged price, β_2 = coefficient of $R_t - R_{t-1}$ and β_3 = coefficient of urban lagged price.

$IMC = \beta 1/\beta 3$ 6

Where $0 \leq IMC \leq \infty$

IMC < 1 implies high short-run market integration, IMC > 1 implies low short-run market integration, IMC = ∞ implies no market integration, and IMC = 1 implies high or short-run market integration.

Granger Causality Test

If a pair of series is co-integrated, then there must be Granger causalities in at least one direction, which reflects the direction of influence between series (in this case, price). Theoretically, if the current or lagged terms of a time-series variable, says P_{At}, determine another time-series variable, say P_{Bt} then there exist a Granger-causality relationship between P_{At} and P_{Bt} in which P_{Bt} is Granger caused by P_{At}.

$$\Delta P_{Bt} = \theta_{11}\Delta P_{Bt-1} + ... + \theta_{In}\Delta P_{Bt-n} + \theta_{21}\Delta P_{At-1} + \theta_{2n}\Delta P_{At-n} - \gamma_1(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_t \quad 7$$

$$\Delta P_{Bt} = \theta_{31}\Delta P_{Bt-1} + ... + \theta_{3n}\Delta P_{Bt-n} + \theta_{41}\Delta P_{At-1} + \theta_{4n}\Delta P_{At-n} - \gamma_1(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_t \quad 8$$

The following two assumptions have to be tested using the above two models (equations 7 and 8) to determine the Granger causality relationship between prices.

$\theta_{21} = \Delta = \theta_{2n} = \Delta = \gamma_1 = 0$(Nocausality from P_{Bt} to P_{At}) 9

$\theta_{41} = \Delta = \theta_{4n} = \Delta = \gamma_2 = 0$(Nocausality from P_{Bt} to P_{At}) 10

The causality test procedures offers a framework for the assessment of which market (rural or urban) cause the integration and in which direction is the movement (Ojo *et al.*, 2015).

RESULTS AND DISCUSSION

Summary Statistics of Variables Used For Analysis

The descriptive statistics of the price series used in the empirical models for investigation in this study for cassava marketers presented in Table 1 shows that the prices of cassava attained a maximum of ₦164.5/kg and ₦91.94/kg and a minimum price of ₦109.35/kg and ₦68.95/kg in the urban and rural markets respectively. The mean cassava price shows ₦76.65/kg and ₦136.26/kg for rural and urban prices in Oyo State with standard deviation of ₦6.64/kg and ₦18.65/kg in the rural and urban markets respectively. The result further revealed that the rural and urban market price series in Oyo were all positively skewed, thereby indicating a skewness of variables matching that of a normal distribution

Table 1: Descriptive statistics of cassava price series used in the study

	Oyo State	
Parameters	Rural	Urban
Mean	76.65	136.26
Median	74.81	132.94
Minimum	68.95	109.35
Maximum	91.94	164.5
Standard Deviation	6.64	18.65
Coefficient of Variation	44.09	47.93
Skewness	1.31	0.17
Kurtosis	3.95	1.69

Source: Data Analysis, 2021.

Trend of Cassava Market Price Series in Oyo State.

The result of cassava market price behavior in Oyo State presented in Figure 1 shows a varying degree of price instability over the period of study for both rural and urban markets in the State with the rural prices lower than the urban prices. This could be attributed to the fact that rural markets are perceived as places for surplus and as such lower prices of commodities. For the rural markets (Iluju, Ilora and Omi-Adio), there was a similar price trend in Iluju and Ilora markets while Omi-Adio market shows a higher trend among the rural markets. The peak market prices observed during the period of study were ₦96.66/kg in 2017, ₦98.07 in 2017 and ₦96.17/kg in 2016 for Iluju, Ilora and Omi-Adio respectively. The urban markets however experienced fluctuations throughout the period of study with greater price instability during the period. Bodija market shows the fluctuating trend from 2008 – 2014 with a sharp drop in 2015 which was followed by a sharp rise in price from 2015 – 2017. The sharp drop could be due to surplus in the market which brings about fall in price and as such the forces of demand and supply come into place which in turn led to the sharp rise in price due to adjustment made by various price mechanisms.

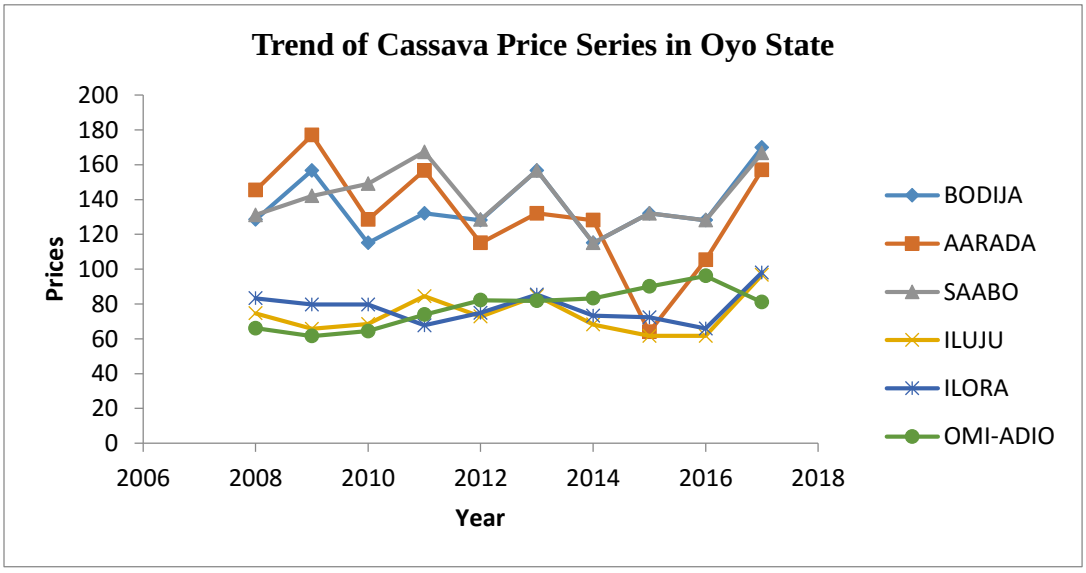

Figure 1: *Trend of cassava market price series in Oyo State.*

Determination of Time Series Properties for Cassava Markets in Oyo State.

Table 2 presents the ADF unit root test of stationarity for cassava market price series in the study area as a prerequisite step in the analysis involving the use of time series data. The results from the ADF test shows that all the market price series were stationary at levels with order of integration 0, I (0). The ADF result is confirmed by Adenagan and Adeboye (2011) who reported similar result in Oyo State, that tomato price series in the rural and urban markets of Oyo State were stationary at their level.

The result also shows that the market price series for Bodija, Aarada and Omi – Adio were all significant at the 0.05 probability level ($P < 0.05$) while the market price series of Saabo, Iluju and Ilora were significant at the 0.01 probability level ($P < 0.01$). This therefore confirms the stationarity of the market price series at levels and integrated of the order I (0) leading to the rejection of the

null hypothesis of non stationarity of the market price series.

Johansen co-integration test for cassava markets in Oyo State

The results of Johansen co-integration test for cassava market price series presented in Table 3 shows at least one co-integrating equation as indicated by the trace statistic of 270.29 which is greater than the critical value of 94.15 at 5% level of significance ($P < 0.05$). This was further confirmed by the max statistics of 110.85 which is greater than a critical value of 39.37 at 5% level of significance.

Based on this, the null hypothesis of no co-integration among the cassava market price series was rejected; this therefore implies a long run relationship among cassava market price series in the rural and urban markets in the study area. This result corroborates the co-integration test result of Akpan *et al*., (2014) which revealed the presence of co-integration between the rural and urban prices of maize and beans, thereby implying a long run relationship among the rural and urban market prices.

Table 2: Augmented Dickey Fuller (ADF) unit root test of cassava price series in Oyo State

Market price series	Level	Order of Integration
Bodija	-3.216**	I(0)
	(0.019)	
Aarada	-3.260**	I(0)
	(0.016)	
Saabo	-3.453***	I(0)
	(0.009)	
Omi – Adio	-2.996**	I(0)
	(0.035)	
Iluju	-4.290***	I(0)
	(0.000)	
Ilora	-3.997***	I(0)
	(0.001)	

Source: Data Analysis, 2021.

Note: ***and**implies significant at the 1% and 5% level of significance respectively; Figures in parentheses are probability values.

Table 3: Johansen co-integration rank test for cassava market

Hypothesized No. of CE(s)	Trace Statistics	Critical Value (5%)	Max Statistics	Critical Value (5%)
r = 0*	270.29	94.15	110.85	39.37
r = 1	159.44	68.52	78.85	33.46
r = 2	80.59	47.21	37.19	27.07
r = 3	43.40	29.68	22.64	20.97
r = 4	20.76	15.41	15.12	14.07
r = 5	5.63	3.76	5.63	3.76

Source: Data Analysis, 2021

* denotes rejection of null hypothesis at 5% significant level.

Vector Error Correction Model (VECM) for cassava markets in the study area.

The ECM results presented in Table 4 revealed that the short run market integration as measured by the magnitude of market interdependence and the speed of price transmission between the urban markets was weak which suggests that the transmission of price changes from one market to another during the study period was weak. Price changes in Aarada and Saabo markets (Urban) was transmitted to other markets at a rate of 26% and 36% respectively within the period; this shows that adjustment towards the long run equilibrium in the short run was relatively slow. Similar pattern was also observed in the rural markets where Iluju and Ilora markets transmitted price changes to other markets at a rate of about 11% and 7% respectively which shows a very slow rate of price transmission. Therefore based on the results, it can be deduced that cassava markets in the study area were not well integrated in the short run. In other words, price adjustment across markets did not happen instantaneously within the study area. Mkpado *et al*. (2013) in their study on price transmission and integration of rural and urban rice markets in Nigeria reported that it took time for spatial price adjustment to take place between rural and urban markets, implying a weak price transmission and as such the markets were not well integrated.

Index of Market Concentration for Cassava Markets in the Study Area.

The IMC results presented in Table 5 revealed that there was high short run market integration between the rural and urban markets for cassava in the study area as indicated by the IMC value of 0.5498 which is less than one. This is a strong indication that price changes in the rural markets do cause immediate changes in the price of cassava in the urban markets in the study area. This finding is in line with Akpan *et al*., (2014) who conducted a study on monthly price analysis of cassava derivatives in the rural and urban markets of Akwa Ibom State and reported that there was high short-run market integration between rural and urban prices of cassava products in the study area.

Table 4: Estimates of Vector Error Correction Model (VECM) for cassava markets

Coint. Eqns	RURAL MARKETS			URBAN MARKETS		
	Omi-Adio	ΔIluju	ΔIlora	ΔBodija	ΔAarada	ΔSaabo
CointEqn1	-0.0512	-0.6933	0.2260	-0.0032	0.0006	0.0001
	(0.0270)	(0.1130)	(0.0707)	(0.0019)	(0.0013)	(0.0010)
	[-1.89]	[-6.14]***	[3.19]***	[-1.67]	[0.44]	[0.08]
CointEqn2	-0.1830	-0.0270	-0.3273	-0.1700	-0.2572	-0.3299
	(0.0917)	(0.0975)	(0.0856)	(0.0949)	(0.0931)	(0.0908)
	[-1.99]**	[-0.28]	[-3.83]***	[-1.79]	[-2.76]***	[-3.63]***

Source: Data Analysis, 2021.

Note: ***and**implies significant at 1% and 5% significance level respectively; Figures in brackets (…) and […] are standard errors and t-values respectively.

Table 5: Results of Index of Market Concentration (IMC) for cassava in the study area

Variables	β_1	β_2	β_3	IMC
Markets	0.2688	0.5410	0.4889	0.5498
	(2.92)***	(2.02)**	(2.68)**	

Source: Data Analysis, 2021.

Note: *** and ** implies significant at 1% and 5% level of significance respectively; Figures in parenthesis are t-values.

Granger causality test on cassava markets in Oyo State

The test statistics for the pair-wise granger causality test on cassava markets in Oyo State presented in Table 6 shows that the market pair of Bodija – Ilora and Aarada – Ilora were both statistically significant at 5% level of significance and showed bi-directional causalities; this implies that the null hypotheses of no granger causality was rejected and that the former markets in each pair granger caused the price formation in the latter markets which in turn provides the feedback to the former markets. The F-statistics of the market pair of Iluju – Ilora was statistically significant at 1% level of significance with a unidirectional causality while the market pair of Bodija – Aarada, Bodija – Iluju and Aarada – Iluju were all statistically significant at 5% significance level with unidirectional causalities; meaning that a change in price in the former markets of each pair granger caused the price formation in the latter markets, whereas the price change in the latter markets were not fed back by the price change in the former markets of each pair as presented in Table 6. Adenagan and Bolariwa (2011) reported both uni-directional and bi-directional granger causalities for rural and urban markets links in the study area.

