AN EXAMINATION OF THE FORECASTING CAPABILITIES OF LINEAR, GRAFTED AND EXPONENTIAL FUNCTIONS FOR NIGERIAN AQUACULTURE OUTPUT

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ABSTRACT
The Nigerian aquaculture sector has been witnessing substantial increases in production for over 2 decades. However, estimates of future supplies, which are necessary inputs in the articulation of plans for increased production, cannot be objectively determined using conventional forecasting tools due to poor data culture. Therefore, such plans whose aims include improving food and international trade balance sheets have to be hinged on trend-based forecasting models. The determination of which trend model is most accurate for a commodity is a matter of experimentation. This work examined aquaculture output forecasts using linear, grafted and exponential functions with the aim of identifying the model that is most reliable for forecasting it. Data on aquaculture output from 1950 to 2015 were sourced from FAOSTAT. Ordinary Least Square Regression framework was used to fit the data for linear, grafted (mean), and exponential functions. Structural parameters from the three models were econometrically plausible and hence were used in forecasting. Comparison of their forecasts through the observation of their deviations from the observed data indicated that the grafted function provided more reliable estimates. The forecasting accuracies of the linear, grafted and exponential functions were 50.71%, 98.55% and 17.52% respectively. ANOVA result confirmed the suitability of the grafted function in forecasting aquaculture output. Visual observations of the forecast errors indicated more even distribution of errors from the grafted function around zero. While the variant of the grafted model experimented with here is reliable for Nigerian aquaculture, its reliability in forecasting other commodities is not guaranteed.

Keywords: Aquaculture, Forecasting, Linear, Grafted, Exponential functions

INTRODUCTION
The oil and agricultural sectors are important to the Nigerian economy (Ekperiware & Olomu, 2015). Agriculture has however continued to remain the bedrock of the economy. Unstable and unpredictable oil prices, as well as the attendant instability in revenue volume, have made Nigeria to once more consider re-thinking agriculture; especially as sustainable agriculture will also help reduce hunger and poverty (Nwankpa, 2017). Agricultural transformation goals of countries are entrenched in their agricultural plans, some of which are forecast based. Forecasting requires data but poor quality data has constrained proper planning in developing countries (Bivan, 2013).

Consequently, more encompassing models like those in Dastagari (2004) and Hartel (1997) are not readily applicable in developing countries. This has limited forecasting attempts to the use of the trend of existing series. Relying on the trend of series for forecasting has been going on for decades but can be misleading if the most appropriate methodologies are not employed. The most important of concerns is the assumption of linearity in trend for all series. This went on until Fuller (1969) presented the results of grafted functions. The argument against the linear trend models is that there is nothing to guarantee that all agricultural series will be linear. Figure 1 for instance, is the aquaculture production graph for the period of 1950 – 2015.

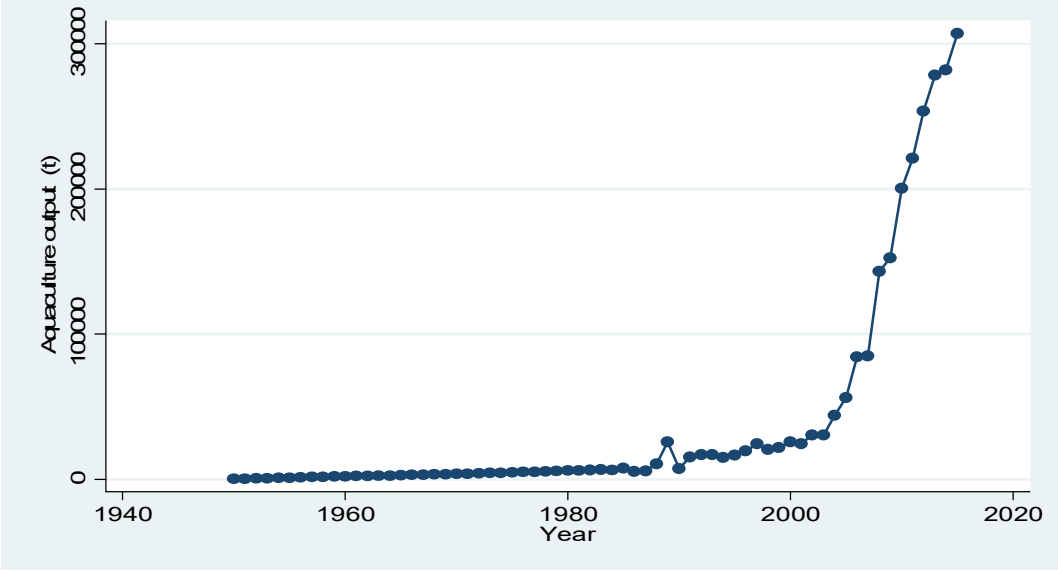

Fig. 1: Graph of Nigerian aquaculture output in tons (1950-2015)

Source: Constructed based on Nigeria aquaculture data from FAOSTAT

There is nothing in Fig 1 to suggest that a linear trend is the most appropriate representation for the Nigeria aquaculture output for this period. Thus, researchers have, apart from the linear trend model, also experimented with grafted functions, where trend is the only available forecasting option. In most cases, these researchers have compared the results emanating from the two methodologies (Philip, 1990., Bivan *et al.,* 2013., Nmadu *et al.,*2009 , Rahman, 2001., Onuche *et al.,* 2015[a], Onuche *et al.,* 2015[b], Odedokun, 2015). In such comparisons, the overwhelming verdict gives the grafted polynomials pre-eminence over the trend-based models. In spite of this conclusion, the capability of any grafted functions is not absolute for all commodities. Thus, different attempts must be made for specific commodities. The third series based forecasting procedure is the exponential function.

The grafted model involves segmenting the curve fitted for a series into different sections based on the local characteristic of the curve. Points on the curve which appear to have witnessed similar trend are grouped into a segment. It is usual for a careful visual observation to result in the delineation of 3 segments (Nmadu *et al*., 2009). Thereafter, the derivation of a mean function is undertaken to construct a grafted model for estimation. This grafted (mean) function thus encompasses all the characteristics of the various segments of the curve. The resulting structural parameters from the estimation of the mean function are then utilized in ex-post forecasts.

Variants of grafted model include Linear - Linear - Linear (L-L-L), linear- linear Quadratic (L-L-Q), Linear - Quadratic - quadratic (L-Q-Q), Linear – Quadratic - linear (L-Q-L), quadratic-quadratic–linear (Q-Q-L) and Quadratic - Quadratic - Quadratic (Q-Q-Q). A linear –linear - linear model is essentially a linear trend model and most widely used. A quadratic- quadratic-quadratic could be estimated by higher polynomials. Since it is common for the last segment of the curve to be assumed as linear where forecasting is the goal (Akpan *et al*., 2007), it is essential to limit a study of this nature to such models that have their terminal segments in the linear form - that is, the LQL, QQL. There is no universality as to which grafted model to adopt (Nmadu, 2009), hence

the differences in the forecasting capabilities (Philip, 1990., Bivan *et al.,* 2013., Nmadu *et al.,*2009, Rahman, 2001., Onuche *et al.,* 2015[a] and Onuche *et al.,* 2015[b]). The implication is that different commodities require specific attention in demonstrating the most plausible forecasting framework.

Whereas Onuche (2015) and Federal Department of Fisheries- FDF (2008) relied on the trend model due to its simplicity in estimation and understanding, in forecasting fish supply at different periods, the grafted polynomial forecasting framework has not been applied to the Nigerian aquaculture output. The goal of this study is to fit linear, grafted and exponential models for Nigerian aquaculture data from 1950-2015, in order to demonstrate their forecasting capabilities.

METHODOLOGY

This study was conducted using the time series data for Nigerian aquaculture output in tons (t) for 1950-2015. This data set was sourced from FAOSTAT. First, the linear trend equation given by equation 1 was estimated.

$$Q = a + b_1 t \quad (1)$$

Where; Q = aquaculture output in tons; a and b = parameters to be estimated and t = trend.

Then a grafted polynomial was proposed as follows:

By carefully observing the graphical representation of the data in Fig. 1, the following three periods: 1950-1999, 2000-2008 and 2009-2015 were identified, leading to the construction of the following three segments;

$$Q = a_0 + a_1 t, \text{ for } 1950 \leq t \leq 1999 \quad (2)$$

$$Q = b_0 + b_1 t + b_2 t^2, \text{ for } 2000 \leq t \leq 2008 \quad (3)$$

$$Q = c_0 + c_1 t, \text{ for } t > 2008 \quad (4)$$

Where; a, b and c in equations 2, 3 and 4 are structural coefficients.

According to Bivan *et al.* (2013), it is a requirement that this mean function be continuous, linear in structural parameters and differentiable at the joints of the pairs of the trend functions. In short, the following restrictions are required to hold.

$$\alpha_0 + \alpha_1 k_1 = \beta_0 + \beta_1 k_1 + \beta_2 k_1^2 \quad (5)$$

$$\beta_0 + \beta_1 k_2 + \beta_2 k_2^2 = c_0 + c_1 k_2 \quad (6)$$

$$\alpha_1 = \beta_1 + 2\beta_1 k_1 \quad (7)$$

$$c_1 = \beta_1 + 2\beta_2 k_2 \quad (8)$$

Where: the k_s are the joints of the segmented function: k_1=1999, k_2=2008. There are 7 structural parameters and 4 restrictions. This implies that only 3 parameters will be estimated from the mean function. Following (Bivan *et al*., 2013), the coefficients (c_0, c_1 and β_2) in the last segment were retained for subsequent estimation since our goal is to forecast.

The mean function was derived in the following way:

We start with equation 8 in order to make β_1 the subject of the equation. This leads to

$\beta_{1=} c_1-2\beta_2k_2$ (9)

Then, using (9), we eliminate β_1 from (7) to get an expression for α_1 as

$\alpha_{1=} c_1 -2\beta_2(k_2- k_1)$ (10)

Furthermore, using (9) we also derive an expression for β_0 from (6) thus:

$\beta_0 = c_0 + \beta_2k^2_2$ (11)

Finally, we substitute β_1, α_1, and β_0 into (5) to get an expression for α_0 (12)

$\alpha_0 = c_1 – \beta_2 [k_1^2-k_2^2]$.

To get the mean function, α_0, α_1, β_0 and β_1 were substituted for as they appear in (2-4). In the case of (2), $t\leq k_1$, coefficients α_0, and α_1 were substituted for using (9) and (10). The resulting calculation yields

$Q=c_0 +c_1t+ \beta_2[k^2_2-k^2_1-2(k_2-k_1)t]$ (13)

In the case of (3), $k_1\leq t\leq k_2$, β_0 and β_1 were substituted for using (11) and (12) to yield

$Q =c_0 +c_1t+\beta_2(t-k_2)^2$ (14)

In (4), $t>k_2$, coefficients c_0 and c_1 were retained for forecasting purpose. Thus, we have the mean function as in equation 15.

$Q= cX_0 +c_1X_1+ \beta_2X$ (15)

Where,

$X_0=1$, for all t

$X_1=t$, for all t

$X_{2=} [k^2_2-k^2_1-2(k_2-k_1)t]$, for $t\leq k_1$

$=(t-k_2)^2$, for $k_1\leq t\leq k_2$

= 0, otherwise

The mean function (eq.15) is now continuous, given the set of restriction from (5)-(8).

The exponential function is expressed as:

$Q_i= \partial T^{b1}e^{ui}$ (16)

Where; Q = level of aquaculture production; ∂ and b = parameters to be estimated, T = trend variable, U_i = error term, and e (Euler's constant)=*2.718*. Equation 16 can be expressed alternatively as:

$\ln Q_i = \ln\partial + b_1 \ln T + U_i$ (17)

Where ln =natural log (i.e., log to base e).

This can be re-written as:

$\ln Q_i = a + b_1 \ln T + U_i$ (18)

Where a $=\ln\partial$

OLS was used to estimate 1, 15 and 18 based on the observed data for aquaculture output from 1950 to 2015. To carry out the ex-post forecast comparison of the models, some observed data at the tail end of the series are usually retained. Hence, data for 2008 to 2015 were retained for the ex-post evaluation of the estimated functions. Usually, the model whose forecasts deviate the least from the observed data is identified as the most appropriate model for forecasting. The Analysis of Variance (ANOVA) was employed in mean comparisons of the observed data and forecasts from the models as a confirmatory test.