Table 6: Pair-wise Granger causality test on cassava markets in Oyo State

Null Hypothesis	F-Statistics	P-Value	Direction of Causality
Bodija → Aarada	2.3033	0.0922	
Aarada → Bodija	3.1718**	0.0347	Unidirectional
Bodija → Iluju	0.7805	0.5504	
Iluju → Bodija	3.4163**	0.0266	Unidirectional
Bodija → Ilora	3.0802**	0.0383	
Ilora → Bodija	3.9553**	0.0152	Bidirectional
Aarada → Iluju	1.7692	0.1728	
Iluju → Aarada	3.9606**	0.0151	Unidirectional
Aarada → Ilora	4.3506**	0.0102	
Ilora → Aarada	3.6388**	0.0210	Bidirectional
Iluju → Ilora	4.8602***	0.0062	
Ilora → Iluju	0.8242	0.5245	Unidirectional

Source: Data Analysis, 2021.

Note: → indicates direction of causality; *** and** means significant at 1% and 5% level of significance respectively.

CONCLUSION AND RECOMMENDATION

The study analyzed the dynamics of price transmission and market integration of cassava in the rural and urban markets of Oyo State, Nigeria and concludes that the trend of cassava prices was unstable over the period of study due to irregular price movement in the rural and urban markets. Also, there was long run relationship among the variables, high short run market integration between the rural and urban markets and a weak speed of adjustment between the integrated markets with both uni-directional and bi-directional causalities in the rural and urban markets. Based on these findings, the study therefore recommended that, there is the need for efficient transmission of price information among the various market actors in the urban

and rural markets through the establishment of market information centers to facilitate adequate communication and flow of information.

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Journal of Applied Agricultural Research 2021, 9(1): 58-64
ISSN 2006-750X

HOW HAS COVID-19 EXACERBATED FOOD PRICES AND COMPLICATED FOOD SECURITY CRISIS IN NIGERIA?

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ABSTRACT

The COVID-19 situation in Nigeria, the level of management of the disease, the socioeconomic consequences that followed the lockdown and global economic disruptions that followed have been implicated among the root causes of the current food situation in Nigeria. Nigeria was dealing with the pre-established fact of food and nutrient insecurity before the advent of the coronavirus pandemic. The pandemic and management of the economic and social fallout have left food prices sky-rocketing amid the complication of job losses raising the unemployment profile of Nigeria. Hence, the paper identified the ways through which COVID-19 pandemic has contributed in worsening Nigeria's food crisis and the spike in prices of food. The factors of food insecurity include the depreciation of local currency against the dollar, decline in aggregate demand due to job-loss, rise in poverty level economic downturn of the country occasioned by shocks in global oil market and Nigeria's lack of food self-sufficiency. It was recommended that Nigeria's government, must as a matter of urgency, grab a hold of the sky-rocketing prices of food and food-related commodities before they go spiralling out of control. The best way to do this is by improving productivity and investing deliberately in productivity-enhancing agriculture policy and programme. Productivity-enhancement agriculture projects must be result-based and devoid of unnecessary politics.

Keywords: COVID-19, food prices, food security crisis, Nigeria

INTRODUCTION

Nigeria is facing a real economic challenge from which it is trying to extricate itself. The prices of commodities had risen astronomically in the later parts of 2020 but the rise has been sustained in 2021 with some commodities simply going out of the reach of the common man. The COVID-19 pandemic has actually taken its toll on economies all over the world (Ozili and Arun, 2020). Nigeria is certainly no exception. However, certain factors make Nigeria's case especially concerning. One of it being that Nigeria is one of the three countries predicted to have the highest number of poor people (World Bank, 2020c). The pandemic has made situations worse with millions of Nigerians losing their jobs and falling back into the unemployment circle. Unemployment rate in Nigeria increased to 33.3% in the fourth quarter of 2020 and the underemployment statistics was 22.8% (National Bureau of Statistics, 2021).

Nigeria has struggled for long with food insecurity, this can be inferred from the country's high Global Hunger Index (GHI), low Food Consumption Score (FCS), and high calorie deficiency (Global Hunger Index, 2019). As a result of the effects of the COVID-19 pandemic on economic activities, there was direct consequences on food security as food comprises 58% of all household expenditure, while poorer households spend 75% of their resources on food (FAO, 2020). Due to the lockdown and mobility restrictions, poor households depending largely on the informal economy are likely to suffer more. Closure or disruption of informal food markets, where the poor obtain the majority of their food, may be more severe in extent and food security impacts than impacts on formal markets (Devereux *et al*., 2020; Barrett, 2020). These shocks may be responsible for the significant hike in prices of food and food-related commodities that is currently prevalent in Nigeria.

Owing to the inflation and the diminishing value of the Naira, food prices are not the only commodities raising in cost. A vicious cycle is created where non-food commodity vendors need to raise the prices of their goods and services while food commodity producers and vendors as well need to raise prices of their own goods so that they can afford other goods not in their hands. This situation continues to push prices higher.

Food Crisis

Nigeria is facing several food security and nutrition problems, with 32.1 million food and nutrition deficient people, of which an estimated 3.65 million people are deficient as a direct result of COVID-19 (GAIN, 2020). The disruptions in national economic activities as well as the overall impacts of the pandemic on are likely to affect food security of Nigerian households in various ways (Haddad *et al*., 2020; Béné, 2020). Also contributing to the food crisis is the fact that Nigeria is heavy importer of major staple foods like rice and wheat, both of which registered marked rapid climbs in spot prices, this situation continues to create an added financial burden for households in Nigeria (World Bank, 2020a).

As a result of the pandemic and the movement restriction, 38% of households that engaged in farming reported modifications in their farming due to COVID-19; of the 38%, 52% reported reducing their cultivation area, 30% switched to crops that took less time to mature and 25% delayed their planting altogether (World Bank, 2020d). In the middle of 2020, 30% of households reported experiencing severe food insecurity owing to lack of money and other resources and could not gain access to safety nets or other support (World Bank, 2020d). These, in combination with recurrent conflict, especially the farmers-herders crisis, have made the food situation in Nigeria particularly concerning and can be fingered as some of the causes of some unimaginable increase in the prices of goods and services.

Across major markets, prices of staple foods increased by 30 to 100 percent from pre-pandemic levels and above last year and a five-year average. The high food prices and decreasing incomes are reducing poor households' purchasing power, especially for those of highest concern in conflict-affected areas where prices were already higher relative to other parts of the country and among poor urban households.

Figure 1 shows the food security outlook of Nigeria in phases of acute food security. None of the states is absolutely food secure. However, most states are in minimal stress

levels but significant number of states are stressed. Some states on the North West and North East are in crisis. Borno state is of particular concern given the fact that the state is in two critical phases of acute food security; most of Borno is in crisis while some parts are in emergency. There are still areas in the North East facing the concentration of displaced people as well as being in a state where it may get worse without current or programmed humanitarian assistance. The COVID-19 pandemic hitting this food system that was already fragile, exacerbated the situation and led to protracted and sustained inflation of food prices as well as food security situation in the country.

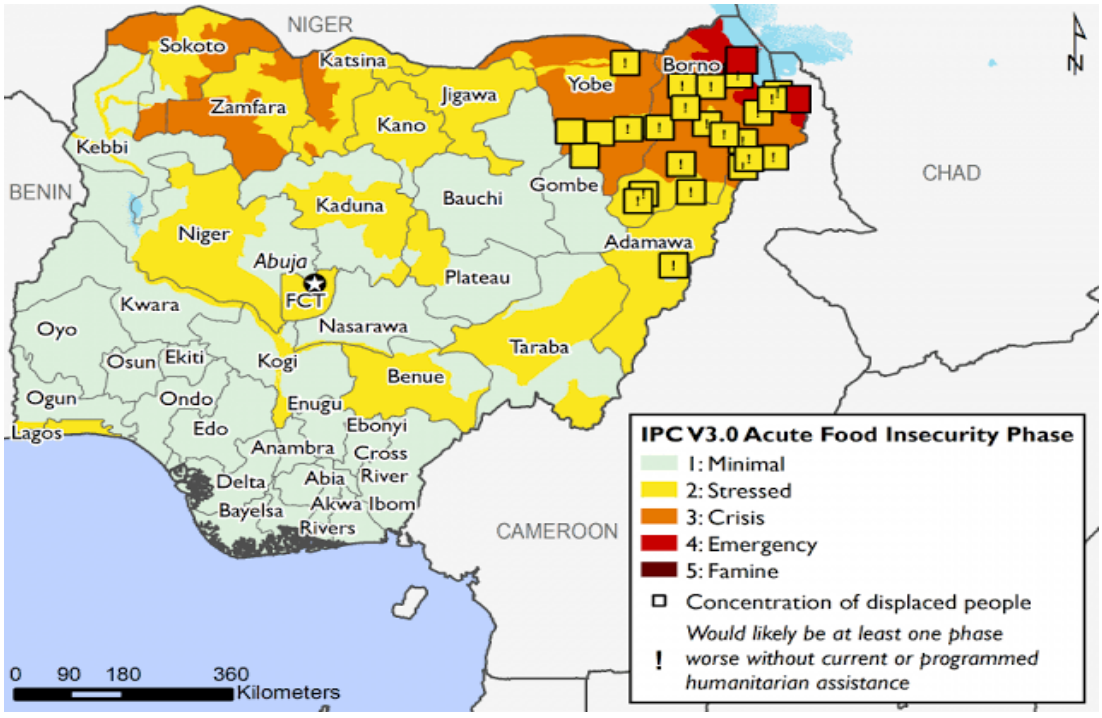

Fig. 1: Nigeria Food security outlook June 2020 – January 2021 Source: FEWS NET, 2020.

Food Prices

Nigeria is a country of more than 200 million persons (about 211 plus million people) with a large proportion under the age of 29 (Macrotrends, 2021). It is about the biggest food commodity market in the whole of Africa. The long lockdown period was a particular challenge to the food industry in Nigeria including the agricultural sector of the country.

The emergence of the COVID-19 pandemic, like all other emergency situations, had greater impacts on countries with weak response systems than those with strong emergency response systems. The era of the COVID-19 lockdown in Nigeria emerged with its own food crisis mostly as a result of restrictions on mobility and the absence of purchasing power for the vast populations who engage in daily pay activities. Household food insecurity was more markedly pronounced on individuals more exposed to the combined elements of the lockdown and lack of finances (GAIN, 2020).

Overall, prices increased for key nutritious food items, especially during the COVID-19 lockdown in April/May, but the price increases were also due to inflation (there

was a 17.4% year-on-year food inflation rate in October 2020), reduced demand due to income losses, unrest in the north, as well as the Naira weakening against the dollar. The diminishing purchasing power of Nigerians is negatively impacting access to staple foods, with an estimated 24% of households unable to purchase staple foods (November 2020).

The Combined Forces Causing Nigeria's Current Economic Crisis

The factors that led to economic crises or recession, among others include, market corrections (Jones, 2016), market failure (Petrakos, 2014), external trade and price shocks (Francois and Woerz, 2009), political instability (Lagravinese, 2015), and civil unrests through protests (Bernburg, 2016). A country's ability to recover from economic crisis or remain in stable state during a period of economic duress has been linked to the country's level of development. Generally, the more developed countries are more likely to recover from economic crises at a faster rate than the less developed ones.

Ozili (2020) opined strongly that the reason why the impacts of the coronavirus pandemic were severe in Nigeria and caused suffering to poor citizens was because of weak institutions that were ineffective in responding to the pandemic and the lack of adequate social welfare programs that would have catered for majority of the poor citizens and vulnerable citizens who were affected by the crisis. Furthermore, the economic agents that were supposed to help revive the economy were unable to engage in economic activities due to the palpable fear precipitated by the COVID-19. Also, on May 30, 2020 the government imposed a social distancing law through mandatory lockdown to flatten the curve of the COVID-19 spread in Nigeria, making it impossible for other economic agents to engage in economic activities (Ozili, 2020). Many other states across the country also put lockdown policies in place cutting off the supply chain from one end of the country to another and hindering activities of economic agents.

As a result of globalization, it is expected that there will be economic spillover effects to emerging and developing economies due to their dependency on developed countries for the importation of goods and services (Ozili and Arun, 2020). There is evidence that the COVID-19 pandemic is destabilizing supply chains leading to food supply instability and fluctuation in prices of food-related commodities (Torero, 2020; Reardon *et al*., 2020; FAO, 2020). Therefore, hike in food-related commodities is most likely a global phenomenon. Aside from the rise in prices of food commodities, the pandemic is also forcing people down the long of economic prosperity; the World Bank (2020d) forecasts that about 49 million people will be pushed into extreme poverty as a result of the pandemic and 45% (23 million) of them in Sub-Saharan Africa. This implies that the region will be hardest hit by extreme poverty. The World Food Programme (WFP, 2020) predicted that the number of people suffering from acute food insecurity, about 135 million people, have almost doubled since the end of 2020 as a result income and remittance losses, and disruption of food systems.

Furthermore, about 5 million Nigerians are projected to be pushed into poverty as a result of COVID-19, lockdown and movement restrictions (World Bank, 2020a; IMF, 2020). The period of lockdown and movement restrictions were predicted to have been responsible for contraction of the economy by between 3.5 to 5 percent in 2020 (World Bank, 2020c; IMF, 2020).

CONCLUSION

The economic situation in Nigeria is worrisome and has culminated in the hike of food prices and a looming food insecurity episode. It appears that the mechanisms applied for the resuscitation of the economy are inadequate and should be reviewed and upgraded to avoid a major economic disaster. The effects of the coronavirus combined with sharp drop of oil in the international market has led directly to hike in prices of food. Now, more than ever, Nigeria needs to put in place a robust food productivity programme and raise yield by at least 50% to curb this incessant rise in food prices.

RECOMMENDATIONS

1. Nigeria needs a well-developed digital economy achieved through intense digital penetration. Digital penetration and a well-established digital economy is a panacea to digital farming which Nigeria so direly requires to help the country become food secure.
2. Nigeria's government must as a matter of urgency grab a hold of the sky-rocketing prices of food and food-related commodities before they go spiralling out of control. The best way to do this is by improving productivity and investing deliberately in productivity-enhancing agriculture policy that is different from the white elephant projects of the past. Productivity-enhancement agriculture projects must be result-based and devoid of unnecessary politics.
3. The government may also consider price control and controlled importation. Some reasons why the prices of food commodities are so high in Nigeria is because of the scarce value that is attached to smuggled food in a country with a population of over 200 million people. The government must reduce the power of the informal sector in determining food prices by allowing the controlled influx of certain commodities instead of smuggled ones.
4. It is important for the next mammoth investments in Nigeria's agriculture to be targeted deliberately toward the digitization of the sector. Nigeria's agriculture can simply no longer follow the path of traditional farming and reliance on traditional technology and low energy agriculture.

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Journal of Applied Agricultural Research 2021, 9(1): 65-73
ISSN 2006-750X

ASSESSMENT OF INDIGENOUS CLIMATE CHANGE ADAPTATION MEASURES USED BY ARABLE CROP FARMERS IN SOUTH WESTERN NIGERIA

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ABSTRACT

Cassava and yam are of immense use for consumption and industrial purposes, their cultivation must not be allowed to dwindle. Climate change is a threat to agriculture and arable crops are particularly vulnerable to the adverse effects. Unfortunately, there is paucity of information on the influence of climate change on yam and cassava production and the adoption of the indigenous climate change adaptation measures in south west Nigeria. The aim of the study was to assess indigenous adaptation of measures used by arable crop Farmers in South western Nigeria. Multi stage sampling was used to select arable farmers, the first stage involved selection of two states among the 6th states in south west Nigeria, at the second stage 12% of local government areas of each of the two state were selected, in the third stage 1% of the villages in each of LGA which were all randomly selected. There after 15% of the arable crop farmers were purposefully selected in Oyo and Ekiti States. 154 and 69 respectively in Oyo and Ekiti states, totalling 223 selected farmers, a structured questionnaire was administered to elicit information from the respondents. The data were subjected to descriptive and inferential statistical analysis ($p<0.050$) and Likert rating scale Respondents and data were subjected to descriptive inferential statistical analysis and Likert rating scale. Respondents from Oyo (99.4%) and Ekiti states (98.6%) ranked planting of cover crops as the highest innovative/adaptive method, while irrigation method was ranked the least 8.4% and 2.9% respectively. This is due to the cost involved in irrigation adaptation measures used by farmers under yam and cassava based cropping systems in the study areas. Government can support farmers with mitigation/adaptive measures on impact of climate change in the states that are anticipating on coming impact.

Keywords: Assessment, Indigenous, Adaptation, Arable crop farmers, Climate change

INTRODUCTION

Inter-governmental panel on climate change, IPCC'S (2007) fourth assessment report summary for the African continent, described a trend of warning at a rate faster than the global average and increasing aridity in many countries in Africa, climate changes effects exerts multiple stresses on the biophysical as well as social and economic factors. The international competition policy choices and the technological development as well determined the pattern and impact that agro-climatic changes effects would have on agricultural producer (IFPRI, 2020).

Khanal (2009) classified the patterns of produce into socio-economic effects and bio-physical. Socio-economic effects; this results in declined in yield and production, reduced marginal crop from

n number of people at risk of hunger, changes in geographic distribution of trade regime and food security. The biophysical effects are; changes in land soil and water resources physiological effects on crops and livestock increased in weed and pest challenges, sea levels rise and changes to oceanic salinity and sea temperature rise causing fish to inhabit in different ranges and shift in spatial and temporal agricultural produce, fluctuation and world market price, migration and civil unrest, increased distribution of effects. Khanal (2009) further said, the pattern of the effects of climate change are however dependents on the following parameters; Type of crop grown, livestock reared, altitude and latitude.

Odjugo (2008) highlighted some of the direct effects of climate changes on agricultural activities; seasonal changes in rainfall and temperature, which can cause effects on agro-climatic conditions by altering growing seasons, planting and harvesting season, water availability, weed, pest and diseases control. Alteration in evapotranspiration, photosynthesis and biomass production. Some of the induced changes are expected to be abrupt, while others may involve gradual shifts in temperature, vegetation cover and species distribution, when looking at plant Production critically. The pattern of climate change effects have both negative and positive effects such as rise in temperature helps to grow crops in high altitude areas and towards the poles, in these regions higher temperature extends the length of the potential growing season, allowing earlier planting, early harvesting, opening the possibility of completing two crop cycles in the same season, in the other hand, when temperature exceed the optimal level for biological process, crop often respond negatively with a steep drop on whole physiological development, maturation and finally reduces the yield of crop cultivated. Agricultural remains the mainstream of Nigeria economy, contributing over 22.35% of the country gross domestic product (GDP) (NBC 2021). It is the lead sector responsible providing income and employment for rural dwellers. The sector employs about 90% of the rural poor and nearly 70% of the global labour force, which generate about 90% of non-oil export revenue. (CIA, 2013). Analysis of the real GDP performance in 2007 shows that agricultural sector contributes the largest share 42.2% compared to 41.7% in 2006 (CBN, 2007). Evidence has shown that climate change is already affecting crop yield in many countries (IPCC, 2007; Deressa et al., 2008, BNRCC, 2008). This is particularly true in low income countries, where climate is the primary determinant of agricultural productivity and where adaptive capacities are low (SPORE, 2008). Thus, necessitate the assessing of adoption of indigenous climate change adaptation measures in south western Nigeria.

MATERIALS AND METHOD

Study Area

The study was carried out in Oyo and Ekiti states, south western Nigeria. These two States lies between latitude 6.00^0N and 9.00^0N, Longitude 2.00^0E and 7.00^0E. The Agro climatic conditions in the two States favours the cultivation of crops like maize, yam, cassava, rice, plantains, cocoa, palm produce and cashew. Agriculture has been the backbone of these two states, providing income and employment opportunities for over 70% of the rural population (http://geographic.org.2019).

SAMPLING PROCEDURE AND SAMPLING SIZE.

Multi- stage sampling methods was used in selection of the respondents for the study. In the first stage, involved selection of two States out of the six States in the South West Nigeria Ekiti and Oyo were randomly selected. *At the second stage 12% local government areas (LGAs) were selected from each of the two States.* The LGA selected were purely rural with high

concentration of arable crop farmers. During the third stage 1% of the village in each local government were randomly selected, thereafter, 15% of arable crop farmers in the states were randomly selected in each village which constitutes the sample size of the study. Purposive sampling technique was used in selecting the respondents in the study areas with the assistance of the extension agents in each LGA who recognised the registered arable crop farmers and questionnaire were used to elicit information from the farmers.

Data Analysis.

Four rating scale of very severe (3); severe (2) mild (1) and not severe (0) respectively were employed, Weighted Mean Score (WMS) computed and ranked as well. Formula for Weighted Mean Score (WMS) is also known as lited rating. WMS is Arthemetic Mean in which some elements of the data set carry more important than others, both in Maths and Statistics WMS can be calculated by multiplying each value in sets by its weight then add up the production and divide the products sum by the sum of the weight

Formula

$\sum w \times \sum w$

In other words, multiply each weight W by its matching value X, sum that all up and divide by the sum of the weights.

Formula for Percentage

1. Determine the whole or total amount of what you want to find a percentage for.
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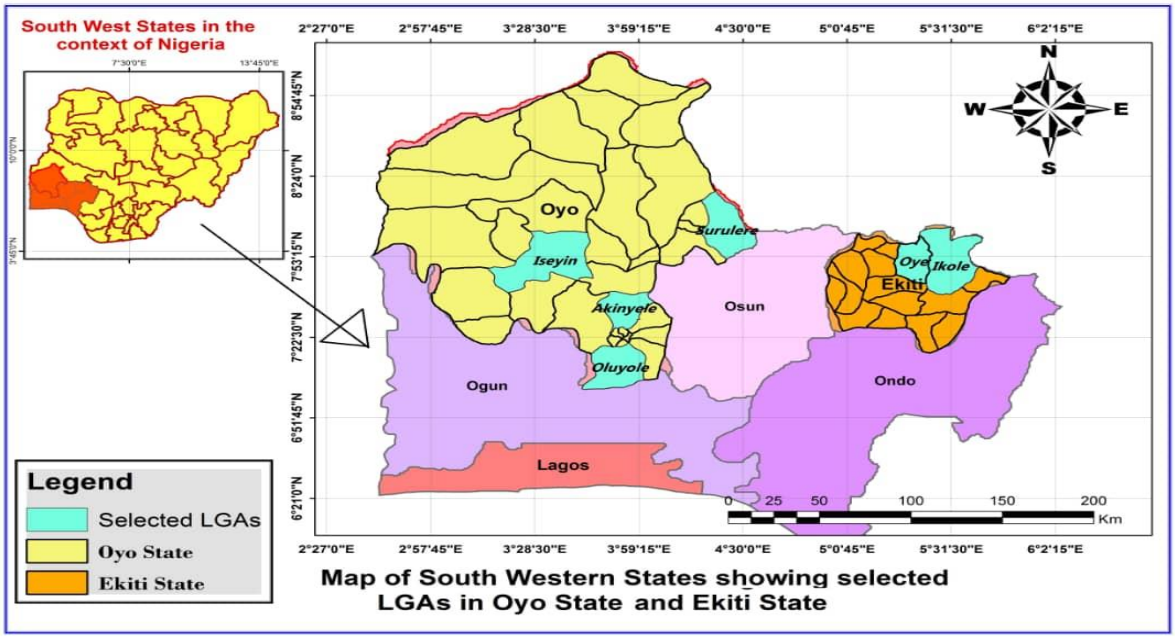

Map of South Western States showing selected LGAs in Oyo State and Ekiti State

Source: Lautech URP Dept. GIS Lab (2021)
Figure 1: Map showing the selected areas for sampling

RESULTS

Age of Respondents.

The age distributions of the respondents were 46.1% and 50.7% in Oyo an Ekiti states respectively shown in table 1. Sampled farmers indicated 50yrs and above were majority (47.5%) from the pooled result. Also, 12%, 18.4% and 22.0% indicated maximum of 30yrs, 31-40yrs and 41-50yrs of age respectively, while the mean age was 51.88years.

In the same table 1, majority (80.3%) of both states farmers sampled were male, while only (19.7%) were female.

Religion of the Respondents.
On distribution, 76.0% and 94.2% of the respondents from the both states were Christian, while 23.4% and 5.8% respondents from both states were Muslim. Traditional worshipers were 0.06% in Oyo state alone.

Marital status
Most of the respondents 99.4% and 92.2% from Oyo and Ekiti states respectively were married, while only 0.6% and 5.8% were single from the two states in similar order.
(Table 1)
Level of Education
The level of education of the respondents presented in (table 1) showed that 35.1% and 8.7% from Oyo and Ekiti states respectively have primary education, 39.0% and 36.% respectively have secondary education, 9.1% and 46.6% have tertiary education respectively, while only 16.9% and 8.7% respectively do not have formal education.
Household Size
The household size revealed that more than half (52.6%) from Oyo and 42.0% from Ekiti indicated more than 6persons are their household size. Also 32.5% (Oyo) and 30.4% (Ekiti) had between 4-6 persons as shown in table 1.

Primary Occupation
The data obtained showed that 62.3% and 37.2% from Oyo and Ekiti States respectively were engaged in farming as their primary occupation, 37.0% (Oyo) and 36.2% (Ekiti) engaged in trading as primary occupation. However, few 26.1% from Ekiti and 0.6% from Oyo among the respondents indicated artisan as primary occupation as shown in table 1

Year of Farming Experience
The data obtained showed that ≤10 years of farming experience of the respondents on yam and cassava production, 11% (Oyo), 11.6% (Ekiti), 11 – 20 years 25.3% (Oyo), 31.9% (Ekiti), 21 – 30 years 26% (Oyo), 23.2% (Ekiti), 31 – 40 years 16.9% (Oyo), 14.5% (Ekiti), 41 – 50 years 9.7% (Oyo) 14.5% (Ekiti), greater than 50 years 11% (Oyo) and 4.3% (Ekiti). Table 1.

Farm Size
From Table 1 more than half of the respondents 57.1% in Oyo and 50.7% in Ekiti had a maximum of ≤ 2 hectares of farmland, 49.3% in Ekiti and 35.1% in Oyo cultivated between 3 – 6 hectares of farmland, furthermore, 5.8% in Oyo and 0% in Ekiti cultivated between 7 – 10 hectares, 0.9% in Oyo and 0% in Ekiti cultivated more than 10 hectares of farmland.