RESULTS AND DISCUSSION

Table 1: Structural Estimates for Linear, Grafted and Exponential Functions for Nigerian Aquaculture Output (1950-2015)

	Model		
Variable	**Linear**	**Grafted**	**Exponential**
Coefficient of X_1	2677.84	26249.54	1.651034
	(7.33)*	(76.70)*	(14.53)*
Coefficient of X_2	-	1439.14	-
		(69.40)*	
Intercept	-50777.76	-1413992	3.776828
	(-3.61)*	(-71.74)*	(9.90)*
Adj. R^2	0.448	0.998	0.7638
F ratio	53.75*	4456.30*	211.17*
RMSE	6474.3	56530	0.83028
N	66	66	66

*Note: Figures in parenthesis are t ratios, * denotes significance at 1% probability.*
Source: Computation based on FAO data on Nigerian aquaculture from 1950 to 2015

The structural parameters from OLS estimations in Table 1 were significant at 1% for all models; hence their suitability for forecasting. The grafted model, however, appeared more econometrically plausible. While about 99.8% of the variation in the series was explained by the grafted function, the linear and exponential models accounted for only 45% and 67.4% of the variation respectively. Similarly, the F ratio was highest for the grafted function. Root Mean Square of Error (RMSE) for the exponential model was however the least. Next, the forecasting capabilities of the models were scrutinized by comparing their forecasts with observed data.

Table 2: Ex-post Forecasts, Forecast Error and Accuracy of the 3 Models for Nigerian Aquaculture Output (tons) from 2008 to 2015

Year	Observed data	Linear function-based forecast	Grafted function-based forecast	Exponential function – based forecast	Forecast error in linear function	Forecast error in grafted function	Forecast error in exponential function
2008	143207	107214.6	134730.9	36603.21	35992.44	8476.14	106603.8
2009	152796	109892.4	160980.4	37633.04	42903.6	-8184.4	115163
2010	200535	112570.2	187229.9	38674.09	87964.76	13305.06	161860.9
2011	221128	115248.1	213479.5	39726.31	105879.9	7648.52	181401.7
2012	253898	117925.9	239729	40789.64	135972.1	14168.98	213108.4
2013	278706	120603.7	265978.6	41864.01	158102.3	12727.44	236842
2014	282034.2	123281.6	292228.1	42949.36	158752.6	-10194	239084.8
2015	307135.2	125959.4	318477.6	44045.64	181175.8	-11342.5	263089.6
		Accuracy= 50.71%	Accuracy= 98.55%	Accuracy= 17.52%	Error= 49.29%	Error =1.45%	Error= 82.48%

Source: Computation based on FAO data on Nigerian aquaculture from 1950 to 2015

The ex-post forecasts and associated parameters for the functions compared in this study are presented in Table 2. The results provide parameters for further comparison in order to identify the model with the most accurate forecasting capability. Casual observation indicates that the deviations of the grafted model-based forecast from the observed data are less than those of the other models. The forecasts from the grafted model are more reliable than those made by Onuche (2015) and FDF (2008) for output in the same subsector. The superiority of grafted models in this study agrees with the reports earlier cited. Philip (1990) had applied the Q-Q-L model to the Nigerian cotton production while Rahman *et al.* (2001), Bivan *et al*. (2013), Onuche *et al.* (2015[a]) and Onuche *et al.* (2015[b]) applied the linear quadratic-linear form to Nigerian maize, sorghum, wheat and capture fish outputs respectively. Odedokun (2015) also reported a similar finding in the application of Quadratic–Linear model to Nigerian cotton production. Which variant of grafted functions is best for a series is a matter of trials. For instance, in their application of different variants of the grafted polynomials to cereals production and their contributions to GDP in Nigeria, Nmadu *et al* (2009) noted that there is no universality as to which grafted model is best.

Furthermore, a forecast error of less than 1.5% was recorded for the grafted function-based forecast, whereas almost half of the observed data was unaccounted for in the linear-based forecast. A forecast error for the exponential function was over 80%. These deviations also support the preference of the grafted model. Whereas the largest absolute deviation from the grafted model was 14,168.98 tons, the least absolute deviation from the linear function was 35,992.44 tons. Deviation of the forecast from the exponential function ranged from 106,603.8 to 263,089.6 tons. The forecasts are graphed in (Fig 2) for visual examination.

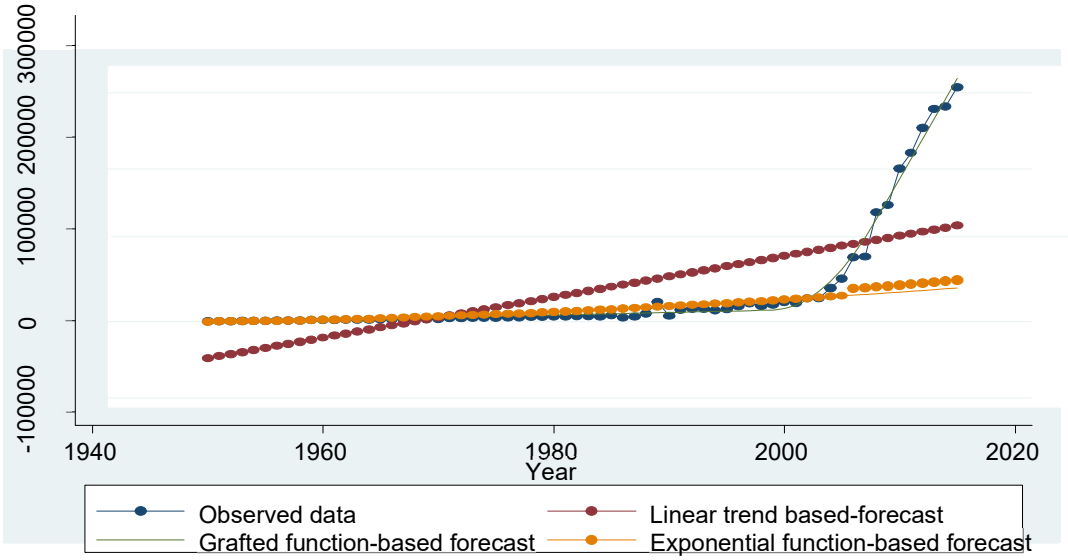

Fig 2: Graph of Ex-post forecasts of Aquaculture Output (tons) in Nigeria from 2008-2015

Source: Constructed based on FAO data on Nigerian aquaculture from 1950 to 2015.

The graph indicates that forecasts from the grafted model aligned closely to the observed data. Profound deviations are also noticed for the forecast from the other models. A confirmatory test of mean difference, hence, superiority, using ANOVA is presented in Table 3.

Table 3: ANOVA Based Comparison of Ex-post Forecasts

Parameter	Observed data	Liner model-based forecast	Grafted model- based forecast	Exponential model -based forecast	F-ratio
Mean Forecast	229929.9 [a]	116587.0[b]	226604.3[a]	40285.7 [c]	34.23*

Note: Figures with different superscripts differ significantly; denote significance at 1% probability.*

Source: Constructed based on FAO data on Nigerian aquaculture from 1950 to 2015

The mean comparisons indicate that whereas the difference between forecasts of the grafted function and observed data is statistically equal to zero, forecasts of the other models are each statistically different from the other forecasts, and the observed data (Table 3). This finding confirms the grafted function as the superior forecasting model for Nigerian aquaculture output.

Further graphs (Fig 3, 4 and 5) are used to test for the stability of the forecast.

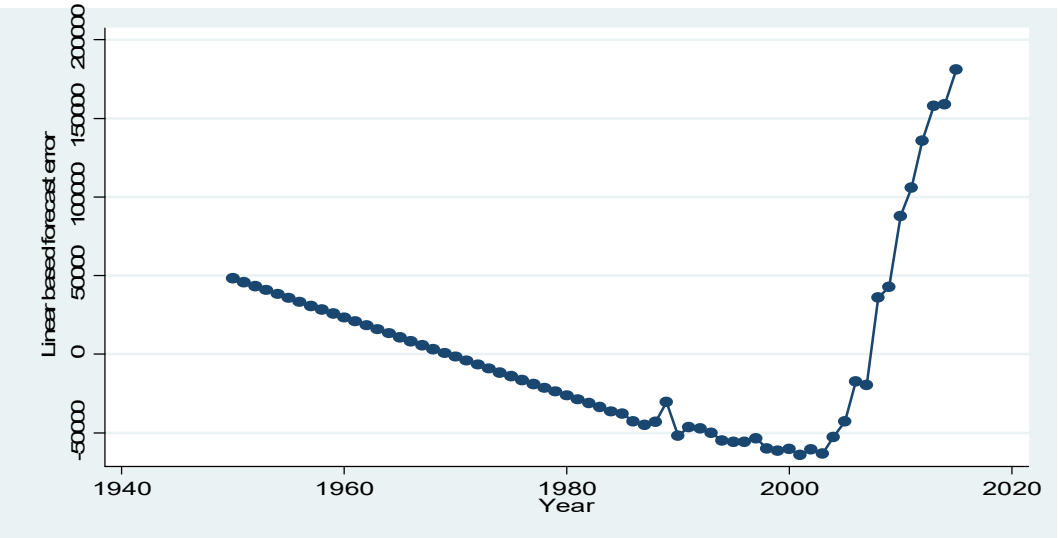

Fig. 3: Plot of Forecast errors from Linear Function.
Source: Constructed based on FAO data on Nigerian aquaculture from 1950 to 2015

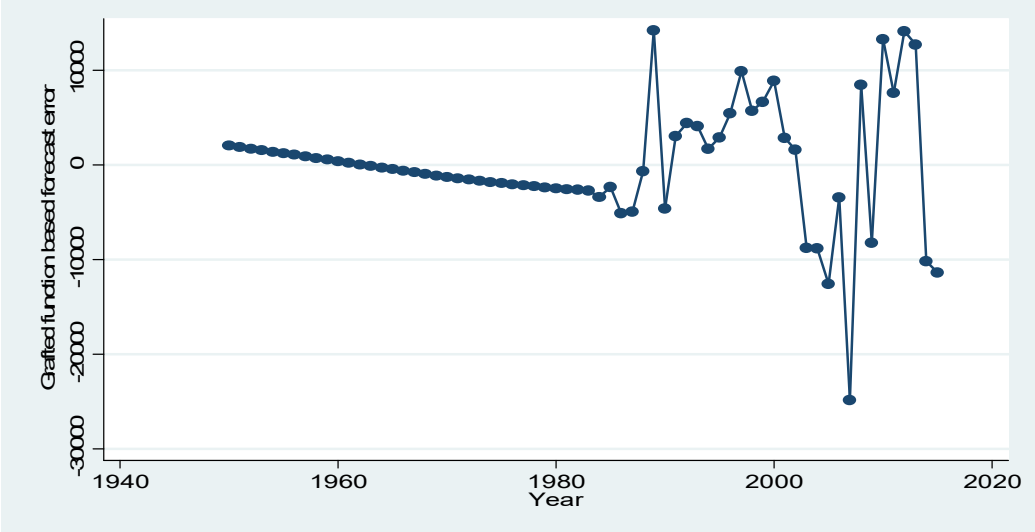

Fig. 4: Plot of Forecast errors from Grafted Function.
Source: Constructed based on FAO data on Nigerian aquaculture from 1950 to 2015

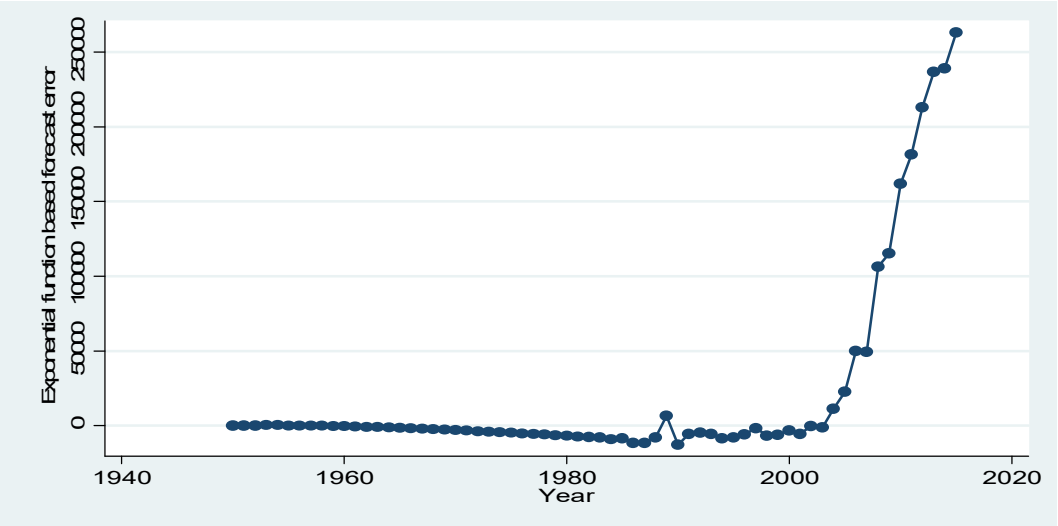

Fig. 5: Plot of Forecast errors from Exponential Function.
Source: Constructed based on FAO data on Nigerian aquaculture from 1950 to 2015

The stability property of the forecasting capabilities of the models can be inferred from the visual examinations of the distributions of their errors around zero. As opposed to the distribution of forecasting errors of the linear and exponential functions (in Figs 3 and 5), errors from the grafted function are fairly distributed around zero (Fig. 4), confirming that the grafted model is the most stable forecasting methodology based on the period considered.