COPPING STRATEGIES USED BYTHE RESONDENTS

Strategies revealed that the responses were multiple in nature and according to pooled results, 99.1%, 98.2%, 96.0%, 95.5% and 92.4% of the respondents respectively indicated planting of cover crops, mulching, shifting cultivation, crop rotation, making ridges along slope and altering of planting dates.
Again 85.7%, 84.3%, 81.6% and 62.8% indicated composite application, cultivation of improve varieties, fertilizer application and alley cropping respectively. While very few 6.7% indicated irrigation respectively.

Level of Use of Climate Change.
Adaptation strategies by the respondents Likert Measurement of very high (5), high (4), moderate (3), low (2) and very low (1) were used and weighed mean score (WMS0 was computed and ranked accordingly. Table 2 reveals that mulching had the highest weighed mean score (WMS) of 4.83 and ranked 1st followed by Altering of planting date (WMS= 4.74: 2nd), Ridges across slope (WMS = 4.74: 3rd), Cultivation of improve varieties (WMS = 3.52:

4th) and Crop rotation (WMS = 3.12: 5th), Irrigation (WMS = 3.22: 11th), Alley cropping (WMS = 1.32: 10th), Shifting cultivation (WMS =2.01: 9th) and Compost application (WMS = 2.45: 8th).

Table 1: Distribution of respondents by age, sex, religion, marital status and educational level in Oyo and Ekiti states

	SAMPLED STATES (Percentages)		
Socio-economic variables	**Oyo (n = 69)**	**Ekiti (n = 31)**	**pooled (n = 100)**
Age (years)			
<30	11.0	14.5	12.0
31-40	22. 1	10.1	18.4
41-50	20.7	24.6	22.0
>50	46.1	50.7	47.5
Sex			
Male	87.7	63.8	80.3
Female	12.3	36.2	19.7
Religion			
Christianity	76.0	94.2	81.6
Islam	23.4	5.8	17.9
Traditional	0.6	-	0.4
Marital status			
Married	99.4	94.2	97.8
Single	0.6	5.8	2.2
Level of education			
No formal	16.9	8.7	14.3
Primary	35.1	8.7	26.9
Secondary	39.0	36.2	38.1
Tertiary	9.1	46.4	20.6
Household size			
<3	14.9	27.5	18.8
4-6	32.5	30.4	31.8
>6	52.6	42.0	49.3
Primary occupation			
Farming	62.3	37.2	18.8
Trading	37.0	36.2	36.8
Artisan	0.6	26.1	8.5
Years of farming experience			
<10	11.0	11.6	11.2
11-20	25.3	31.9	27.4
21-30	26.0	23.2	25.1
31-40	16.9	14.5	16.1
41-50	9.7	14.5	11.2
>50	11.0	4.3	9.0
Farm size			
<2	57.1	50.7	55.2
3-6	35.1	49.3	39.5
7-10	5.8	-	4.0
>10	1.9	-	1.3
Total	**100.0**	**100.0**	**100.**

Table 2: Distribution of farmers by coping strategies employed against the climate change effects on yam/cassava production

STATES (Percentage)			
Coping strategies	Oyo (n = 69)	Ekiti (n = 31)	Pooled (n = 100)

Cultivation of improved varieties	92.9	65.2	84.3
Altering of planting date	90.3	97.1	92.4
Mulching	98.1	98.6	98.2
Fertilizer application	85.1	73.9	81.6
Compost application	99.0	78.3	85.7
Ridges across slope	94.2	98.6	95.5
Planting of cover crops	99.4	98.6	99.1
Crop rotation	94.8	98.6	96.0
Shifting cultivation	98.1	98.6	98.2
Alley cropping	62.3	63.8	62.8
Irrigation	8.4	2.9	6.7

Source: Field Survey, 2019
Figures parentheses are percentages
*: Multiple responses

Table 3: Distribution of respondents by level of use of climate change adaptation strategies employed against its effects on yam/cassava production

Adaptation strategies	Level of use (Percentage)						
	Very high	High	Moderate	Low	Very low	WMS	Rank
Cultivation of improved varieties	39.4	12.8	12.8	4.8	-	3.52	4th
Altering of planting date	74.3	35.0	0.5	-	-	4.74	2nd
Mulching	91.8	8.2	-	-	-	4.83	1st
Fertilizer application	10.4	13.2	56.0	20.3	-	2.56	7th
Compost application	11.0	16.8	36.6	70	7.9	2.45	8th
Ridges across slope	48.8	20.2	15.0	16.0	-	3.98	3rd
Planting of cover crops	7.3	37.1	8.6	33.0	14.0	2.88	6th
Crop rotation	10.7	29.9	37.9	16.4	5.1	3.12	5th
Shifting cultivation	5.0	8.2	20.1	19.6	47.0	2.01	9th
Alley cropping	-	-	35.0	40.0	25.0	1.32	10th
Irrigation	-	-	86.7	13.3	-	0.19	11th

Source: Field Survey, 2019.
Figures in parentheses are percentages
WMS: Weighted Mean Score
* Multiple respon

DISCUSSION

The sampled farmers that were involved in yam and cassava production were of different age group, the result showed that many of the sample respondents were married, this is an indication that they were expected to be matured and possess ability and to be

conversant with climate variability and changes, effects on yam and cassava production. Both male and female were involved in yam and cassava production In the study areas, the variation in the percentages may be attributed to the fact that male are more involve in agricultural production, this may be due to energy and stress associated with farming. When many men can survive than women. It is a usual assumption that male dominate agricultural production in many part of the world, including Nigeria. This finding is in conformity with Ejembi and Ejembi (2006), who reported that traditionally, recognised visible human input in the agricultural sector is more of male than female. All the sampled farmers are of different age groups that are involved in yam and cassava production, an indication that most of them are matured and were expected to be conversant with possible innovative adaptation measures on yam and cassava based cropping systems in south western Nigeria. This is an indication that they were expected to be mature and possess ability to take appropriate decision on the application on different climate change adaptation strategies to subdue its side effects on yam/cassava production. This assertion is in line with Akintonde*et al*(2019) who reported that being married as a status may suggest high degree level of responsibility and great capacity for sound rational decision making among farmers.

Many of the respondent were literate and are expected to be familiar with climate change phenomenon on climate variability and possess the ability in the application of appropriate strategies to curb its effects in order to ensure expected output from yam and cassava production. This finding corroborates with *Akintondeet al (2016),* who reported that It's also an indication that they will be conversant with yam and cassava production process and are expected ti have a better understanding of the possible effects of climate change on yam and cassava production and employ remedies to curb its different effects. The variation in their years of experience may due to age differences and time of engagement in farming as either primary or secondary occupation, however the farmer year of experience is expected to determine the type and level of climate change adaptation strategies. The result is in line with Hassan and Nhemachena (2007), in their study of climate adaptation strategies in South Africa, noted that the more farming experience increases, the probability of farmers adapting to climate change. According to *Akintonde et al (2016)*. The higher the farmland cultivated is, the size of possibility of high crop yield which of course would determine the income level of the farmers and a factor that is expected to influence the use of climate change adaptation strategies among farmers.

CONCLUSION.

Climate change effect undermine livelihood with grave consequences on food security, health and well-being as well as the overall socio-economic development of any country. Food security is a major challenge in Nigeria and its effects are making food unavailability and inaccessibility worse. In order to avoid hunger and poverty, farmers are adapting to climate by using different methods. Some attribute of farmers that significantly related to the adaptation measures were land ownership, soil type and land distance to water sources. The study revealed different cropping strategies employed against climate effects on yam and cassava production,

assessing adoption of indigenous climate change adaptation measures is a bottom to top approach that will go a long way to broaden research methods and make the research work more acceptable to the farmers.

RECOMMENDATION.

Farmers need to be encouraged on the use of recommended climate change adaptation strategies of which both the government and non-governmental organisation can assist. Hence, food insecurity would be discouraged having ameliorated climate change effects on yam/cassava production, local/state government should prepare mitigation measures to alleviate the impact of climate change and also plan for the appropriate adaptation strategies in accordance with the needs and conditions in the study areas.

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ISSN 2006-750X

ACTIVITIES OF FARMERS THAT EXACERBATE THE EFFECTS OF CLIMATE CHANGE IN YAM AND CASSAVA PRODUCTION IN SOUTH WESTERN, NIGERIA

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ABSTRACT

Agriculture remains the main stream of Nigerian economy contributing about 22.35% of the Country gross domestic Product [GDP]. It is major sector responsible for providing income and employment for Rural dwellers [NBS,2021]. The sector employs about 90% of the poor in Rural areas and virtually 70% of the entire labour force, and generate about 90% of non-oil export revenues [CIA,2013]. Nigeria is the highest producer of Cassava and Yam [FAO,2017; FAO2016]. Despite the significance of Cassava and Yam production to Nigeria's Rural set up, it is being endangered by Climate variability. The aim of this project is to investigate the activities of Farmers that exacerbate the effect of Climate change in arable crop Farmers South Western Nigeria. Multi stage sampling was used to select arable farmers, 154 and 69 respectively in Oyo and Ekiti states, totalling 223 selected farmers, a structured questionnaire was administered to elicit information from the respondents. The data were subjected to descriptive and inferential statistical analysis ($p<0.050$) and Likert rating scale. On the activities of farmers that exacerbated climate change, Oyo and Ekiti states ranked 1st with Weighed Mean Score (WMS) of 3.50, use of fertilizer was ranked the least in both states with WMS of 0.78. The study is to identify activities of farmers that exacerbate the effects of climate change in yam and cassava production in the study areas.

Keywords: Activities, Farmers, Exacerbate, Climate change

INTRODUCTION

Climate change has become an international issue that has attracted considerable attention in recent years due to its effect on agricultural production. Until recently, the effects of human activities that exacerbate the cause of climate change were seen as very negligible, thus, climate change and climate variation were taken for granted (IPCC 2007].

It became palpably established that climate change a trivial event, it has become a reality that is adversely affecting the entire earth. Its effects are especially challenging agricultural production. Food security in developing and developed countries of the world glaring. There are growing concerns of food insecurity around the World which is expected to be more critical for Developing Counties in Sub Saharan Africa and South East Asian, Thus the call for urgent attention. Though the impact of climate change on agricultural production may be either positive or negative, in most cases, empirical studies indicated that latter

outweigh the former (Adejuwon, 2004; Enete*et al.,* 2011). The inter-governmental panel on climate change (IPCC2011), states that the climate change is a change in the states of the climate that are identifiable (e.g. using statistical tests) by the change in the mean and or the variability of its properties that persist for an extended period of time, typically decades or longer, United Nations framework convention on climate change (UNFCCC,2007) states that climate change is a change of climate (air, temperature, windfall, wind speed), that are attributed directly or indirectly to human activities that changes the composition of the global atmosphere, which is in addition to natural climate variability observed over a comparative time. In recent times, countries across the globe are threatened by changes in climatic conditions, from drought to delayed rainfall and continuous melting of the polar region resulting into severe flood as well as speculation about acid rain in some countries (FANRPAN, 2010).

In Nigeria and the world in general, rainfall pattern has changed, affecting the commencement of planting season, resulting in poor harvest yield, IPCC projections suggested rainfall in southern hemisphere will increase (IPCC, 2001a). Simultaneous increase in temperature, increases evaporation and potential evapotranspiration leading to the tendency of droughts. Recent studies indicated 10 to 25% decreased precipitating in southern Nigeria since the beginning of the century. If this trend persist, rainfall in the humid region of southern Nigeria may be about 50-60% of the 1900 values by the year 2100 (Adejuwon, 2004). Periods of drought will have drastic impact upon agricultural production in the region if there is no forest to act as buffer. Yam and cassava production in Nigeria seems to be the vulnerable to effects of climatic change. Both crops are annual tubers and monocot plants. (*Musa et al., 2011).*

Yam belongs to the genus *Dioscoreae* and family *dioscoreae.* Comprising of 600 species out of which 10 species produces edible tubers. Only 6 are cultivated in Africa (Musa *et al., 2011*). Yam plays an important role in dietary and culture of people in Nigeria and west Africa in general. It also serves as source of income, becoming more expensive and relatively unaffordable in urban areas as production rate has not kept pace with population growth, resulting into demand exceeding supply (Horticulture and Forestry, 2019). Yam production is dominant by small scale farmers (Odjugo, 2011).

Cassava belong the genus *manihot* and family *euphorbiaceae* and is the third biggest source of food carbohydrates (UNFAO, 2013). It is a major stable food in developing world, providing a basic diet for half a billion people. Cassava is the most drought-tolerant crop capable of growing on marginal soil (UNFAO, 2013).

The production of these crops is affected by factors varying from physical, economic to cultural factors. Climate is one of the physical factor and the most crucial factor which determines the nature of natural vegetation, the characteristics of the soils, the crops that can be grown and the type of farming that can be practiced (OBIOKORO, 2005). The most important climatic elements for crop growth and yield re radiant energy and solar radiation in turn determine the thermal characteristics of the environment, namely net radiation, day length or photoperiod, air and soil temperature [Regina *et al., **2001]***. Both soil and air temperature affects the developmental stage more than other factors (Ayoade, 2004).