CONCLUSION

Regression analysis, visual observation and inferential statistics estimation applied to the Nigerian aquaculture output for 66 years identified the grafted models as the subsector's most reliable forecasting function. This superior forecasting capability of the grafted model over the other two models is due to its absorption of the peculiarities of trend segments, thereby accommodating every aspect of the series in a mean function**.** Hence, by taking into cognizance the peculiarities of the local trends observed in the delineated segments, the grafted model was able to provide reliable estimates for Nigerian aquaculture output.

RECOMMENDATIONS

From the findings, experimenting with the grafted models is advised in trend-based forecasting attempts.

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DETERMINANTS OF LABOUR USE AMONG OFADA RICE FARMERS IN EWEKORO LOCAL GOVERNMENT AREA, OGUN STATE, NIGERIA

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ABSTRACT
Ofada rice production is a labour intensive farming enterprise usually cultivated by small scale farmers at subsistent level due to inadequate and short supply of labour. This study analysed the determinants of labour use by Ofada rice farmers in Ogun State, Nigeria. Multi-stage sampling techniques was used to select 120 respondents from Ewekoro Local Government Area of the state. Data were collected with a pre-tested questionnaire administered by personal interview method. Descriptive statistics and multinomial logit models were used for data analysis. Results revealed that majority (78.3%) of the respondents were male with a mean age of 42 years, married (65.8%), cultivated a mean farm size of 4.81 hectares and used an average of 24 persons as labour on their farms. Family, exchange, hired and a combination of both family and hired labour were the major types of labour used in Ofada rice production in the study area. The type of labour used by the Ofada rice farmers were significantly determined by the age of the farmers, sex, marital status, household size, farm size, income and labour cost in the study area. Therefore, government support is needed to promote and support Ofada rice farmers to adopt mechanized farming, this will not only ease the economic burden of using paid labours, but it will also reduce the tedious and time consuming nature of manual labour resulting to increased Ofada rice production in the study area.
Key words: Determinants, Labour use, Ofada rice, Ewekoro

INTRODUCTION
Rice, (*Oryza sativa),* is a major staple food in Nigeria. It is one of the most cultivated and consumed cereals in the world, especially in Asia and Africa (Akerele *et al.,* 2018). It is the most important cereal after wheat and it is widely consumed in one form or the other (Omoare, 2016). In sub Saharan Africa, West Africa is the leading producer and consumer of rice (WARDA, 1996). West Africa accounts for 64.2 percent and 61.9 percent of total rice production and consumption respectively in sub Saharan Africa. The annual demand for rice in Nigeria is estimated at 7 million tons, while domestic production is 3.7 million tons resulting in a deficit of 3.3 million tons (United State Department of Agriculture, USDA, 2019). According to Akinwunmi (2013), Nigeria spends over ₦356 billion on yearly importation of rice, out of which about ₦1 billion is used per day. The implication of this excessive importation is the huge drains on the country's foreign exchange earnings over time (Oyedepo & Adekanmbi, 2017). Consequently, the Nigerian government embarked on a plan to make the country self-sufficient in rice production in 2015 under the Agricultural Transformation Agenda, or ATA (USDA, 2016) and recently, a policy decision to ban importation of polished rice completely was implemented by the federal government, effort is also currently being made through the presidential rice initiative to improve local rice production in Nigeria by encouraging commercial large scale rice farmers through the provision of loans at low interest rate, grants and technology by non-profit organisation such as International Forum for Agricultural Development (IFAD) and funding from foreign agencies such as World Bank. For instance, the Central Bank of Nigeria set up a $130m initiative offering farmers who have at least 1 hectare of land loans at 9% interest rate, which is below the benchmark interest rate of 14%

Ofada rice is a name for a local variety of rice grown mostly in Ogun State, a state in South-West Nigeria and named after a town known as Ofada in Ogun State. Ofada rice types are mostly blends, and are not indigenous to Africa. They contain *Oryza glaberrima* (African rice) as well as the more common *Oryza sativa* (Asian rice), and may be categorized as either brown/red Ofada or white Ofada on the basis of un-milled seed colour, grain size, shape, and shade (PropCom, 2012). Its production occurs during the rainy period, from March to August. Ofada rice variety contains higher protein, fiber and lower water than the commonly consumed polished rice. The local rice whose consumption has long been abandoned by the elites for imported rice brands, is now widely preferred by many guests at parties, restaurants and so on. Common problems associated with its production are pest attack, insufficient rain, difficulty in harvesting and weeding, inadequate labour supply, among others. The inadequacy of farm labour supply has had negative effects on planting accuracy, better weed control, agrochemical application, timely harvesting and crop processing (Oluyole *et al.,* 2011).

Labour is one of the factors of production. It is the group of productive service provided by human physical effort, skill, and mental power which involves family and non-family including those that are rated on hourly, daily or seasonal basis (Panwal, 2018). Farm labour is a major source of employment opportunity for the rural labour force in Nigeria (Agwu *et al.,* 2014). Evidence abound that, there has been a steady decline in farm labour supply in the country while the available ones comprised mostly of aged farmers. This could be attributed to rural-urban migration, poor infrastructural facilities in the rural areas, as well as poor farm income and low life expectancy in rural areas (Gill, 1991; Anyiro *et al.,* 2013;). Human labour is about the only main source of labour available to small-holder farmers in Nigeria. Ajibefun *et al.,* (2000) noted that hired labour contributes a chunk of the total labour use on farms thus emphasizing its importance in agricultural activities in Nigeria. Other types of labour that could be employed are family labour and exchange labour. The preference for Ofada rice by consumers as reflected in the demand and relative higher price has led to an increase in the level of its production as well as demand for labour. This study focused on analyzing the determinants of labour use by Ofada rice farmers in Ewekoro Local Government Area of Ogun State, Nigeria. The specific objectives were to describe the socio-economic characteristics of the Ofada rice farmers, identify the types of labour use and analyse the determinants of labour use in Ofada rice production in the study area.

METHODOLOGY

The study was conducted in Ewekoro Local Government Area (LGA), Ogun State, South western Nigeria. The headquarters are in the town of Itori. It is located on latitude 6^0 `54'25" N and longitude $3^0$12`31" E. The LGA has an area of 636km^2 and estimated population of 76,000 (NPC, 2016). It is bounded by Yewa south LGA in the west, Ifo LGA in the south, Abeokuta north and Obafemi Owode LGAs in the north and east respectively. The people engage primarily in farming and trading activities.

The study was based on the primary data obtained from Ofada rice farmers in the study area using an interview schedule with the aid of pre-tested questionnaire. Data were collected on socio-economic characteristics of Ofada rice farmer and sources of farm labour used in Ofada rice production in the study area

Multi-stage sampling technique was used in selecting the respondents for this study. First stage was the purposive selection of two wards (Mosan and Wasimi) out of the ten wards in the LGA due to predominance of rice production in the wards. The second stage was a random selection of four villages in each of the selected wards making a total of 8 villages (Oteye, Oluwagun, Temo

and Osupori in Mosan; Wasimi, Lugbena, Baye and Aaba in Wasimi). In the third stage, 15 Ofada rice farmers were randomly selected from each village making a total of 120 respondents for the study. The sampling frame was the list of Ofada rice farmers provided by the Agricultural extension agents of the Ogun State Agricultural Development Programme (OGADEP) serving in the LGA.

Descriptive statistics: Descriptive statistics such as frequency, percentage and mean was used to describe the socio-economic characteristics of the respondents and types of labour used in Ofada rice production in the study area.

Multinomial Logit (MNL) Model: This was used to analyse the determinants of the type of labour employed by the Ofada rice farmers in the study area. MNL model is used to handle the case of multi class dependent variables. The model used for this study was adopted from Balogun *et al.,* (2017). The various types of labour used by the Ofada rice farmers are classified as the dependent variables. It is supposed that the dependent variable Qit can take on one of j categories 1, 2... k (the different alternative choices of labour type available to farmers). In this study, four distinct categories of labour type employed by farmers were, family, exchange, hired, both family and hired. It is assumed that all the alternative labour types are mutually exclusive

Let Pr (Q_{it} =M/X) be the probability of observing outcome M given X, the probability model for Z_{it} can be constructed thus:

$$\Pr(Q_{it}=M/X)=\frac{exp\beta_0+\beta_i X_{2i}+\cdots\beta_k X_{mi}}{\sum_{j=i}^{k} exp(\beta_{0\lambda}+\beta_{ij}X_{2i}+\cdots+\beta_{kj}X_{ni}} \qquad (1)$$

for j = 1, 2,., k. In multinomial logit, it is impossible to identify parameter vectors β_0 to β_j simultaneously. Hence, the parameters relating to a given category are usually set to zero, known as the reference category. The reference category chosen in this study is family labour, that is, to say category 0. In other words, parameters of the first choice category (in this case family labour) are used as the base against which the other choices are compared. The log likelihood function for the multinomial logit can be written thus;

$$\ell = \sum_{i=I}^{n}\sum_{j=I}^{k} d_{ij}\, Log\left(P_{ij}\right) \qquad (2)$$

Where Z_{ij} is a dummy variable that takes the value of 1 if observation i has chosen alternative j; 0 otherwise. The first-order conditions are;

$$\frac{\delta\ell}{\delta\beta\ell} = \sum_{i=I}^{n}\left(q_{ij} - P_{ij}\right)X_{kj} \qquad (3)$$

In this case, the choice of labour type is modelled as a function of socioeconomic characteristics and Ofada rice farming activities. This can be presented as a general form equation:

$Q_{it} = f(Xi)$ (4)

Where Q_{it} takes on values 1, 2, …., k if individual i chooses alternative j (that is, labour types) at time t. The MNL model is however operationalized empirically in this study with the following equations:

$Qit = \alpha o + \beta ijXi + ….. + \beta iXn + \varepsilon i$ (5)

The dependent variable Q_i is when farmers sourced labour from source i and 0 when otherwise. Thus Q_1, Q_2, Q_3, and Q_4 represent probabilities of farmers using family, exchange, hired and both family and hired labour respectively.

X_i - X_n represents vector of the explanatory variables where n = 1-9

β_1-β_2 represents the parameter or coefficients, ε_i represents the independent distributed error term and α_0, α_1, α_2, α_3 shows the intercept or constant term.

The Explanatory Variables are:X_1 = Age of farmer (years), X_2 = Sex (if male 1; 0 if female), X_3 = Marital status (1 if married, 0 otherwise), X_4 = Household size (number of persons), X_5 = Educational level of rice farmer (years), X_6 = Farm size (ha), X_7 = Years of experience in Ofada rice production (years), X_8 = Annual income (₦), X_9= Cost of Labour (₦)

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents in the study area

Table 1: Distribution of respondents by socio-economic characteristics ***n = 120***

Description	Frequency	Percentage	Mean	Std. dev.
Age				
Less or Equal to 30	24	20.0	42.06	10.324
31-50	64	53.3		
Above 60	32	26.7		
Sex				
Male	94	78.3		
Female	26	21.7		
Educational status				
None formally	7	5.8		
Primary	22	18.3		
Secondary	41	34.2		
Adult/vocational	16	13.3		
Tertiary	34	28.3		
Marital status				
Single	18	15.0		
Married	79	65.8		
Widowed	13	10.8		
Divorced	10	8.3		
Household size				
Less or Equal to 5	70	58.3	5	2.452
6-10	48	40.0		
Above10	2	1.7		
Total Farm size				
Less or Equal to 3ha	54	45.0	4.81	1.452
3.1-5ha	31	25.8		
5.1-7ha	15	12.5		
Above 7ha	20	16.7		
Experience				
Less or Equal to 5	42	35.0	8.14	2.081
6-10	51	42.5		
Above 10	27	22.5		
Income				
Less or Equal to 500,000	93	77.5	660,271	1184.76
501,000-1,000,000	20	16.6		
Above 1,000,000	7	5.8		

Extension contact		
No	40	33.3
Yes	80	66.7
	120	**100.0**

Source: Field Survey Data, 2019

Table 1 presents the result on the socio-economic characteristics of Ofada rice farmers in the study area. The result reveals that majority (53.3%) of the respondents were within the age range of 31-50 years. The mean age of 42 years implies that, the Ofada rice farmers were still young and within active labour force group and can cope with vigorous activities of Ofada rice farming. Majority (78.3%) of the respondents were male while 21.7% were female. This implies that Ofada rice farming is male dominated in the study area. This result agrees with Oseni *et al.,* (2015) that, men have more access to land, extension services, physical inputs and labour which directly affect their productivity level compare to their women counterparts. Distribution by educational status indicates that majority of the respondents had one form of education or the other. Only 5.8% of the respondents had no formal education. This implies that, the level of literacy is high in the study area and could help in the choice of right labour type for their farming activities. The result is in agreement with the findings of Osun *et al.,* (2014) that educated farmers easily understand innovative information on farm practices and production technologies. Majority (65.8%) of the respondents were married. This suggests that, the rice farmers have obligations to meet their family needs and would want to choose the labour type that would help increase their production level in the study area.

Household size distribution reveals that 58.3% of the respondent had 5 people or less in their household. The mean household size of 5 persons implies that the respondent had small household size and this has implications for family labour availability and usage in the study area. The result further reveals that 45% of the respondents cultivated 3ha of farmland or less, the mean farm size of 4.81ha implies that Ofada rice production in the study area was at small scale on small fragmented farmlands which could have negative impact on their output. This result is in tandem with the report of Olawepo (2010) that Agriculture in Nigeria is characterized by large number of small-scale farmers, scattered over wide expanses of land, with holdings ranging between 0.05 to 3.0 hectares, but not more than 10 hectares per farmer, with low capital use and low yield per hectare. Distribution by farming experience reveals that 42.5% of the respondents had Ofada rice farming experience of between 6 to 10 years. The mean years of experience of about 8 years implies that the farmers had gained some experience overtime which could help in effective farm management decisions with respect to input combination, labour use and resource allocation in the study area. Distribution by income reveals that majority (77.5%) of the respondents realized ₦500,000 or less at the end of the production season. The mean income of ₦660, 271 per season could have good impact on the production and possible expansion of Ofada rice production in the study area. This is in consonance with the findings of Akerele *et al.,* (2018) that higher income would avail the farmers enough money to procure inputs for the next farming season, hire labour when needed and reduce borrowing rate from cooperative societies and other credit organizations.

Labour use activities of Ofada rice farmers in the study area

Table 2: Distribution of respondents by labour use activities ***n = 120***

Description	Frequency	Percentage	Mean	Std. dev.
Type of labour used				
Hired	30	25.0		
Exchanged	25	20.8		
Family	14	11.7		
Family and hired	51	42.5		
No of Labour Employed				
Less or Equal to 20 what?	70	58.3	24	13.272
21-40	31	25.8		
Above 40	19	15.8		
Labour Cost in what?				
Less or Equal to 100,000	23	19.1	206,173	18097.85
101,000-200,000	31	25.8		
Above 200,000	52	43.3		

Source: Field Survey Data, 2019

The result on the type of labour use in Ofada rice farming activities is presented in Table 2. The result reveals that four types of labour were used by the respondents in the study area namely; family labour, exchange labour, hired labour and a combination of both family and hired labour. Family labour is the unpaid category, that is, use of wife, children or extended family members. Exchange labour is sort of cooperative labour type, where people take turns to collectively work on one another's farm. Hired labour involves employment of people to work on farm for a specific period for an agreed amount/wage. The result shows that family labour (11.7%) was the least form of labour used in Ofada farming in the study area. This is not unexpected considering the size of the farmers' household. This is in consonance with the findings of Agwu *et al.,* (2014) that, the subsistence nature of agricultural production in the rural areas encourages many household members to seek for additional income through other livelihood activities such as trading and artisan which may be fetching them more income when compared to farming, thereby reducing the tendency of participating in farm labour. Exchange labour was used by 20.8% of the respondents in the study area. This will help reduce the burden of labour cost in the study area. Furthermore, 25% of the respondents hired labour to work on their Ofada rice farms. This may have implications on their income as well as profit levels in the study area. This agrees with Ajibefun *et al.,* (2000) and Anyiro *et al.,* (2013) that hired labour contributes significantly to the total labour used on farms. A combination of family and hired labour was used by 42.5% of the respondents in the study area. This implies that a combination of both family and hired labour was the highest labour type used in the study area. In this category, family labour was used to complement hired labour to reduce cost spent on hiring labour while maximizing output level.

In terms of the number of labour employed, the result reveals that majority (58.3%) of the respondents employed 20 labour or less to work on their farm in the last production season.

The mean number of labour employed per season was 24 people. This underscores the labour intensive nature of Ofada rice production as these labours engage in such tasks as land clearing, land cultivation, planting, agrochemical spraying, bird control, harvesting, threshing and so on, in the study area. For instance, in the area of control of bird infestation, the respondents explained that they need to scare the birds for at least 30 days prior to maturity of the rice grains. This behoves the farmer or the labour employed for this job to be in the farm before the waking up of the birds

around 6.00 am and remain there till evening around 7.00 pm, when the birds go to sleep with routine process of blowing whistle or beating a kind of drum to raise sufficient noise that will drive away the birds. This corroborates the findings of Osabuohien *et al*., (2018) who reported a similar findings and submitted that, the farmer needs many labour to effectively combat the bird infestation challenge which has huge cost implication. Furthermore, 43.3% of the respondents spent more than ₦200,000 on labour in the last production season in the study area. The mean labour cost of ₦206, 173 per production season implies that, the Ofada rice farmers spent a huge amount on labour and could impact negatively on their profit level in the study area.

Determinants of labour use in Ofada rice farming in the study area

Table 3: Determinants of labour use in Ofada rice farming in the study area

Parameter	Exchange Labour	Hired Labour	Family and Hired Labour
Age	-4.352**	3.199***	2.833***
	(2.26)	(0.000)	(2.67)
Sex	0.122	0.588	1.313***
	(0.17)	(0.12)	(2.83)
Marital Status	-2.13	0.645	1.728**
	(0.018)	(0.58)	(2.19)
Household size	0.097	-0.525***	1.289**
	(0.11)	(-3.70)	(2.22)
Education	0.968	0.849	-0.279
	(0.24)	(0.05)	(-0.06)
Farm size	0.740**	2.011**	1.897***
	(2.23)	(2.24)	(3.22)
Experience	-0.153	0.634	0.062
	(0.63)	(0.16)	(0.11)
Income	0.797	1.060***	0.313
	(2.33)	(4.11)	(0.72)
Labour cost	-0.181	-3.070**	0.629
	(-1.28)	(-2.01)	(1.06)
Constant	7.019***	-11.742***	-5.156**
	(2.65)	(-3.98)	(-2.03)

Note: Reference category is family labour, No of observation = 120, LR chi^2 (27) = 161.73, Prob > chi^2 = 0.000, Pseudo R^2 = 0.7228, loglikelihood = -73.809992. Figures in parenthesis are Z-ratios of the coefficients. *** Significant at 1%; ** Significant at 5%

Source: Computed from Field Survey Data, 2019

Multinomial logit result of the determinant of labour use in Ofada rice farming in the study area is presented in Table 3. The diagnostic statistics indicates that; the model has a good fit in assessing the factors that influences Ofada rice farmers' choice of labour type in the study area. The likelihood ratio value of -73.81, statistically significant at 1 % alpha levels indicates that the predictor regression coefficients are significantly different from zero. Also, the high pseudo R squared value of approximately 72% above the McFadden (1979) satisfactory range of 20 to 40% equally confirms that the model has an excellent fit.

The result reveals that age of the Ofada rice farmers had a negative significant relationship with exchange labour at 5% alpha levels while it had a positive significant relationship with hired labour and both family and hired labour at 1% alpha levels respectively. The negative influence of age on the use of exchange labour implies that, the probability that an Ofada rice farmers would use exchange labour on his farm decreases with age. This implies that younger farmers have higher likelihood of using exchange labour compared to family labour in the study area. This is so

because, most of the younger farmers were not married and therefore had limited access to family labour. This is in line with the findings of Anyiro *et al.,* (2013) that younger farmers are more energetic, open and likely to be exposed to new farm methods and techniques. The positive significant influence of age on the use of hired labour and both (family and hired) labour implies that the likelihood that a farmer would use hired labour and both family and hired labour rather than only family labour increases with age. This indicates that a year increase in the age of the Ofada rice farmers will increase the probability of the farmers using hired labour and combination of both family and hired labour by 3.199% and 2.833% respectively. Ofada rice farmers being a male and married positively influence the likelihood of using a combination of both hired and family labour rather than only family labour in the study area. Being a married, male rice farmer increase the probability of having more people to work as family labour, at the same time, labour is hired to augment the short falls of family labour. Household size of the farmers had a negative significant influence on the use of hired labour ($p<0.01$) while it had a positive significant influence on the use of both family and hired labour ($p<0.05$) in the study area. This implies that farmers with small household size were more likely to use hired labour compared to family labour in the study area. On the other hand, farmers with large number of people in their household will probably complement the use of hired labour with family labour which will help them to reduce cost expended in hiring labour in the study area.

The area of land cultivated to Ofada rice production had a positive significant relationship with all the tabulated labour types in the study area. This implies that the probability of using exchange labour ($p<0.05$), hired labour ($p<0.05$), and both family & hired labour ($p<0.05$) increases with farm size, suggesting that farmers with large farm size will prefer to use these labour types rather than only family labour in the study area. An increase in the farm size by 1 hectare would increase the use of exchange labour by 0.740%, hired labour by 2.011% and both family and hired labour by 1.897%. This result corroborates the findings of Agwu *et al.,* (2014) that larger farm sizes have often been associated with higher output and profitability and so farmers will be able to afford the costs associated with the use of these labour types. Furthermore, income earned by the Ofada rice farmers had a positive significant relationship with the use of hired labour at 1% level of probability. This implies that the higher the income of farmers, the higher their economic power and the more the probability of using hired labour compared to family labour in the study area. Finally, labour cost had an inverse significant relationship with hired labour ($P<0.05$) in the study area. This implies that the likelihood that a farmer will hire people to work on his farm decreases with the wage charged by the labour, indicating that, as the labour cost increases, the farmers are more likely to use less of paid labour compared to family labour in the study area.

CONCLUSION

The study investigated the determinants of labour use among Ofada rice farmers in Ewekoro Local Government Area of Ogun State. Results revealed that family, exchange, hired, both family and hired labour were the major types of labour used in Ofada rice production in the study area. This indicates that Ofada rice farming is a highly labour intensive enterprise. The results also revealed that the preference for the use of exchange, hired and both (family and hired) labour compared to only family labour was determined by the age of the farmers, sex, marital status, household size, farm size, income and labour cost in the study area. Therefore, exchange and hired labours should be adequately catered for by the Ofada rice farmers since they are the most readily used labour type in the study area. This could come in form of feeding while working on the farms or good wage rate.

RECOMMENDATIONS

Policies aimed at:

1. Encouraging members of the farming households especially the youths to engage in rice production should be enunciated. This will help reduce the economic burden of hiring labours in the study area.
2. Also, government support that will encourage the Ofada rice farmers to operate at mechanized level of production and provide the technical know-how is earnestly solicited, this will not only ease the economic burden of using paid labours, but it will also reduce the tedious and time consuming nature of manual labour leading to increased Ofada rice production in the study area.

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SMALLHOLDER MAIZE-BASED FARMERS' ACCESS TO ANCHOR BORROWERS' CREDIT IN AKOKO NORTH EAST LOCAL GOVERNMENT AREA OF ONDO STATE, NIGERIA

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ABSTRACT
The persistent reduction in smallholder farmers' access to agricultural credit by formal and informal lending institutions gave rise to this research. The study focused on the smallholder maize-based farmers' access to anchor borrowers' credit in Akoko North East Local Government Area of Ondo State, Nigeria. It specifically described the socio-economic characteristics of the respondents, awareness of necessary conditions, factors and constraints to respondents' access to anchor borrowers' credit in the study area. A two-stage sampling procedure was used for a random selection of 120 smallholder maize-based farmers from six communities in the study area. Primary data were collected through the use of structured questionnaire. Data were analysed using descriptive statistics such as frequency counts, percentages and mean scores while Pearson's Product Correlation and Spearman Rank Correlation were used to make inferences. Results showed that smallholder farmers were aware that cooperative association membership (88.3%) was a fundamental condition for farmers' access to anchor borrowers' credit. Majority (78.3%) of the farmers accessed between ₦100,001 to ₦200,000 with a mean naira equivalence of credit of ₦184,875. Inadequate sensitization ($\bar{x}$ = 4.63) was the most challenging constraint encountered by the farmers. There was a significant and positive relationship ($r = 0.271$, $p \leq 0.001$) between farmers' awareness level of conditions necessary for accessing credit and the constraints encountered by them. The study recommended that farmers should be properly sensitized in time and on regular basis about all the required conditions for easy access to credit for an improved agricultural production and income.