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The level of education of the respondents presented in (table 1) showed that 35.1% and 8.7% from Oyo and Ekiti states respectively had primary education, 39.0% and 36.0% respectively had secondary education, 9.1% and 46.6% have tertiary education respectively, while only 16.9% and 8.7% respectively do not had formal education.

Household Size

Analysis of the household size revealed that more than half (52.6%) from Oyo and 42.0% from Ekiti indicated more than 6 persons are their household size. Also 32.5% (Oyo) and 30.4% (Ekiti) had between 4-6 persons as shown in table 1.

Primary Occupation

The data obtained showed that 62.3% and 37.2% from Oyo and Ekiti States respectively were engaged in farming as their primary occupation, 37.0% (Oyo) and 36.2% (Ekiti) engaged in trading as primary occupation. However, few 26.1% from Ekiti and 0.6% from Oyo among the respondents indicated artisan as primary occupation as shown in table 1

Year of Farming Experience

The data obtained showed that ≤10 years of farming experience of the respondents on yam and cassava production, 11% (Oyo), 11.6% (Ekiti), 11 – 20 years 25.3% (Oyo), 31.9% (Ekiti), 21 – 30 years 26% (Oyo), 23.2% (Ekiti), 31 – 40 years 16.9% (Oyo), 14.5% (Ekiti), 41 – 50 years 9.7% (Oyo) 14.5% (Ekiti), greater than 50 years 11% (Oyo) and 4.3% (Ekiti). **Table 1.**

Farm Size

From Table 1 more than half of the respondents 57.1% in Oyo and 50.7% in Ekiti had a maximum of ≤ 2 hectares of farmland, 49.3% in Ekiti and 35.1% in Oyo cultivated between 3 – 6 hectares of farmland, furthermore, 5.8% in Oyo and 0% in Ekiti cultivated between 7 – 10 hectares, 0.9% in Oyo and 0% in Ekiti cultivated more than 10 hectares of farmland.

COPPING STRATEGIES USED BYTHE RESONDENTS

Strategies revealed that the responses were multiple in nature and according to pooled results, 99.1%, 98.2%, 96.0%, 95.5% and 92.4% of the respondents respectively indicated planting of cover crops, mulching, shifting cultivation, crop rotation, making ridges along slope and altering of planting dates.

Again 85.7%, 84.3%, 81.6% and 62.8% indicated composite application, cultivation of improve varieties, fertilizer application and alley cropping respectively. While very few 6.7% indicated irrigation respectively.

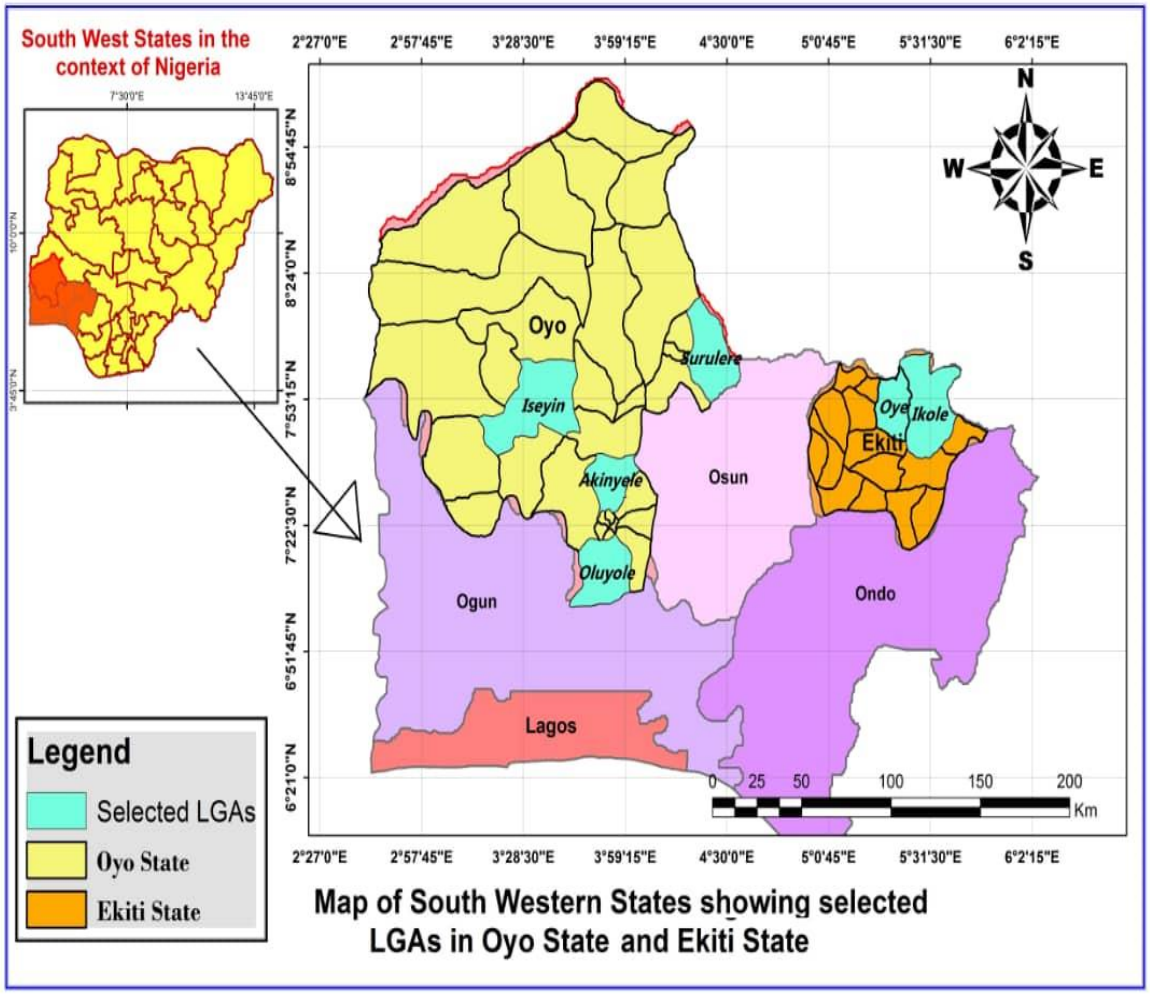
Risks/Hazards Associated With Climate Change

The associated risks/hazards with climate change were given multiple responses and all (100.0%) the respondents both indicated poor yield and erosion as risks/hazards that are associated with climate change. Again, 99.6% each indicated low income, pest and diseases and heat. Also 98.7% each indicated heavy rainfall and fires; 93.7% and 71.3% indicated

cold and late rainfall, while only 20.6% of the respondents indicated wind (Figure 1).

Farmers' Activities That Exacerbate Climate Change

Likert measurement of very great extent (4); great extent (3); some extent (2); little extent (1) and no extent (0) were used to determine the extent to which each of the activities of the Farmers contributed in exacerbating Climate change. The result has presented in Table 2 revealed that deforestation had the highest WMS of 3.50 and was ranked 1st; followed by burning of fossils (industrial) and burning of fossils (automobiles) both have WMS of 3.43 and ranked 2ndeach. Again burning of firewood and bush were ranked 4th with WMS of 3.32 each; while burning of waste (WMS = 3.29), continuous cropping (WMS = 1.18) and use of herbicide (WMS = 0.99) were ranked 6th, 7th and 8th respectively while the use of fertilizer was ranked 9th with WMS of 0.78.



Source: Lautech URP Dept. GIS Lab (2021)
Figure 1: Map showing the selected areas for sampling

Table 1: Distribution of respondents by age, sex, religion, marital status and educational level in Oyo and Ekiti states

	SAMPLED STATES (Percentages)		
Socio-economic variables	**Oyo (n = 69)**	**Ekiti (n = 31)**	**pooled (n = 100)**
Age (years)			
<30	11.0	14.5	12.0
31-40	22. 1	10.1	18.4
41-50	20.7	24.6	22.0
>50	46.1	50.7	47.5
Sex			
Male	87.7	63.8	80.3
Female	12.3	36.2	19.7
Religion			
Christianity	76.0	94.2	81.6
Islam	23.4	5.8	17.9
Traditional	0.6	-	0.4
Marital status			
Married	99.4	94.2	97.8
Single	0.6	5.8	2.2
Level of education			
No formal	16.9	8.7	14.3
Primary	35.1	8.7	26.9
Secondary	39.0	36.2	38.1
Tertiary	9.1	46.4	20.6
Household size			
<3	14.9	27.5	18.8
4-6	32.5	30.4	31.8
>6	52.6	42.0	49.3
Primary occupation			
Farming	62.3	37.2	18.8
Trading	37.0	36.2	36.8
Artisan	0.6	26.1	8.5
Years of farming experience			
<10	11.0	11.6	11.2
11-20	25.3	31.9	27.4
21-30	26.0	23.2	25.1
31-40	16.9	14.5	16.1
41-50	9.7	14.5	11.2
>50	11.0	4.3	9.0
Farm size			
<2	57.1	50.7	55.2
3-6	35.1	49.3	39.5
7-10	5.8	-	4.0
>10	1.9	-	1.3
Total	**100.0**	**100.0**	**100.**

Table 1: Distribution of respondents by age, sex, religion, marital status and educational level in Oyo and Ekiti states

	SAMPLED STATES (Percentages)		
Socio-economic variables	**Oyo (n = 69)**	**Ekiti (n = 31)**	**pooled (n = 100)**
Age (years)			
<30	11.0	14.5	12.0
31-40	22. 1	10.1	18.4
41-50	20.7	24.6	22.0
>50	46.1	50.7	47.5
Sex			
Male	87.7	63.8	80.3
Female	12.3	36.2	19.7
Religion			
Christianity	76.0	94.2	81.6
Islam	23.4	5.8	17.9
Traditional	0.6	-	0.4
Marital status			
Married	99.4	94.2	97.8
Single	0.6	5.8	2.2
Level of education			
No formal	16.9	8.7	14.3
Primary	35.1	8.7	26.9
Secondary	39.0	36.2	38.1
Tertiary	9.1	46.4	20.6
Household size			
<3	14.9	27.5	18.8
4-6	32.5	30.4	31.8
>6	52.6	42.0	49.3
Primary occupation			
Farming	62.3	37.2	18.8
Trading	37.0	36.2	36.8
Artisan	0.6	26.1	8.5
Years of farming experience			
<10	11.0	11.6	11.2
11-20	25.3	31.9	27.4
21-30	26.0	23.2	25.1
31-40	16.9	14.5	16.1
41-50	9.7	14.5	11.2
>50	11.0	4.3	9.0
Farm size			
<2	57.1	50.7	55.2
3-6	35.1	49.3	39.5
7-10	5.8	-	4.0
>10	1.9	-	1.3
Total	**100.0**	**100.0**	**100.0**

Table 2: Distribution of farmers by coping strategies employed against the climate change effects on yam/cassava production

	STATES (Percentage)		
Coping strategies	Oyo (n = 69)	Ekiti (n = 31)	Pooled (n = 100)
Cultivation of improved varieties	92.9	65.2	84.3
Altering of planting date	90.3	97.1	92.4
Mulching	98.1	98.6	98.2
Fertilizer application	85.1	73.9	81.6
Compost application	99.0	78.3	85.7
Ridges across slope	94.2	98.6	95.5
Planting of cover crops	99.4	98.6	99.1
Crop rotation	94.8	98.6	96.0
Shifting cultivation	98.1	98.6	98.2
Alley cropping	62.3	63.8	62.8
Irrigation	8.4	2.9	6.7

Source: Field Survey, 2019
Figures parentheses are percentages
*: Multiple responses

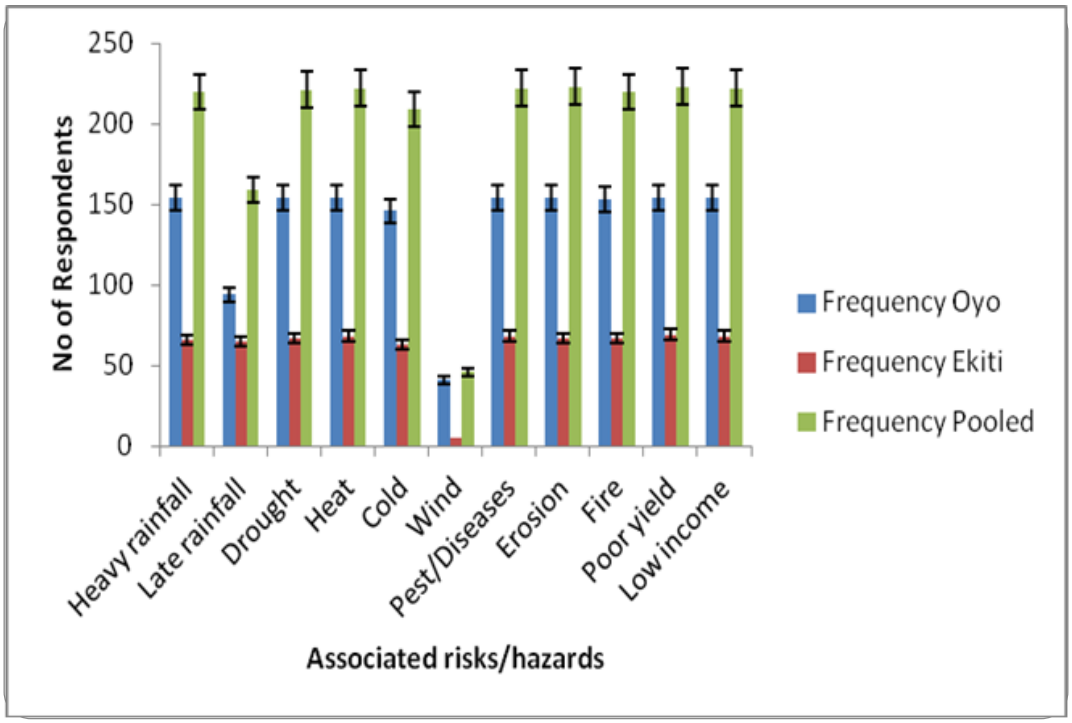


Figure 2: Distribution of respondents by associated risks/hazards with climate change