Key words: Access, Credit, Anchor, Borrowers, Smallholder

INTRODUCTION
The term credit is usually emphasized due to its central role in agricultural production. In the view of Asogwa, Abu and Onoche (2014) credit is an essential ingredient necessary for the smooth running of farming operations and plays crucial role in economic development of any nation. Mgbakor, Uzendu and Ndubisi (2014) defined credit as the capacity to borrow, the use of or possessing of fund and services without immediate payment. It can be in form of money borrowed or agricultural incentives. Agricultural credit therefore can be in various forms such as seeds, fertilizer with deferred payment, use of tractors, labour, storage facilities among others. According to Simeon and Ijirshar (2017), credit or loanable fund (capital) is regarded as more than just another resource such as land, labour and equipment, because it determines access to all other resources on which farmers depend. The reason is that farmers' adoption of new technologies necessarily requires the use of some improved inputs, which must be purchased.

Access to credit is the ease or difficulty of acquiring fund by borrowers to enhance business performances (Ajah, Igiri & Ekpenyong, 2017). Credit when judiciously used can significantly improve the quality and quantity of farm produce for an increased farmer's income. Therefore,

credit needs to be accessible for it to be utilized by smallholder farmers to enhance productivity. Farmers' access to credit can be influenced by varying factors such as awareness creation and the prevailing conditions specified by the lending institutions. According to John and Osondu (2015), smallholder farmers are usually not aware of the credit opportunities provided by the various arms of governments and financial institutions. Formal credit institutions are usually not located within the reach of rural farmers due to insufficient dissemination of relevant information by the formal agricultural credit sector. Most credit institutions in Nigeria have complicated, cumbersome and time consuming procedures which delays the approval and untimely disbursement of loans to targeted farmers (Asogwa, Abu & Ochoche, 2014).

Nigerian agricultural sector apparently lies in the hands of smallholder farmers, whose expansion in terms of provision of scale of production is low due to low inputs and low income (Vihi, Nguuma, Sadik & Adedire, 2018). The decline in the Nigerian economy, particularly in the area of agricultural productivity, has often been blamed on lack of credit facilities, which prevented many smallholder farmers from adopting improved practices, since some of them lack the collateral for secure loan or credit from financial institutions (Asogwa et al. 2014). In view of this Vihi, et al. (2018) pointed that the absence of rural banks or their unwillingness to meet credit need of rural farmers largely account for the wide influence of informal lending institutions on agricultural production in the rural areas.

However, in an attempt to tackle the problem of access to agricultural credit by smallholder farmers, the Nigerian government established anchor borrowers programme (ABP). The scheme was designed to create linkage between anchor companies involved in processing and smallholder farmers of required crops such as rice, maize, wheat, cowpea among others. The program thrust of the anchor borrowers is provision of inputs in kind and cash is only released for labour to beneficiaries to boost production of these crops (Central Bank of Nigeria, CBN, 2016). At harvest, the farmer supplies produce to the agro-processor who pays its cash equivalent to the farmers' account at 2-9 percent rate of interest. The lending condition of anchor stipulates that intending beneficiaries must be fully registered members of cooperatives, maintain an FCMB account with a minimum balance of N2,000 (CBN, 2016).

Hence, while previous research efforts focused on the lending operations of other commercial banks, there seems to be little or no work with respect to the anchor borrowing programme particularly in Akoko North East Local Government, Ondo State, Nigeria, therefore, the need for this study. To this end, the study sought to provide answers to the following research questions: are maize farmers actually aware of the conditions necessary for accessing anchor borrowers' credit in Akoko North East Local Government, Ondo State? What are the factors influencing access to anchor borrowers credit by the respondents in the study area? It was in attempt to address these questions that the study was designed to assess smallholder maize-based farmers' access to anchor borrowers' credit in Akoko North East Local Government Area of Ondo State, Nigeria. The specific objectives of the study were to: describe the socio-economic characteristics of smallholder maize-based farmers in Akoko North East Local Government, Ondo State, Nigeria; examine respondents' awareness of necessary conditions for accessing anchor borrowers' credit in the study area; determine factors influencing farmers' access to anchor borrowers credit in the study area and; identify constraints to smallholder maize-based farmers' access to anchor borrowers credit in the study area.

METHODOLOGY

The study was carried out in Akoko North East Local Government Area of Ondo State, Nigeria with the administrative headquarters located in the town of Ikare Akoko. The Local Government Area falls within Longitude 5°38' and 6^0 04' E and Latitude 7°26' and 7^0 42' N and bounded to the North by Akoko North West Local Government Area, to the East by Edo State, the South by Akoko South East Local Government Area and to the West by Ekiti State. It covers a land area of 372km^2 with an estimated population of 241,700 (National Population Committee (NPC), 2016). A two stage sampling procedure was employed in the sampling of 120 smallholder farmers through the use of structured questionnaire. The first stage involved a purposive selection of six (6) communities in Akoko North East Local Government Area of Ondo State based on the significant involvement of smallholder maize-based farmers in the Anchor Borrowers Programme in the area. These included: Ikare, Augba, Ugbe, Iboropa, Ikakumo and Ise. The second stage was a simple random sampling of 20 farmers from each of the selected communities giving a total of 120 smallholder maize-based. Data were analysed using descriptive statistics such as frequency counts, percentages and mean scores while the Pearson's Product Moment Correlation and Spearman Rank correlation analyses were used to draw inferences.

The models are stated below as: **Pearson's Product Moment Correlation**

$$r_{xy} = \frac{\sum xy}{\sqrt{(\sum x^2)(\sum y^2)}} = \frac{\sum(X-\overline{X})(Y-\overline{Y})}{\sqrt{\left[\sum(X-\overline{X})^2\right]\left[\sum(Y-\overline{Y})^2\right]}} \quad \ldots\ldots\ldots\ldots (7)$$

Where:

X = Influencing factors (x_1-x_n)
Y = Access to credit
x = Deviations from the mean of the influencing factors ($X - \overline{X}$)
y = Deviations from the mean of accessed credit ($Y - \overline{Y}$)

Spearman Rank correlation analyses:

$$r_s = 1 - \frac{6 \Sigma D^2}{N(N^2 - 1)}$$

Where:

D = Difference between farmers' awareness level of conditions and the constraints to accessing credit.
N = Number of estimated variables
Σ = Sigma or Summation sign

RESULTS AND DISCUSSION

Socio-economic characteristics of smallholder maize-based farmers in Akoko North East Local Government Area of Ondo State, Nigeria

Distribution of smallholder maize-based farmers according their socio-economic characteristics in the study area is shown in Table 1 below.

Table 1: Socio-economic characteristics of smallholder maize-based farmers in Akoko North East LGA, Ondo State

Variables	Description	Freq.	Perc.	Mean
Age	20 – 30	24	20.0	42.8
	31 – 40	36	30.0	
	41 – 50	28	23.3	
	51 – 60	18	15.0	

	61 – 70	14	11.7	
Sex	Male	86	71.7	
	Female	34	28.3	
	Married	92	76.7	
Marital Status	Single	25	20.8	
	Divorced	3	2.5	
	1 – 4	50	41.7	
Household size	5 – 8	58	48.3	5
	9 – 12	12	10.0	
	0.1 - .5	4	3.3	
Farm Size	0.6 - 1.5	49	40.8	1.9
	1.6 - 2.5	49	40.8	
	2.6 - 3.5	18	15.0	
	No Formal Education	12	10.0	
Level of Education	Primary Education	12	10.0	
	Secondary Education	36	30.0	
	Tertiary Education	60	50.0	
Cooperative membership	Yes	112	93.3	
	No	8	6.7	
Extension Contact	Yes	119	99.2	
	No	1	0.8	
Naira Equivalence of Credit Accessed	100001 – 200000	94	78.3	
	200001 – 400000	24	20.0	184875.00
	400001 – 600000	2	1.6	

Source: Field survey, 2019

Result presented Table 1 shows that majority (71.7%) of the smallholder maize farmers were males within the mean age of 43 years. The result suggests that more young men had access to anchor credits than women in the study area. This result compares well with the finding of Magesa, Michael and Ko (2020) where majority of respondents who had access to marketing information were male between 18 to 43 years of age. Result further shows that majority (76.7%) of the respondents were married with a mean household size of 5 persons. Balarane and Oladele (2012) pointed that marital status and household size are economic indicators of additional farm labour, though might pose negative effect on the farm income.

Most (90.0%) of the respondents had one form of formal educational attainment or another as well as members of cooperative associations (93.3%) which is necessary for informed decision making for successful access and utilization of credits. Agbarevo and Obinne (2010) education enhances the farmer's ability to effectively keep records, develop feasibility reports and other requirements contingent to the acquisition of bank credit. However, Bruni and Santucci (2017) noted that formally established cooperatives can guarantee to their members access to credit, markets and short-term inputs. Result further shows that most (99.2%) of the farmers had contact with extension worker. This high level of extension contact is expected to increase the respondents' chances of obtaining bank credit. According to Kahan (2013) apart from the dissemination of technical information on production practices, extension workers can facilitate farmers' contacts with banks and ensuring that borrowed funds are judiciously managed.

However, the result shows that majority (78.3%) of the farmers accessed between ₦100,001 to ₦200,000 with a mean naira equivalence of credit ₦184,875 accessed by them. By implication every beneficiaries of the anchor credit had access to at least ₦180,000.00 worth of inputs including labour cost. According to CBN (2016) the anchor programme supplies inputs in kind and cash is only released for labour to the benefitting farmers to boost crop production. Hence,

this result similar to the range of credit facility by the Lift Above Poverty Organization (LAPO, 2016) which offers between ₦50,000.00 to ₦500,000.00 loan to its loan beneficiaries for a repayment duration of 1 to 12 months.

Awareness of the conditions necessary for accessing anchor borrowers' credit in Akoko North East LGA, Ondo State.

Presented below were the respondents' awareness of the conditions necessary for accessing anchor borrowers' credit in the study area.

Table 2: Awareness of the conditions necessary for accessing anchor borrowers' credit in the study area.

	Not Aware		Aware	
Necessary Conditions for access to credit	**Freq.**	**Perc.**	**Freq.**	**Perc.**
Organize themselves into groups/cooperatives	14	11.7	106	88.3
Cross guarantee one another	21	17.5	99	82.5
Utilize the facility (kind and cash) for the purpose for which it was granted	24	20.0	96	80.0
Ready to abide by the terms of agreement and not to side sell produce	23	19.2	97	80.8
Must possess capacity to pay back by demonstrating evidence of farm ownership/lease/rent	23	19.2	97	80.8
Repay the loan as and when due by surrendering the output to the Anchor or State	26	21.7	94	78.3
Provide equity contribution in cash of minimum of 5 per cent of loan amount (a form of collateral)	42	35.0	78	65.0
Representative of the Small-scale Farmer association to serve on the PMT	52	43.3	68	56.7
Ensure participating member open bank account and obtain Bank Verification Number (BVN)	19	15.8	101	84.2
Agree to work with extension workers	18	15.0	102	85.0
Must be ready to borrow at 2-9 percent interest rate	30	25.0	90	75.0

Source: Field survey, 2019

Table 2 shows that most (88.3%) of the farmers were aware of organizing themselves into groups/cooperatives in order to the access anchor borrowers' credit, while only 11.7% of the respondents were not aware. This was closely followed by "agree to work with extension workers (85.0%)" and "ensure participating member open bank account and obtain Bank Verification Number (BVN) (84.2%)" respectively. By implication, the result suggests that most of the smallholder maize farmers are well informed about the benefits of identifying with formal group such as cooperatives and extension workers as pre-conditions for acquiring loans from financial institutions. According to Agbarevo and Obinne (2010), through cooperative efforts, farmers can easily access loans by attracting favourable government policies with the assistance of agricultural extension workers than the individual farmers. Again, smallholder farmers were significantly awareness of the Bank Verification Number (BVN) as requirement for loan acquisition from the government in the study area. This according to the Central Bank of Nigeria (CBN, 2019), the bank verification number is a biometric identification system to curb illegal banking transactions in Nigeria. With the BVN, banks can easily track customers' history with other banks to ascertain their borrowing credibility and to discourage the cases of loan defaulters from accessing credit.