Table 2: Distribution of respondents by identified farmers' activities that exacerbate climate change = 223

Activities	Frequency (Percentage) Extent						
	Very great extent	Great extent	Some extent	Little extent	No extent	WMS	Rank
Bush burning	79.8	1.8	2.2	3.1	13.0	3.32	4th
Continuous cropping	22.0	1.3	3.6	19.3	53.8	1.18	7th
Burning of fossil fuel (industrious)	82.1	1.8	3.6	2.7	9.9	3.43	2nd
Burning of waste	78.5	2.7	1.8	3.6	13.5	3.29	6th
Use of fertilizer	13.5	0.9	2.7	16.1	66.8	0.78	9th
Deforestation	85.2	1.8	0.9	1.3	10.8	3.50	1st
Burning of fire wood	79.8	1.3	3.6	1.3	13.9	3.32	4th
Use of herbicide	16.1	-	4.0	26.5	53.4	0.99	8th
Burning of fossil fuel (automobile)	82.5	2.2	2.2	1.3	11.7	3.43	2nd

Source: Field Survey, 2019.
Figures in parentheses are percentages
WMS: Weighted Mean Score

DISCUSSION

All the sampled farmers were of different age groups that are involved in yam and cassava production, an indication that most of them are of adult age and they are expected to be conversant with possible climate change effects on yam and cassava production which would necessitate the application of appropriate adaptation climate change strategies against such effect. The respondents sampled had different knowledge and interpretation of changes observed in climate.

Variation in their knowledge and interpretation of climate change may be due to differences in their perception towards climate change in relation to their experience in agricultural production over time. This assertion is level with Akintonde*et al.,* (2019) who reported that being married as a status may suggest a high degree of responding good great capability for sound rational decision making among farmers.

Different activities both agricultural and non-agricultural exacerbate climate change as indicated by the farmers. The differences in the ranking order may be due to variation in their perception and knowledge of the respondents from both Oyo and Ekiti States on the identified agricultural and non-agricultural activities. Several risks/hazards are linked with climate change as shown by the respondents which has effects on yam and cassava production. The variation in the responses may be attributed to differences in age and experience of the respondents sampled in agricultural production, risks/hazards identified to come along with climate change have severe effects on agricultural production as indicated by the respondents in the study.

The variation in the level of severity may be due to differences in the respondents' perception and their years of experience in agricultural production. The result is in line with that of Hassan and Nhemachena (2007) in their study of climate adaptation strategies in South Africa noted that the more farming experience increases the probability of farmer adaptation to climate change.

All the identified risks/hazards that are linked with climate change have severe effects on

yam and cassava production. The differences in the level of severity as indicated by the respondents may be due to differences in their perception and experience of individual farmers with respect to climate change impacts on yam/cassava crops.

CONCLUSION

The study revealed that farmers activities exacerbate climate change, and associated risks/hazards with climate change were identified. The study established that climate charge have different effects on both yam and cassava production.

RECOMMENDATIONS

The identified human/ Farmers activities that exacerbate the effects of Climate change on Agricultural products be eliminated or reduced to the minimum.

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Journal of Applied Agricultural Research 2020, 9(1): 85-92
ISSN 2006-750X

EVALUATION OF MATERNAL HEALTH CARE SERVICES IN SEMI-URBAN AGRARIAN COMMUNITIES OF KADUNA STATE

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ABSTRACT

Women are significant actors in agriculture from land preparation to marketing but maternal mortality is one of the major health challenges currently afflicting women in Nigeria. This study was conducted to evaluate maternal health care services in semi-urban communities in Northern Nigeria. A multi-stage sampling technique was used to select 120 respondents. Data for this study were collected using structured questionnaires administered by the interviewer. The tools used for analysis are descriptive statistics. Results from this research indicated women farmers were mostly in their reproductive ages of childbearing with most married and in a polygamous house. Over 65% of the women farmers have one form of formal education or the other. The majority (39%) had farming experience of between 21-30 years and inheritance (72%) was the major method of land acquisition. Neighbours and radio listening were the major source of information on maternal health care services. Inadequate facilities and the bad attitude of health personnel during the maternal health care visits were the main barriers identified. The study recommended that health officials should strive to ensure the availability of drugs and efficient service delivery in the respective health centres.

Keywords: Maternal Health, Rural, Women farmers, Utilization,

INTRODUCTION

According to the Federal Ministry of Agriculture and Rural Development (Sahel, 2021), women account for over 70% of the farming population in Nigeria. Despite this large portion, women possibilities and potentials are significantly hindered by traditional and, or formal checks. These checks stemmed from the development of a family institution that remains the basic social institution in every agrarian society, founded on marriage, celebrated with pregnancy and childbirth for the preservation of generation of manpower needed for the development of communities (Oluwasusi, 2020). However, the almost non-existent efficient maternal health services in rural Nigeria puts women farmers at risk of maternal mortality.

Nigeria is the most populous country in Africa with about 200 million people. It is also the country where about 20% of all global maternal mortality deaths occur (World Health Organisation, 2019). Improved maternal healthcare is a very important prerequisite for the advancement of agrarian rural women (Nuamah *et al.*, 2019). The Maternal health care services include family planning, preconception, antenatal, delivery and postnatal care. The goals of preconception care include providing education, health promotion, screening tests for various health problems and interventions for women of reproductive age to reduce risk factors that might affect maternal and child wellbeing. Women who begin prenatal care early in their pregnancies have better birth outcomes than those who receive little or no care during pregnancies. Postnatal care issues which include recovery from childbirth, concerns about newborn care, nutrition, breastfeeding and family planning are also important (Mwaniki *et al*., 2002).

As a result, reduction in maternal mortality and morbidity has been the focus of several international conferences and programs. Examples of such conferences include the International Conference on Maternal, Newborn and Child Health in Africa in 2013 and, African Union Campaign on Accelerated Reduction of Maternal Mortality in Africa (CARMMA). Most programs were aimed at improving the quality, access and utilization of health services by all people with special attention given to women and children (Hiluf and Fantahun, 2008). One explanation for poor health outcomes among women in Nigeria is the non-use of modern health care services by a sizable number of women of childbearing age.

Notwithstanding the efforts being made to improve access and utilization of maternal health services, these services are not enough to save over half a million women who died during pregnancy or childbirth or within few weeks after delivery. Widening differences continue to exist in access to and utilization of maternal health services between the developed and the developing countries and are influenced by cultural, economic and social factors as well as healthcare accessibility and availability (Nuamah *et al.*, 2019).

Estimates have shown that more than 99% of global maternal deaths occurred in developing countries. These differences are said to occur between the rich and poor women, between the young and the old women, between the urban and rural women and between the literate and non-literate women. There are many barriers that maternal health systems interventions could address in addition to the low educational status of women, low economic status and religion. These include financial and geographic access, perceived and actual quality of the healthcare as well as the knowledge and attitudes of the people on the importance of maternal health services (Freedman *et al*, 2005).

Maternal mortality is one of the major health challenges currently afflicting Nigeria. In 2015, Nigeria with an estimated 814 annual maternal deaths per 100,000 live births ranked second after Afghanistan as the country with the highest number of maternal deaths in the world. The World Health Organisation (2019) estimated that over 600 000 maternal deaths and no less than 900 000 maternal near-miss cases occurred in the country. This accounts for nearly 20% 0f the global total of maternal mortality. Even though the maternal mortality rate is very high in Nigeria, there are regional variations where the northwest has mortality rates that are six times higher than the southwest which

has the lowest (Idris *et al*., 2013). Most of these deaths are said to occur in the rural areas where two-thirds of the country's population lives who are in the majority farmers and are caused by what Thaddeus and Maine (1994) classified as three types of delay viz: delay in deciding to seek maternal healthcare; delay in locating and arriving at the medical facility, and, delay in receiving skilled maternal care at the health facility. This indicates the need for in-depth studies and quick interventions about the current magnitude of use and factors influencing the use of maternal health services in rural areas of most parts of Nigeria. This is with the view to closing up possible gaps in the evaluation of maternal healthcare services by rural women in Northern Kaduna State, Nigeria. This paper, therefore, seeks to describe the socio-demographic characteristics of women in the reproductive age group; examine sources of maternal health available to the women farmers and identify the constraints to the accessibility and utilization of maternal health care services to the rural women in the study area.

METHODOLOGY

The research was conducted in Giwa and Makarfi Local Government Areas (LGA) of northern parts of Kaduna State. The study areas are inhabited predominantly by Hausa Muslims with a generally low level of formal education. Farming and trading were the main occupations in the study areas. As a policy of the state government, maternal healthcare services are said to be provided free in the study area. The areas have access to a mobile telephone network with radio and television reception. The study area has a combined projected population of about 600,000 in 2019 at a growth rate of 3.2%. There are also two general hospitals, 11 primary healthcare centres and over two dozen dispensaries and private clinics in the study area. Giwa and Makarfi have borders with Katsina State and Kano State, respectively. There are 10 districts in Makarfi Local Government Area. They are Dandamisa, Danguziri, Gazara, Gimi, Gubuchi, Gwanki, Makarfi, Mayere, Nasarawan - doya and Tudun wada while the 11 districts in Giwa Local Government Area include Kadage, Gangara, Galadimawa, Danmahawayi, Shika, Giwa, Kidandan, Kakangi, Pan -hauya, Idasu and Yakawada.

A multi-stage sampling technique was used to select respondents in the LGAs for this study. In the first stage, two Local Government Areas were purposively selected in northern parts of Kaduna State based on having a primary healthcare service in the area. At the second stage, three districts were randomly selected in each of the Local Government Areas. The selected districts were Shika, Giwa, Yakawada districts in Giwa LGA, and Makarfi, Gazara and Nasarawan- doya districts in Makarfi LGA where a sample frame of women using maternal healthcare services at the General Hospitals was obtained. At the final stage, based on the sample frame, twenty women of childbearing age (15-49 years) were selected randomly in each of the districts based on the criteria of having had a baby within the past 24 months or being pregnant at the time of data collection making 120 respondents.

Primary data were sourced through the use of a structured questionnaire that contained both open and close-ended questions. Data obtained were subjected to analysis using descriptive statistics thus presented in frequencies, averages and percentages.

RESULTS AND DISCUSSION

A sum of 120 women aged 15- 49 years was studied. The mean age was 23.6 years with the majority of the respondents (50%) within the age range of 22-28 years. This is concurrent with the findings of Vos *et al.* (2012) which reveal that respondents who seek maternal services are usually young and economically active childbearing women. Almost all the respondents have Islam as their religion (98.3%). Religion prescribed and proscribe mode of behaviours from generation to generation and it is to be expected that norms of maternal health services which contradicts some religious aspects could be discarded. About 65.8% of the respondents had one form of western education implying that most of the respondents have formal education. though women in semi-urban settlements are married at an early age, most of them hardly got married without attaining either primary or secondary school, hence to a great extent education is expected to influence positively the utilization of maternal health care services as opined by Fasokun *et al.* (2008) that education assists enlightenment of people of all ages and allow them to make free useful life decisions. Table 1 also showed that 88.3% of the respondent are married of which 55.8% are married in homes where polygamy is practised. Also, 33.3% of the respondents' spouses had secondary education and 35.8% of the respondent's spouse are farmers. A majority (39%) had a farming experience of between 21-30 years with about 29% having 11-20 years of farming experience and 22.1% involved in farming for over 30 years. Only 12.6% had farming experience of fewer than 10 years. Inheritance (72%) was the main method of land acquisition.

Table 2 identified the sources of information on the use of ante-natal services by the respondents. It shows that the major sources are neighbours (12.5%), Radio (11.7%), 6.7% acquire information through friends, 5.8% use television and 4.5% reported husbands as to the major source of information used. The distribution shows that 79.2% of the respondents are aware of the existence of ante-natal care service in the community. This finding is in agreement with that of Muhammad (2016) and, Babalola and Fatusi (2009) who revealed that informal and mass media sources were the main sources in maternal health services.

From Table 3, the three major barriers to the use of maternal healthcare service reported by the respondents' shows that inadequate facilities and drugs, bad attitude of the health personnel and, time wastage ranked first, second and third, respectively. The least barriers reported by the respondents included dirty environment, the apathy of visiting the health centres and, lack of mobility.

The responses of the respondents show that 78.33% believe that facilities and drugs are inadequately needed for ensuring effective maternal care services of the rural women and was ranked 1st and most important barrier. The bad attitude of health personnel was ranked 2nd and reported by 73.33% of the respondents. Over 68.33% of the rural women reported that utilization of maternal health care services comes along with lots of time wastage probably because of the man-hour lost which could have been used in their farmlands are being wasted on following queue in such facility. It was ranked as 3rd most important barrier. This study, therefore, agrees with that of Idris *et al.* (2006) which found inadequate facility as one of the major barriers to the use of maternal healthcare service in the study area.

Table 1: Demographic Characteristics of Respondents

Age	Freq	Per cent	Mean
15-21	16	13.33	
22-28	60	50.00	
29-35	34	28.33	23.6
36-42	6	5.00	
43-49	4	3.33	
Religion			
Christianity	2	1.70	
Islam	118	98.30	
Marital Status			
Single	2	1.70	
Married	106	88.30	
Divorced	8	6.70	
Widowed	4	3.30	
Marriage Type			
Monogamy	53	44.20	
Polygamy	67	55.80	
Education Level of Respondents			
No Formal	41	34.2	
Primary Education	46	38.3	
Secondary Education	22	18.3	
Tertiary Education	11	9.2	
Spouses Educational Level			
No Formal Education	22	18.3	
Primary Education	38	31.7	
Secondary Education	40	33.3	
Tertiary Education	20	16.7	
Occupation of Spouses			
Farmer	43	35.8	
Daily Labourer	15	12.5	
Civil Servant	24	20	
Business	36	30	
No Response	2	1.7	
Farming Experience (Years)			
< 10	15	12.6	
11-20	32	26.8	24.7
21-30	46	38.5	
> 30	27	22.1	
Method of Land Acquisition			
Inheritance	86	71.7	
Purchase	9	7.5	
Rent	21	25.5	
Others	4	3.3	

Source: 2019

Table 2: Sources of Information

Source of information	Freq.	Per cent (%)
Neighbour	14	11.7
Radio	15	12.5
Television	7	5.8
Newspaper	2	1.7
Internal poster	3	2.5
Friends	8	6.7
Husband	54	45
Relative	12	10
Public announcement	2	1.7
No response	3	2.5
Total	120	100

Table 3: Barriers in the Utilization of Maternal Health Care Service by Rural women

Barriers	Frequency	Percentage	Ranking
Inadequate facilities and drugs	94	78.33	1st
Bad attitude of health personnel	88	73.33	2nd
Time wastage	82	68.33	3rd
Insufficient health workers	78	65.00	4th
Long-distance	72	60.00	5th
High cost of transportation	63	52.50	6th
Bad road	54	45.00	7th
Costly drugs	42	35.00	8th
Dirty environment	36	30.00	9th
Apathy of visiting the health centres	21	17.50	10th
Lack of mobility	15	12.50	11th

Source: Field Survey, 2019 Multiple Responses

Other barriers that the rural women face in the study area include insufficient health workers (65%), bad attitudes of health workers towards patients (60%), high transportation costs (52.50%), bad roads (45%), costly (35%), dirty environment (17.50%) and lack of mobility (12.5%). The result is in line with the findings of Etukudo *et al* (2014) which identified long distances as one of the most important constraints that stop rural women from use of maternal health care services.

CONCLUSION AND RECOMMENDATIONS

In conclusion, women farmers were found to be mostly in their reproductive ages of child bearing and active involvement in economically viable agricultural activities. Islam was the predominant religion. Most of

the women farmers are educated and married in a polygamous marriage type. Majority had farming experience of between 21-30 years and inheritance was the major method of land acquisition. Neighbours were the major source of information on maternal health care services. Inadequate facilities and drugs needed for ensuring effective maternal care services of the rural women farmers and bad attitude of health personnel during the maternal health care visits were the main barriers identified.

Based on the findings from the study, the following recommendations were suggested;

- Health ministries in conjunction with heads of various rural communities should strive to ensure the availability of drugs and other facilities in the respective health centres.
- There should be a balance of the sources of information used by the women farmers to enable them to take advantage of the other sources
- Further studies are needed to explore ways to alleviate the bad attitude of the health personnel
- The relevant organizations given the mandate for ensuring smooth running of activities of health facilities should ensure the cleanliness of the environment and professionally efficient manpower.

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Journal of Applied Agricultural Research 2020, 9(1): 93-105
ISSN 2006-750X

YOUTH INVOLVEMENT IN AGRICULTURE: EVIDENCE FROM LIVESTOCK PRODUCTION ACTIVITIES IN THE WESTERN AGRICULTURAL ZONE OF NASARAWA STATE, NIGERIA

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ABSTRACT

Global farming population is aging and the participation of youths in agriculture is indispensable in delivering the expected productivity to meet the food security needs of the ever-growing population. Descriptive statistics and Logit regression model were used to assess youths' involvement in livestock production activities in the Western Agricultural Zone of Nasarawa State of Nigeria. Primary data were obtained using structured questionnaire and the data were collected from 100 respondents. Also, the study used Focused Group Discussion (FGD) to access group responses. Results from the study revealed that majority (78%) of the youths involved in livestock production in the study area were male with sheep and goat as their major livestock and a mean annual income estimated at ₦35, 270. The result of the regression analysis established that youth involvement in livestock production activities was significantly determined by the household size ($P<0.01$), years of experience ($P<0.05$) and farm size ($P<0.05$). The study further identified lack of fund, poor access to market, disease outbreaks and high cost of inputs as the major constraints faced by youths in their livestock production activities. Based on the findings, the following recommendations are made for further improvement and development of livestock production among youths. Involvement in the production activities be encouraged by government by providing adequate funds readily available in form of soft loans for the teaming youths; market reformation so as to enable ease of access and marketing of the products; provision of adequate health care facilities and veterinary services to livestock producers; youth should have positive attitude with regard to livestock production activities by a way of continuous investment of the good returns over a longer period of time.

Keywords: Youths, Agriculture, Livestock, Western agricultural zone,

INTRODUCTION

In Nigeria agriculture provides about 40% of the gross domestic product (GDP) as well as employment and income to 70% of the youth's population (Olarewaju, 2010). Unfortunately, Nigeria's agricultural sector is bedeviled with several challenges such as

lack of access to markets and credits, low level of technology especially mechanization, inadequate post-harvest infrastructure (storage, processing, transport), low uptake of research findings by stakeholders and limited availability of improved technological packages especially planting materials and certified seeds (Nasarawa State Agricultural Development Programme, 2020). This has made agriculture unattractive and non-lucrative resulting in decline in the number of youth participation in agriculture (Muhammad-Lawal *et al.*, 2009).

According to Aphunu and Atoma (2010), in Nigeria, farming population is aging. It is practically impossible for this aged generation dominating agricultural sector to deliver the expected productivity to meet food needs of the ever-growing population. The reliance on agriculture for food production and food security at domestic, regional and global level depend on youth productive force. Youth have vital role to play in agricultural enterprises and rural development" (Odhiambo, 2012). According to Muthee, (2012), youth are not largely involved in agricultural enterprises due to the fact that agriculture as a career choice is burdened with misperceptions and a lack of information and awareness. Agriculture has huge and diverse opportunities potentials that cannot only transform the national economy but also tremendously impact the personal lives of the farmers particularly the youth.

Despite the perceived potential and success of agricultural activities among youth, the youths from farming communities find agriculture uninteresting leading to exodus to less tedious and more lucrative jobs are on the rise Gemma *et al*. (2013). General speaking, rural youth face several challenges regarding livelihood activities as a result, they often prefer to migrate to urban areas and not minding the type or quality but to take up low paying jobs.

Studies by Akpan (2010) and Rutta (2012) show that the perceptions of grater job opportunities, poor physical infrastructure and social amenities in rural areas and general dislike of village life to be the factors for youth participation in agriculture. The objective of this study is to assess the determinants of youth's participation in livestock production activities.

Specifically, the objectives were to:

i. Describes the socio-economic characteristics of the respondents;
ii. Identify the types of livestock production activities participated by youths in the study area;
iii. Determine the effect of socio-economic characteristics in youth's participation in livestock production activities;
iv. Identify the constraints to youth participation in livestock production activities by the respondents;

METHODOLOGY

Description of the Study Area

The study was carried out in western agricultural zones of Nasarawa state, Nigeria. The zone comprises of four local governments namely; Keffi, Karu, Nasarawa and Toto local government areas. Nasarawa State is a state in central Nigeria, its capital is Lafia. Nasarawa State is centrally located in the Middle Belt region of Nigeria. The state lies between latitude 7° 45' and 9° 25' N of the equator and between longitude 7° and 9° 37' E of the Greenwich meridian. It shares boundary with Kaduna state in the North, Plateau State in the East, Taraba and Benue states in the south while Kogi and the Federal

Capital Territory flanks it in the West. The state has a total land area of 26,875.59 square kilometers and a population of about 1,826,883, spread across thirteen Local Government Areas, namely, Akwanga, Awe, Doma, Karu, Keana, Kokona, Lafia, Nasarawa, Nasarawa Eggon, Obi, Toto, Wamba and Keffi. The people of Nasarawa state includes among others; the Gwandara, Alago, Eggon, Gbagi, Egbira, Migili, Kantana, Fulani, Hausa, Kanuri, Tiv, Afo, Gade, Nyankpa, Koro, Jukun, Mada, Ninzam, Buh, Basa, Agatu, Arum, Kulere, and also settler groups like the Igbo, Yoruba and Hausa. The zone has a climate typical of the tropical zone because of its location and is quite pleasant. It has a maximum and minimum temperature of 81.7° F and 16.7° F respectively. Rainfall varies from 131.73cm in some places to 145cm in others. The months of December, January and February are cold due to harmattan wind blowing across the State from the North-East. It is characterized by two distinct seasons: dry and rainy. The dry season spans from November to February, while the rainy season is from March to October.

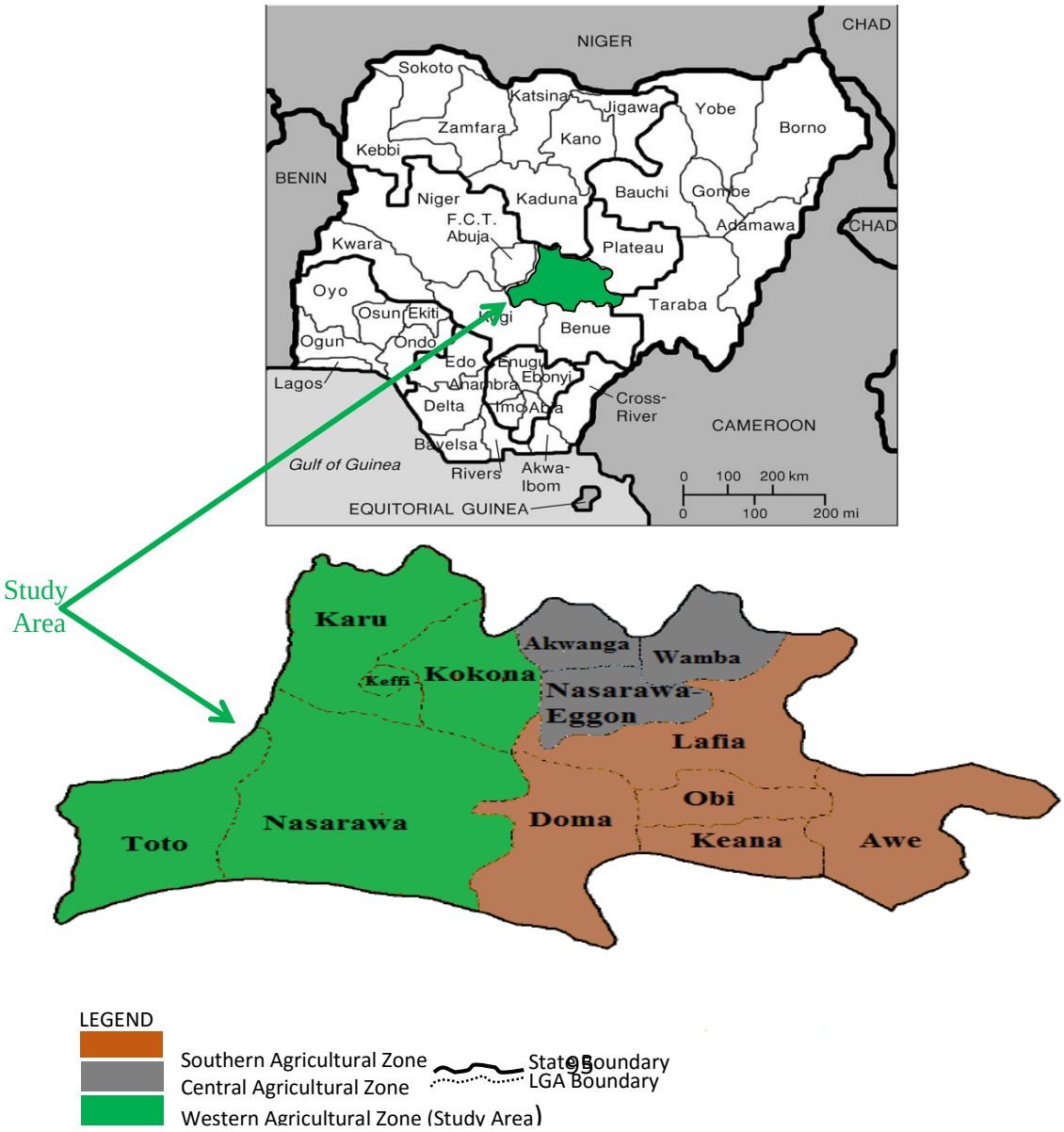

Figure 1: Map of Nigeria and Nasarawa State indicating the study area location

Sampling Technique and Sample Size

The target population of the study comprised of all youth including young men and women. A multi-stage sampling technique was adopted for the selection of the respondents. In the first stage, all the five (5) LGAs namely, Kokona, Keffi, Karu, Nasarawa and Toto that makes up the Western Agricultural zone were purposively selected. The second stage involved the random selection of ten (10) communities/villages across the LGAs. At the final stage, ten (10) youths were selected from each of the ten (10) selected communities/villages. This gives a total of one hundred (100) youths as respondents for the study.