Determinants of factors influencing respondents' access to anchor borrowers' credit in the study area.

Shown below were the determinants of factors influencing respondents' access to anchor borrowers' credit in the study area.

Table 3: Factors influencing respondents' access to anchor borrowers' credit in the study area.

Independent variables	Coefficient	P-value
Level of Education	0.348**	0.000
Cooperative membership	-0.080	0.388
Extension Contact	0.228*	0.012
Age	-0.348**	0.000
Household size	0.243**	0.007
Years of experience	0.41	0.656
Farm Size	0.243**	0.007
Naira Equivalence of credit	-0.376**	0.000
Farm income	0.104	0.259
Non farm income	-0.201	0.051

Source: Field survey, 2019**; **. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The result in Table 3 shows that smallholder farmers' level of education ($r = 0.348$, $p \leq 0.001$), extension contact ($r = 0.228$, $p \leq 0.005$), household size ($r = 0.243$, $p \leq 0.001$), farm size ($r = 0.243$, $p \leq 0.001$) were significant and positively influenced their access to anchor borrowers credit. It therefore suggests that the identified variables were the significant predictors of the respondents' access to credit in the study area. By implication, an increase in any of these variables leads to a corresponding increase in their chances of getting access to credit in Akoko North East Local Government Area of Ondo State. This result in consistent with the findings of Assogba *et al.,* (2017) as well as Moahid and Maharjan (2020) were significant determinants of small scale farmers' access to credit. However, age ($r = -0.348$, $p \leq 0.001$) and naira equivalence of borrowed credit ($r = -0.376$, $p \leq 0.001$) were significant and negatively influenced the respondents' access to anchor borrowers credit in the study area. This implies that an increase in any of these variables will result in a decrease in the respondents' chances of having access to credit from the scheme and agrees with the findings of Saqib, Kuwornu, Panezia and Ali (2018) where age and income significantly influenced farmers' access to agricultural credit.

Constraints to smallholder farmers' access to anchor borrowers credit in the study area

Presented below were the constraints encountered by the respondents in the study area.

Table 4: Constraints to smallholder farmers' access to anchor borrowers credit in the study area

	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree			
Influencing Factors	**Freq.**	**Perc.**	**Freq.**	**Perc.**	**Freq.**	**Perc.**	**Freq.**	**Perc.**	**Freq.**	**Perc.**	**Mean**	**Rank**
Inadequate sensitization	0	0.0	0	0.0	5	4.2	35	29.2	80	66.7	4.63*	1st
Poor extension services delivery	0	0.0	1	0.8	4	3.3	66	55.0	49	40.8	4.36*	2nd
Non-membership of associations	1	0.8	2	1.7	7	5.8	63	52.5	47	39.2	4.28*	3rd
Bureaucratic disbursement process	0	0.0	3	2.5	14	11.7	58	48.3	45	37.5	4.21*	4th
High interest rate	2	1.7	1	0.8	13	10.8	64	53.3	40	33.3	4.16*	5th
Stringent repayment conditions	0	0.0	4	3.3	12	10.0	66	55.0	38	31.7	4.15*	6th

Limited farm size	0	0.0	7	5.9	12	10.1	57	47.9	43	36.1	4.14*	7th
Attitudes of disbursing staff	1	0.8	5	4.2	18	15.0	64	53.3	32	26.7	4.01*	8th
Distance to disbursement centres	2	1.7	8	6.7	17	14.2	56	46.7	37	30.8	3.98*	9th

*Significant Mean: x≥3.0

Source: Field survey, 2019

Table 4 shows that inadequate sensitization was prominent ($\bar{x}$ = 4.63) among constraints encountered by smallholder maize farmers in Akoko North East LGA and therefore ranked first position (1st). Next in the ranking were poor extension services delivery ($\bar{x}$ = 4.36), non-membership of associations ($\bar{x}$ = 4.28), Bureaucratic disbursement process ($\bar{x}$ = 4.21), high interest rate ($\bar{x}$ = 4.16), stringent repayment conditions ($\bar{x}$ = 4.15), Limited farm size ($\bar{x}$ = 4.14), Attitudes of disbursing staff ($\bar{x}$ = 4.01), and distance to disbursement centres ($\bar{x}$ = 3.98). This result implies that farmers' access to credit was seriously hindered by inadequate sensitization in the study area. Sabi'u (2019) posited that sensitization is very important in farming. This is because it is vital tool for awareness creation and farmers' education on how to plan their farms from the beginning of the season up to harvest without encountering problems.

Relationship between respondents' awareness level and constraints to accessing credit in Akoko North East Local Government Area of Ondo State, Nigeria

Table 5: Relationship between respondents' awareness level of conditions and the constraints to accessing credit in the study area

Variable	Coefficient (r)	t – ratio	P – value
Awareness	-0.271**	-3.0580	(p<0.001)

Source: Field Survey, 2019; ***** Significant at 1% Level***

Result presented in Table 5 shows a significant and negative relationship (r = -0.271, p≤0.001) between smallholder famers awareness level and constraint to accessing credit in the study area. This implies that the more the respondents' awareness of conditions necessary for borrowing credit, the lesser the constraints encountered when accessing credit. According to Agbarevo and Obinne (2010), awareness is the first stage in adoption process and provides the platform for the farmer to learn about the existence of an innovation. Therefore, for the farmers should be provided with useful knowledge and conditions that will assist them for easy access to credit and effective decision making in farm business.

CONCLUSION

The study showed that smallholder maize-based farmers were prominently aware that cooperative association membership was a fundamental condition necessary for individual's access to anchor borrowers' credit. The average naira equivalence of credit accessed by each smallholder farmer was ₦184,875.00. It was found that farmers' level of education, extension contact, household size, farm size among other variables were significantly influenced respondents' access to anchor borrowers credit. Inadequate sensitization was the most challenging constraint encountered by the respondents. On the other hand, the spearman rank correlation established that there was a significant and positive relationship between smallholder maize-based farmers' awareness level of conditions and the constraints to accessing credit in the study area.

RECOMMENDATIONS

Based on the foregoing conclusion, the study recommended that:

Farmers should be properly sensitized in time and regular basis about all the required conditions for easy access to credit for an improved agricultural production and income generation.

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SOCIO ECONOMIC DETERMINANTS OF RICE FARMERS' CLIMATE CHANGE ADAPTATION STRATEGIES IN ANAMBRA STATE, NIGERIA

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ABSTRACT
The study assessed the socioeconomic determinants of climate change adaptation strategies used by rice farmers in Anambra State, Nigeria. Two-stage sampling technique was used to select 71 key rice farmers for the study. Collection of data was done using structured questionnaire complemented with interview schedule and analyzed using descriptive statistics. Ordinary least square regression analysis was used to test the hypothesis. Application of chemical fertilizers (99%), pesticides (92%) and herbicides (85%), treatment of seeds (86%) and the use of stress tolerant varieties (80%) were the major climate change adaptation strategies while lack of access to credit source ($\bar{x}$ =3.92), high cost of improved rice varieties ($\bar{x}$ =3.41), lack of access to supporting institutional facilities ($\bar{x}$ =3.37), high cost of irrigation facilities($\bar{x}$ =3.33), lack of access to weather forecast technologies ($\bar{x}$ =3.10), poor access to and control of land ($\bar{x}$ =3.06) were the major constraints faced by rice farmers in adapting to climate change in the study area. There were significant relationships between rice farmers age (0.056, P≤0.01), farming experience (0.399, P≤0.01), farm size (0.318, P≤0.05) monthly income (0.453, P≤0.01), level of education (0.476, P≤0.01) and the climate change adaptation strategies they utilized. The study recommended that extension agents should implement field-based teaching methods and practices to facilitate the building of knowledge and skills in rice farmers as well as develop strategies with appropriate resources to address the needs of rice farmers in the study area.

INTRODUCTION
The agricultural sector contributes significantly to the Nigerian economy. The sector employs over 60% of the country's population and contributing substantially to the nation Gross Domestic Product (GDP) (Food and Agriculture Organisation, Nigeria at a glance). Despite the over emphasis on the oil sector of the country, the agricultural sector plays major role in sustaining the nation's economy. Agricultural production in most developing nations of the world like Nigeria is dominated by crude and indigenous practices and technologies reducing its potential to maximally produce and impact food security as expected. This dependence on crude practices heightened by low infrastructural capacity of farmers also reduce farmer's capacity to adapt their agricultural activities to the change in climate. Climate change constitutes major challenge experienced not only in agricultural production but in almost every sector of economy. The African continent is vulnerable to climate change as a result of its physical and socio-economic characteristics comprising of its low capacity to adapt and other multiple stressors (Intergovernmental Panel on Climate Change (IPCC), 2007). Agricultural production is estimated to decline severely by the year 2020 hence adversely impacting food security.

African climate will become more variable and extreme weather events more frequent threatening health and life (United Nations Framework Convention on Climate Change (UNFCCC), 2007).

Specifically, in Nigeria, climate variation heightens and impacts becomes more conspicuous. Irregularity in rainfall, reduced rainfall, increased temperature, increased intensity and prolonged drought are already being experienced in the country (Enete &Amusa, 2010; Onyeneke & Madukwe, 2010; Akinbami, Ifeanyi-obi, Appiah & Kabo-Bah, 2016; Ifeanyi-obi & Togun, 2017; Ifeanyi-obi, Togun, Lamboll & Arokoyu, 2017). Continuation in variation of climate index will intensify risks and threats associated with climate change, this will cut across different crops and categories of farmers (Nigeria Meteorological Agency (NIMET), 2010, 2012). Different varieties of crops are grown and consumed in the country with some in very large quantity hence constitutes staple foods in the country. Rice is a globally cultivated crop and has contributed immensely to global food security (Ajah & Ajah, 2014). Its possession of upland and lowland varieties makes it able to grow in both flooded and non- flooded areas (Philips, Kehinde & Ganiyu, 2006).

In Nigeria, rice remains an important crop to many households. It is one of the major foods mostly consumed by many families in the country maybe as a result of its preference by youths and children as well as its ability to be prepared in a variety of ways. It also constitutes a major food component served in almost every occasion in the country. Nigeria is known to be one of the countries with potentials to produce rice in large quantity (Idoma, Ikpe, Ejeh & Mamman, 2017). This may be associated with the suitability of her agricultural land for rice production. But it is worrisome to note that despite the potential of Nigeria to produce rice in large quantity, the country has not been able to meet the rice demand of the populace leading to increase in the country's importation of rice. The Agricultural Promotion Policy (APP)(2016-2020) in reporting the achievement of the Agricultural Transformation Agenda (ATA) quoted the domestic rice demand in Nigeria to be 6.3million tons while supply is 2.3million tons. This shows the important need to enhance rice production in Nigeria. Various factors including climate change constitute significant hindrance to rice production. An understanding of climate change impacts and how rice farmers can successfully adapt their farming activities to these changes is crucial. Several studies have assessed climate change impacts as well as identified adaptation strategies that can be used by farmers (Abu, Pur & Ogunbameru, 2011; Hassan, 2014; Ifeanyi-obi, Asiabaka and Adesope, 2014; Aja, Ani, Mathews-Njoku and Ifeanyi-obi, 2015; Ifeanyi-obi & Togun, 2017; Ifeanyi-obi, Togun, Lamboll & Arokoyu, 2017). These studies fail to take cognisance of the factors that could influence farmers adaptation decisions. It is important to understand these factors so as to make informed decisions in climate change adaptation issues both on the side of the farmers and intervention agencies. In addition, the determinants of climate change adaptation strategies used by rice farmers in Nigeria has not been extensively studied. This study seeks to close this gap.

It is against this background that this study assessed the socio-economic determinants of climate change adaptation strategies used by rice farmers in Anambra State, Nigeria. Specifically, it described the socio-economic characteristics of the rice farmers in the study area, determined the climate change adaptation strategies used by the rice farmers and identified constraints faced by rice farmers in adapting to climate change in the study area.

Hypothesis of the study

H_{o1}: There is no significant relationship between rice farmer's socio-economic characteristics and the climate change adaptation strategies they use.

Theoretical and conceptual framework

This research project is based on the theory of Environmentally Responsible Behaviour (ERB) which was proposed by Hines, Hungerford and Tomera (Akintunde, 2017). The model noted that for one to act in an environmentally friendly way, there must be an intention to act. It proposes five major factors to influence environmental responsible behaviour namely; intention to act, locus of control (an internalized sense of personal control over the events in one's own life), attitudes, sense of personal responsibility, and knowledge. This research recognizes that rice farmers are already experiencing the effects of climate change and as such possess the intention to act (adapt to climate change). Their ability to act responsibly will be determined by various factors including their socio-economic characteristics. The research intends to determine the socio-economic characteristics of rice farmers that will affect their climate change adaptation decisions with the intent of properly informing intervention programmes. Identifying these determining factors will better position policy makers and intervention agencies to develop programmes and intervention packages that will effectively address the rice farmers needs hence build their knowledge, attitude and sense of responsibility to adapt to climate change in an environmentally friendly manner.

The conceptual framework is based on the premise that the socio-economic characteristics of rice farmers affects their capacity to adapt successfully to climate change. It conceptualized that in adapting to climate change, varying factors affects rice farmers capacity to adapt. The conceptualization assumes that relationship between the dependent (climate change adaptation strategies) and independent variables (socio-economic characteristics) is strong, but a weak relationship exists between the intervening variables (availability of recreational facilities, church denomination membership etc.) and the independent variables.

METHODOLOGY

This study was conducted in Ayamelum Local Government Area of Anambra State, which is the major rice producing zone in Anambra State. Anambra state is divided into 20 Local Government Areas and is situated in the South East Geopolitical Zone of Nigeria. It has an annual rainfall which is high, ranging from 1,400mm in the north to 2,500mm in the south. The state is one of the most densely populated states in Nigeria according to the 1991 National Population Census; the State has a total population of 2,796,475 in a land area of 4,416 sq. km (Online Nigeria, 2018). Ayamelum is a Local Government Area of Anambra State with its Headquarters situated in Anaku and it shares boundaries with Kogi State to the north, Enugu State to the east, Imo, Abia and Rivers states to the south, and Delta and Edo state to the west. Towns that make up Ayamelum local government are Omor, Umueje, Omasi, Igbakwu, Umumbo, Anaku, Umuerum, IfiteOgwari. The major agro raw materials in the Local Government are rice, yam, cassava, maize, cocoyam, melon, fruits as well as other natural resources like clay and kaolin (Raw Materials and Research Development Council RMRDC, 2012).

The population of the study comprised all the rice farmers in Ayamelum local government area of Anambra state. Two - stage sampling procedure was used to select sample for the study. The first stage was the purposive selection of three communities namely; Umumbo, Ifite-ogwari and Omor from the eight communities in the Local Government Area. These are the major producers of rice in the local government. The second stage comprised the development of the list of all rice farmers in the three selected communities using snowballing approach, from this list, a total of 71 rice farmers was randomly selected for the study. The instrument for data collection was structured questionnaire for rice farmers which was also used to interview non literate farmers. Climate change adaptation strategies used by rice farmers and constraints to adaptation were captured using a 14- item statements and 12-item statements respectively rated on a four-point scale with values of strongly agree = 4; agree = 3; disagree = 2; strongly disagree = 1. A midpoint of 2.50 was obtained and based on this, decision rule was that any mean score greater than or equal to 2.50 implies agreement with the statement, and any mean score less than 2.50 implies disagreement with the statement. The data collected from the study were described using descriptive statistical tools namely; mean, frequency and percentages while the hypothesis was tested using Ordinary Least Square Multiple Regression analysis.

Model Specification for the Ordinary Least Square Regression Analysis

The model is implicitly stated as follows:

The OLS regression model that was used is implicitly stated as: $Ya = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, e)$

Where Y_a = Pooled index of adaptation strategies used (based on statements measured on 4-point Likert- type rating scale of Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree =1)

X_1= Age (measured in years)

X_2 = Marital status (Dummy variable, single = 0, married = 1)

X_3= Level of education (Number of years spent in school)

X_4 = Farming experience (Measured in years)

X_5 = Household size (Number of persons per household)

X_6= Major occupation (Dummy variable, farming = 1, non-farming = 0)

X_7= Farm size (measured in hectares)

X_8= Monthly income (measured in Naira)

X_9 = Major aim of production (measured on a three point- Likert type scale of; sale = 1, consumption = 2, both = 3)

e = error term

It is expected *a priori* that the coefficients of $X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9 > 0$

Four functional forms of the model namely linear, double log, exponential and semi-log was estimated. A lead equation was chosen based on the appropriateness of signs, magnitude of coefficient of multiple determinations (R^2), statistical significance of the variables and a priori theoretical expectations.

Linear: $Y= B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + e$

Semi-Log: $Y= B_0 + B_1 \log X_1 + B_2 \log X_2 + B_3 \log X_3 + B_4 \log X_4 + B_5 \log X_5 + B_6 \log X_6 + B_7 \log X_7 + B_8 \log X_8 + B_9 \log X_9 + e$

Exponential: $\log Y=B_0 +B_1X_1 +B_2X_2 +B_3X_3 +B_4X_4 +B_5X_5 +B_6X_6 +B_7X_7 +B_8X_8 +B_9X_9 + e$

Double Log: log $Y=B_0 +B_1 \log X_1 +B_2 \log X_2 +B_3 \log X_3 +B_4 \log X_4 +B_5 \log X_5 +B_6 \log X_6 +B_7 \log X_7 + B_8 \log X_8 + B_9 1\log X_9 + e$

Bo = intercept

$B_1, B_2...B_{11}$ = estimated coefficients

e = error term

RESULTS AND DISCUSSION

Socio-economic characteristics of rice farmers

Table 1: Socio-Economic characteristics of rice farmers in the study area

Variable	Frequency n=15	Percentage (%)	Mean
Sex			
Male	64	90.00	
Female	7	9.90	
Age			
≤ 20	4	5.60	39.30years
21-30	14	19.60	
31-40	25	35.20	
41-50	15	21.00	
51-60	8	11.20	
61 and above	7	7.00	
Marital status			-
Single	15	21.10	
Married	56	79.00	
Household size			
1-3	2	3.20	6 persons
4-6	36	58.10	
7-9	17	27.40	
Above 9	7	11.30	
Highest level of education attained			-
No formal education	2	2.80	
Primary	20	28.20	
Secondary	40	56.00	
Tertiary	7	10.00	
Farming Experience			-
1-5years	5	7.20	
6-10years	14	20.30	
11years & above	50	73.00	
Size of farm(plots)			
1-10	65	95.60	5.56
11-20	1	1.50	
21-30	1	1.50	
31-40	-	-	
41 and above	1	1.50	
Type of cropping system			-
Mono-cropping	28	39.40	
Mixed cropping	43	61.00	
Main aim of producing rice			-
Sale	9	12.90	
Consumption	-	-	
Both sale & consumption	61	87.00	

Income at the end of every planting season			
≤ 500,000	32	42.40	₦1232575.76
501,000-1000000	15	22.70	
1,001,000-1,500,000	6	9.00	
1,501,000-2,000,000	6	9.00	
2,001,000-2,500,000	1	1.50	
2,501,000-3,000,000	1	1.50	
>3,000,000	5	7.50	
Do extension agents visit your farm?	34	48	-
How often do they visit if your answer is yes?			-
Frequently	15	44.00	
Occasionally	13	56.00	
Rarely	6	17.60	

Source: Field Survey Data, 2018

The result in Table 1 showed that 90% of the farmers were males with 79% married. The rice farmers had a mean household size of 6 persons, which means that the farmers maintained an average family size and may need additional labour during planting seasons. Majority (66%) of the rice farmers had at least secondary school education which shows that they were relatively literate enough to understand the vagaries of climate change and corresponding adaptation strategies. Onubuogu and Esiobu (2014) reported that educated farmers are better informed and are more likely to be aware of climate change and its adaptation strategies. Also, it was shown that 73% of the farmers had more than 11years of farming experience which is an indication that the farmers must have farmed long enough to have acquired indigenous knowledge that helps them farm efficiently as well as adapt successfully to climate change. The result further showed that 61% of the farmers practiced mixed cropping to boost their income as well as guide against loss in any particular crop. Majority (87%) of the farmers had their major aim of production to be for both sale and consumption whereby the farmers had a mean farm size of 5.56plots and a mean income ₦1,232,575 at the end of every planting season (annually). This is an indication that the rice farmers cultivate at a commercial scale. Only 48% of the rice farmers had been visited by Extension agents with 44% being visited frequently while the remaining 56% were occasionally visited. This could be as a result of insufficient number of agricultural extension agents in the country as well as transportation constraints faced in the study area. Agricultural extension agents are key to innovation dissemination as they are in charge of agricultural information dissemination hence efforts to increase their frequency of visit must be a priority for the adaptive capacity of rice farmers to be enhanced.

Climate change adaptation strategies used by rice farmers

Table 2: Climate change adaptation strategies used by rice farmers in the study area

S/N	Variable	Mean	Standard Deviation
1	Use of stress tolerant varieties	3.18*	0.9
2	Cultivation of short duration rice	2.97*	0.6
3	Water management techniques (irrigation techniques)	2.10**	0.7
4	Changing of planting date	2.61*	0.5

5	Changing of harvesting date	2.61*	0.8
6	Rice species diversification	2.21**	0.7
7	Treatment of seeds before planting	3.30*	0.8
8	Application of pesticides	3.33*	0.9
9	Application of herbicides	3.21*	0.8
10	Practice of Agro-forestry	1.32**	0.5
11	Other cropping systems such as crop rotation, mulching, mixed cropping	2.41**	0.6
12	Chemical Fertilizers	3.42*	0.7
13	Increase of farm land	2.93*	0.7
14	Crop diversification (cultivating other crops in case of rice failure)	2.86*	0.5
15	Livelihood diversification (engaging in non-farming activities in case of rice failure	2.71*	0.7

Source: Field Survey Data, 2018: *means agreement ** means disagreement

The results in Table 2 shows that application of chemical fertilizers ($\bar{x}$ *=3.42*), application of pesticides ($\bar{x}$ =3.33), treatment of seeds ($\bar{x}$ =3.30), application of herbicides ($\bar{x}$ =3.21) and the use of stress tolerant varieties ($\bar{x}$ =3.18) were the major climate change adaptation strategies adopted by the rice farmers in the study area. The increased use of chemical fertilizers and herbicides and pesticides in the area as a climate change adaptation strategy could be as a result of government direct access to the farmers in distributing subsidized fertilizers rather than using intermediaries to distribute them. Also, the existence of commercial agricultural extension delivery system in the zone who distribute these chemicals may contribute to the high use of chemicals in planting rice in the zone.

However, it is worthy to note that, in some cases what seems to be good adaptation strategies may negatively impact on their environment in the long term (Adger, *et al*., 2005; Eriksen *et al.,* 2010), therefore it may be necessary to assess the use of these chemicals by rice farmers in the zone to ensure it is safely used. Use of improved rice varieties like the stress tolerant variety has been known to be effective in coping with the climate change risks. Kawasaki and Herath (2011) noted that improved rice variety such as Jasmine rice variety and RD 12 have high capacities for coping with climate change, such varieties according to them can survive in submerged water for up to 20 days. With the study area known for flooding, such improved variety could go a long way in helping them cope with the risk of flooding. Also the results showed that respondents adopted cultivation of short duration rice ($\bar{x}$ =2.97), increase of farm land ($\bar{x}$ =2.93), crop diversification (cultivating other crops in case of rice failure) ($\bar{x}$ =2.86), changing of planting and harvesting dates ($\bar{x}$ =2.61), livelihood diversification (engaging in non-farming activities in case of rice failure) ($\bar{x}$ =2.71). This result is in consonance with Idoma, Ikpe, Ejeh and Mamman, (2017) which identified rice farmers climate change adaptation strategies in Benue state to include use of climate tolerant varieties, early planting of rice, diversification of livelihoods and application of chemical fertilizers.

Constraints faced by rice farmers in climate change adaptation

Table 3: Constraints rice farmers faced in adapting to climate change

S/N	Variable	Mean	Standard Deviation
1	Insufficient knowledge of credit source.	2.63*	1.4
2	High cost of improved rice varieties.	3.41*	1.6
3	Lack of access to weather forecast technologies.	3.10*	1.2

4	High cost of irrigation facilities.	3.33*	1.4
5	Lack of access to supporting institutional facilities.	3.37*	1.5
6	Poor agricultural extension service delivery on climate change adaptation.	2.90*	0.8
7	Unavailability of farm labor.	1.92**	0.5
8	Inadequate government policies to empower rice farmers.	3.26*	0.9
9	Lack of access to credit source	3.92*	1.4
10	Tedious nature of climate change adaptation strategies.	1.96**	0.5
11	Traditional beliefs against adaptation e.g. on the commencement of farming season or crop festival period.	1.53**	0.6
12	Poor access to climate change adaptation strategies to climate change information by rice farmers.	2.90*	0.9
13	Inadequate training to acquire knowledge and skills on rice production.	2.92*	1.2
14	Poor access to and control of land.	3.06*	1.6

Source: Field Survey Data, 2018: *means agreement, ** means disagreement

Table 3 shows that the major constraints faced by the rice farmers in climate change adaptation were; lack of access to credit source ($\bar{x}$ =3.92), high cost of improved rice varieties ($\bar{x}$ =3.41), lack of access to supporting institutional facilities ($\bar{x}$ =3.37), high cost of irrigation facilities($\bar{x}$ =3.33), lack of access to weather forecast technologies ($\bar{x}$ =3.10), poor access to and control of land ($\bar{x}$ =3.06). This showed that the rice farmers faced significant challenges while trying to adapt to climate change. During the interview in the course of data collection, farmers complained of the difficulties they faced in trying to access credit facilities from banks and other financial institution. According to them, farmers at their level cannot afford the level of collateral required by these financial institutions. As regards improved varieties, it was observed that most of the improved varieties of rice are being provided by commercial agricultural extension systems in the area making it expensive for farmers to procure. Institutional facilities like weather forecast technologies were completely lacking in the area making it difficult for farmers to access weather information on timely basis. Eisenack & Stecker (2010) posited that public access to early warning information is an important factor affecting adaptation to climate change. When farmers have the timely information on weather, it helps them avert some losses as a result of climate change.