Data were collected with the aid of a well-structured questionnaire that was supported by a focused group discussion (FGD).

Data Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequency, percentage and mean were used to satisfy objective i, ii, and v while regression analysis (logit regression model) was used to analyze objective iii to estimate the relationship between youth's participation in livestock production activities. That is, the dependent variable and the socio-economic characteristic of the respondents on youths (independent variables).

The logit regression model is specified as follows;

$$Y = \text{in}\left[\frac{Pi}{1-Pi}\right] = \alpha + \sum \beta_i X_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon$$

Where, Y is the youth participation in livestock production activities. (1=participation, 0 = non participation)

β = the coefficient for the respective variables in the linear function

X_1= house hold head

X_2= house hold age (years)

X_3= education (years of formal schooling

X_4 =household size (number)

X_5 = farm size (hectare)

X_6 = household income (naira)

X_7= access to credit (naira)

X_8= youth perception characteristics

α = constant term

ε = error term

RESULTS

Socio-Economic Characteristics of Respondents

Result in Table 1 revealed that majority (61.0%) of the respondents were between the age range of 31-40 years old. The mean age is 33 years old. This implies that most of the participants were matured and below 40 years of age. This agreed with the findings of Muhammad-Lawal *et al.* (2009) that youths below 40 years of age engage more in livestock production activities. It therefore implies that most youth in the area are in their active years and very much involved in livestock production activities. Majority (78%) of the youths in the study area were male which suggests that males had higher participation than females in livestock production activities. Nnadi and Akwiwu (2008) reported males participate more in livestock production activities. Chikezie (2012), further explained that the low participation by female youths in livestock production activities could be attributed to the fact that females are more involved in off farm activities such as food vending,

tailoring, petty trading and hair dressing. Oladele *et al.* (2012) also revealed that males more energetic and could readily be available for energy demanding jobs in livestock production.

Results in Table 1 showed that 70.0% of respondents had tertiary education. The implication of this finding is that the majority of the respondents were literate, hence, literacy is expected to influence their perceptions of information received and utilized for livestock production activities, as well as, their decision to migrate to urban areas. Youths generally have greater knowledge acquisition propensity (Jibowo and Sotomi, 1996) and hence they are eager to learn, receptive to new ideas, looking for ways to be productive and searching for avenues to direct their energies. Education is important in creating positive mental attitude towards adoption of modern farming innovations (Benor *et al*., 1997). Household size of most (49%) respondents ranges between 6 and 10 persons. This implies that most respondents had small household size and this may be connected to their educational level that have increased their awareness on family planning.

Most (57%) of the respondents belonged to one or more groups of social organization or cooperatives. These implies that majority of youths have access to sharing of ideas, experience and knowledge through group discussion thereby aiding in sharing of common interest that can assist them with informed knowledge on agricultural production activities. Majority (55%) of the respondents in the study area had farming experience within the range of 1-5 years. The mean farming experience was 5 years old. This implies that most respondents are fresh hands in livestock production activities. The farming experience of youth to a large extent affects their managerial know-how.

Results also showed that majority (78%) of the respondents had farm size of ranging between 1-5 hectares with a mean farm size of 5.75 hectares. Also, most (45%) earned less than twenty thousand naira (N20, 000) annual income. Only 23% of the respondents had an annual income of 40,000 naira and above. These indicate that the majority of the respondents in the study area earn low income which was not reasonable enough to meet their daily needs.

Types of Livestock Production Activities Participated by Youth's in the Study Area

Table 2 revealed the major types of livestock production activities in which youths are involved in the study area from Table two (2) It revealed that majority (40%) of the respondents was involved in sheep and goat, the table also revealed that (38%) of the respondents are involved in poultry production, (34%) of the respondents are involved in other livestock production activities (14%) of the respondents involved in cattle production, (10%) involved in milk production, whereas (9%) of the respondent are involved in swine production, and (3%) are involved in breeding programmed respectively. The majority of the youth's in Nasarawa State western agricultural zone involved themselves in livestock production activities which include sheep and goat production, poultry production, swine production, beef production, breeding programmed and whereas others involved in other important agricultural production activities in the study area. Sheep and goat production seem to be popular as large percentages of the respondents cited involvement in sheep and goat production activities, probably due livestock production

activities in the study area required large capital to practice. These results disagree with Gwary *et al*. (2008) in their study report that youths were interested in crop production than livestock, probably due to the short gestation period of the crop varieties produced, which ensures quick turnover. In addition, livestock production could be more capital intensive than crop production, hence the preference for crop production by most youths. Livestock production activities provide employment opportunities for teaming youths labour force in developing country especially Nigeria, Through active participation of youths in agricultural livestock production activities thereby reducing the problem of unemployment especially among youths therefore government and other nongovernmental organization (NGO_s) should put more effort on increasing youth participation in livestock production activities in order to achieve sustainable development goal of the united nation as well as reducing poverty in developing countries. Farm labour is a major source of employment opportunities for the rural labour force (Reuben and Berg, 2001).

The Effect of Socio-Economic Characteristics on Youth's Participation in Livestock Production Activities

The result in Table 3 revealed that farm size and farming experience were significant at 5% levels of probability; this implies that a longer year of experience is an advantage for increased farm productivity because famers may have acquired encouraging return and thus will continue with it, anticipating continued benefits. However, household size was significant at 1% level of probability. This could also be as a result of more dependency on other members of the family who are economically active.

The positive significant of household size, farming experience and farm size implies that that an increase in each of the variable will lead to a probability increase in youth's participation in livestock production activities. These findings disagree with Akpan, (2010) study on Encouraging youths" involvement in Livestock production and processing, revealed that rural credits and unemployment are perceived to be the factors for youth's participation in livestock production activities.

The log likelihood ratio test (F-value) for the model is (45.52) (p=0.00). This indicates that the explanatory variables taken together have effect on youth's participation in livestock production activities. The result also indicates a coefficient of determination (Nagelkerke R^2) to be 0.50 which implies that 50% of the dependent variable (youth participation in livestock production activities) is explained by the explanatory variables included in the model.

Constraints to Youth's Participation in Livestock Production Activities

Result in table 4 present the data on constraints to youth's participation in livestock production activities in the study area. The constraints include lack of fund, poor access to market, challenge of disease outbreak, poor government policies, poor infrastructure, poor extension services, high cost of input resource, over dependent on government jobs, poor agricultural insurance scheme, inadequate credit facilities, lack of commitment, inadequate land, environmental issues and others constraints

The result revealed that (81%) of the respondent identified lack of fund as their major constraints to participation in livestock production activities, whereas (67%), (57%) and (52%) of the respondent indicate poor access to market, challenges of diseases

outbreak and high cost of input resources respectively as their constraints to their participation in livestock production activities. This implies that the major constraints to youth participation in livestock production activities were lack of fund, poor access to market, challenges of diseases outbreak and high cost of input resources to carry out the business. This substantiate the finding of Onuekwusi (2005) that Lack of infrastructure and essential input also hinders youth's participation in agricultural and rural development activities. This may be due to inadequate or lack of continuous funding by government; followed by, inadequate credit facilities corroborating the findings of Ouma, De-Groot and Owour (2006) who posit that prominent among problems affecting the use of improved agricultural technologies by farmers is access to credit. While, inadequate extension service was third in order of severity. This is in line with the findings of Aphunu and Atoma (2010) who affirmed that increased agricultural productivity and enhanced farmers income are only attainable when an effective agricultural extension system is put in place.

CONCLUSION AND RECOMMENDATIONS

Based on the results of the study, it can be concluded that the average age of the respondent is 33 years old. Majority of youths in the study area have tertiary education with low mean income level of N35, 270. The average farm size is s 3 hectares, whereas sheep and goat production are the major livestock production activities in which youths participate.

Household size is significant at 1% level of probability whereas farm size and years of farming experience is significant at 5% level of probability. Livestock production activities is the most important sector for the youth's development for the nation gross domestic product (GDP) and gross national product (GNP), youths are perceived to be a significant engine for the agricultural development whereby they are energetic, creative and innovative which is the important pillars for the agricultural development.

The following are recommendations have been suggested for further improvement and development of livestock production sector via youth's participation in livestock production activities in the study area;

1. Considering the low income yearly from respondents, aggressive awareness is needed to on best livestock production practices to increase income for youths in the study area. .
2. Since farm size affects youth's participation in livestock production, there is need for for government policies to reflect on making more land available so that youths will be more willing to participate in livestock production.
3. Provision of adequate health care facilities and veterinary services to the producer i.e. the youth's and lastly.
4. On the part of youth's, they should have positive perception with regard to livestock production activities, probably due to continuous good returns of the investment over a longer period of time.
5. Provision and improvement of animal healthcare facilities in the study area.

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

Variable	Frequency (F)	Percentage (%)	Mean ($\bar{X}$)
Age			
≤ 20	1	1.0	
21-30	38	38.0	33
31-40	61	61.0	
Gender			
Male	78	78.0	
Female	22	22.0	
Educational level			
No formal education	3	3.0	
Primary education	0	0.0	
Secondary education	27	27.0	
Tertiary education	70	70.0	
Household Size			
1-5	37	37.0	
6-10	49	49.0	7
11-15	9	9.0	
Above 15	5	5.0	
Farm size			
1-5	78	78.0	
6-10	11	11.0	3
11-15	8	8.0	
Above 15	3	3.0	
Farming Experience			
1-5	55	55.0	
6-10	32	32.0	5
Above 10	13	13.0	
Annual Income			
≤ 20,000	45	45.0	
20,001 – 40,000	32	32.0	
Above 40,000	23	23.0	35270
Membership of Organization			
Yes	57	57.0	
No	43	43.0	
Total	100	100.0	

Source: Field Survey, 2018

Table 2: Distribution of respondents according to types of livestock production activities participated by youths in the study area

Livestock Production Activities	*Frequency (F)	Percentage (%)
Poultry production	38	38.0
Sheep and Goat	40	40.0
Cattle production	14	14.0
Milk production	10	10.0
Beef Production	4	4.0
Swine production	9	9.0
Forage production	1	1.0
Breeding	3	3.0

Source: Field survey, 2018

*Multiple responses observed

Table 3: Effect of socio-economic characteristics in youth's participation in livestock production activities

Variables	B	S.E.	Wald	Sig.	Exp(B)
Age	-0.033	0.545	0.004	0.952^{NS}	0.968
Sex	0.511	0.670	0.581	0.446^{NS}	0.600
Marital Status	0.164	0.524	0.097	0.755^{NS}	0.849
Occupation	0.200	0.223	0.805	0.369^{NS}	0.819
Educational qualification	0.504	0.862	0.342	0.558^{NS}	1.656
Farm Size	0.194	0.082	5.572	0.018^{**}	1.214
Annual Income	0.210	0.448	0.219	0.640^{NS}	0.811
Membership of organization	0.141	0.570	0.061	0.805^{NS}	1.151
Access to Credit	0.495	0.627	0.625	0.429^{NS}	1.641
House hold size	0.286	0.088	10.459	0.001^{***}	1.331
Farming Experience	0.974	0.419	5.403	0.020^{**}	2.649
Constant	4.713	0.424	1.894	0.169	0.009

Data Analysis, 2018

$R^2 = 0.50$; *** Significant at 1%; ** Significant at 5%,

Table 4: Constraints to youth's participation in livestock production activities

Constraints	*Frequency (F)	Percentage (%)
Lack of fund	81	81.0
Poor access to market	67	67.0
Challenges of disease outbreak	57	57.0
Poor government policies	11	11.0
Poor extension services	12	12.0
Poor infrastructure	14	14.0
High cost of input resources	52	52.0
Over dependent on government jobs	6	6.0
Poor agricultural insurance scheme	3	3.0
Inadequate credit facilities	8	8.0
Lack of commitment	4	4.0
Inadequate land	12	12.0
Environmental issues	5	5.0
Others	4	4.0

Source: Field survey, 2018
Multiple responses observed

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