Test of Hypothesis

Table 4. Ordinary least square regression result showing the relationship between the socio-economic characteristics of rice farmers and the climate change adaptation strategies used.

Variable	**Functional forms**			
	Linear	**Semi-log**	**Double log**	**Exponential**
Constant	23.576***	49..402***	.478***	.338***
	(6.231)	(4.271)	(9.823)	(19.434)
Age	.478***	.0558***	.0549***	.0323
	(7.833)	(5.576)	(5.733)	(.2991)
Marital status	0.296	0.0263	0.007	0.012
	(0.424)	(0.430)	(0.421)	(0.396)
Household size	.185	-.217	-.161	.159
	(1.621)	(-1.833)	(-1.542)	(1.434)

Farming experience	.283**	.3989***	.259**	.244**
	(5.731)	(6.122)	(4.273)	(4.151)
Farm size	.1554**	.3176**	-0.023*	-0.034
	(2.266)	(5.131)	(-1.063)	(-1.153)
Monthly income	.209***	.453***	.180**	.194**
	(5.467)	(6.445)	(3.432)	(3.777)
Level of education	.502***	.476***	.411**	.329**
	(6.271)	(5.463)	(4.998)	(2.111)
R^2	**0.628**	**0.725**	**0.584**	**0.545**
F-Stat	**10.211**	**10.895**	**8.342**	**8.161**
Prob	**0.000**	**0.000**	**0.000**	**0.000**

*****P≤0.01; **P≤0.05**

Table 4 shows the result from Ordinary Least Square regression analysis to determine the relationship between the rice farmers' socio-economic characteristics and the climate change adaptation strategies used. Semi-log functional form was chosen as the lead equation based on the high value of R^2, number of significant coefficients, appropriateness of signs and highest F-value.

The coefficient of multiple determination (R^2) value of 0.725 indicates that about 72% of the variation in the climate change adaptation strategies used by rice farmers could be explained by the explanatory variables while the remaining 28% was due to other factors not specified in the model. The F-value of 10.895 was significant at both 5% and 10% level.

Out of the seven variables that were used for the analysis, five [age (0.056, P≤0.01), farming experience (0.399, P≤0.01), farm size (0.318,P≤0.05) monthly income (0.453, P≤0.01), level of education(0.476, P≤0.01)] correlated positively and significantly with the climate change adaptation strategies used by rice farmers in the study area.

Farmers' age could be seen to correlate positively with the climate change adaptation strategies used by rice farmers in the study area. This could imply that the older farmers are expected to have farmed long enough to understand better the intricacies of climate change hence adapt better to it. As regards level of education, more educated farmers are known to possess more skill and knowledge to tackle challenges, adopt new technologies and adapt to changing environment. Higher monthly income and large farm size could improve a farmer's financial status hence equips them better to adopt practices and technologies that could help them effectively adapt to climate change.

Increased farming experience could also impact the experience of the farmers positively hence adoption of improved climate change adaptation strategies.

Socio-economic variables have been noted to be one of the major factors influencing farmers adaptation decision to climate change. Hoa Le Dang, Elton Li, Ian Nuberg and Johan Bruwer, (2019) in a systematic review of 47 empirical studies on factors influencing climate change adaptation identified socio-economic factors as one major influencer of farmers adaptation decision. They noted that farm household characteristics is a major determinant of farmer's decision to adapt as well as their choice of adaptation strategy to use. In more specific terms and in line with the results of this study, Mohammed, Bokelmann and Entsminger (2014) in their study

of Factors affecting Farmers' Adaptation Strategies to Environmental Degradation and Climate Change effects in Bangladesh identified age, educational level, family size, family income, farm size and membership of cooperative society to be the major factors influencing farmers adaptation decision.

Similarly, Enimu and Onome (2018) identified eleven socio-economic variables as the determinants of climate change adaptation decision among farmers in Delta state. This include age, educational level, family size, family income, gender, farming experience, access to weather information, access to extension services, access to credit facilities, farm size and membership of cooperative society.

CONCLUSION

This study concludes that rice farmers in Ayamelum Local Government area of Anambra State are not only aware of climate change but are experiencing its effects and as such making conscientious effort to adapt to this change in climate. It observed that some of the adaptation measures used particularly increased use of chemicals like herbicides and pesticides may have long term negative effects on the soil and environment. Rice farmers are experiencing varying constraints in their adaptation efforts ranging from lack of access to credit facilities, high cost of improved rice varieties to lack of institutional facilities. This hampers their ability to effectively adapt their rice farming to climate change.

RECOMMENDATIONS.

Based on the findings of the study, it was recommended that:

1. There is need for increased government agricultural extension services in the area to help farmers access necessary information and services at a reduced cost.

2. Use of chemicals for planting, pests and weed control should be checked by government to ensure safety of environment as well as farm produce. More environmentally sustainable farm management practices should be encouraged by the agricultural extension services.

3.There is also an urgent need for government to provide basic infrastructural facilities like irrigation system, meteorological station etc. that could enhance farmers' adaptive capacity.

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DETERMINANTS OF SMALLHOLDER *'GARRI'* PROCESSORS RESPONSE TO COVID-19 IN ETCHE LOCAL GOVERNMENT AREA, RIVERS STATE, NIGERIA

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ABSTRACT
The study assessed the Determinants of smallholder 'garri' processors' Response to Covid-19in Etche Local Government Area of Rivers State, Nigeria. Multi-stage sampling procedure was used to select 100 respondents. Data for the study were obtained with the aid of structured questionnaire and analyzed using descriptive statistics and bivariate logistic regression model. Results revealed that, 70% of the garri processors are mostly females while most respondents (48%) falls between ages range of 25-54 years.Also, 59% are married and 41% had primary school education, while their average year of experience of garri processors was 25 years. With 50% having 4-6 household size and43% had a farm income of ₦200000 to ₦600000 annually with45% engaged in fishing activities as an additional source ofincome. The bivariate logistic model results revealed that the probability of respondent's, responding to covid-19 increases with their age with a positive coefficient of (0.021546). The probability of respondents, responding to covid-19 also increases with the number of years they have been into garri- processing business. Schooling (-0.054344), income (7.74E-07), households size (-0.095409) and the number of processed garri bags (-0.005134) shows that their probabilities of responding to covid-19 pandemic were all negative as they increase. Also as household size increases, the less the probability of responding to the pandemic. It was recommended that, Smallholder farmers should form cooperative societies in order to assess loans both from financial institutions and government. Modern processing techniques should also be encouraged.
Key words: Garri processors, Response, Covid-19, Etche LGA, Rivers State

INTRODUCTION
Food processing is the action of carrying out a series of mechanical or chemical operations on food in order to change or preserve it (Okpeke, & Onyeagocha,2015)).COVID-19 (Corona Virus Disease 2019) was first discovered in the city of Wuhan, China at the end of December 2019. Until March 2, 2020, more than 80 thousand confirmed cases have been reported in China. Of these cases, 49 thousand were identified in Wuhan City. Epidemiologically, the spread or distribution of this disease has a wide social and economic impact on the world (World Health Organization, WHO, 2020). Recently with COVID-19, pandemic, the challenges hampering food security in Nigeria could expand. The impact was felt in the form of rising food prices. As at April 2020, food inflation rose to 15% compared to 14.7% in December, 2019. (International food policy research Institute (IFPRI, 2020).However, the biggest brunt of this distortions caused by this pandemic was being borne by those with lower educational attainment, people with disabilities, people of color, women, younger workers, and individuals who have less formal education(IFPRI,2020).It was discovered that,age, family size, level of formal education, access to production credit, availability of alternative sources of income and membership of Garri Processing associations contributed to inefficiency level of processors as observed by (Chukwuji1.et al, 2007). Contrary, Ehinmowo.et al, (2015) echoed that education, year of

experience, access to extension services, household size, cost of raw materials and types of cassava purchased were the factors that meaningfully determined profitability of processors.

These processors are faced with some challenges like, lack of palliative measures, inadequate capital, environmental hazard, high cost of fuel, lack of storage facilities and market problems. These challenges could cause risk of massive demand shock due to possible economic recession at this period of covid-19. To ensure that processors are not further impacted by the distortions caused by this pandemic, the government should ensure that more palliatives measures are provided to them by subsidizing the cost of their input resources,good infrastructural development for example good road network, constant electricity, provision of processing machines, improved cassava stems, good packaging materials, good storage facilities,creating conducive markets for their produce, form processors co-operatives societies, funding researches and provisions of farm extension services.(International food policy research(IFPRI,2020). Therefore, is not an oversight that determinant of smallholder *'garri'* processors Response to Covid-19 should anchor on their socioeconomic attributes? The study therefore examined the following specific objectives (1.) describe the socioeconomic characteristics of the processors; (2.) ascertain how their socioeconomic characteristics influenced their responses on Covid-19 and garri processing(3.) identify the commonest garri processing methods \(4.) identify the major challenges faced by the garri processors while responding to Covid-19 in the study area.

METHODOLOGY

The study area is in Etche Local Government Council covering an area of 803km3 and enclosed by Lat. 4050' N and 50 15' N and Lon. 6055' and 7020' E. The area has network of access roads, foot paths which made access to most area surveyed possible. Etche LGA lies within the Niger Delta Complex with the area predominantly located in the Benin formation and low land zones of South Eastern Nigeria. Three fresh water rivers (Otamiri, Ogochie and Imo) spanning across, the area and fan into the sea. Runoff is negligible because of the thick vegetation and the groundwater obtains its recharge from the rivers and the heavy annual rainfall estimated at an average of 2400mm (Offodile, 1984).The people of Etche are predominantly farmers, producing cash crops such as yam, cassava, palm oil, plantain, banana, pineapple, amongst others. These rivers provide water needed for irrigation of farmlands for enhancing food security of the state. The average temperature ranges from 30.0°C -33.0°C and annual rainfall ranges between 2100mm –4600mm (Nimet,2011).The favorable climate and rich soilencouragescontinuous food production in the area. Almost all farmers in Etche are into garri processing both for home consumption and for markets (Nimet,2011).There are several communities and towns in Etche, some of which include Akwu/Obuor, Eberi, Amaji, Opiro, Chokocho, Igboh, Egwi, Afara, Mba, Igbodo, Ofeh, Ohimogho, ObiohiaUmuogba, Umuajuloke Okehi, Obibi, Odufor, Nihi, Okomoko, Ulakwo, Umuakonu, Umuechem, and Egbeke. Etche believe Igbodo to be their ancestral home.Etche is the second place oil was discovered in Nigeria since the beginning of exploration in the area in 1958. Today, Etche has over 250 producing oil wells and a host of flow stations.

Model Specification

The Logistic Equation

$$Zi = \ln\left(\frac{Pi}{1-Pi}\right) = \alpha + \beta_1 x_1 + .. + \beta_n x_n$$

Taking exponent on both sides of the equation gives:

$$Pi = E(y = 1|x_i) = \frac{e^z}{1+e^z} = \frac{e^{\alpha} + \beta_i x_i}{1 + e^{\alpha} + \beta_i x_i}$$

P always lies between 0 and 1.

P_i = 1or 0.

The probability of garri processors responding to whether covid-19 pandemic affected their business positively or negatively was subjected to a binomial response of 0 and 1.
1. Garri processors responding that the covid-19 pandemic has affected their garri processing business positively=1
2. Garri processors responding that the covid-19 pandemic has affected their garri processing business negatively=0.

The explanatory variables are as follows:
X_1 = Age of processor's in years.
X_2 =Number of years spent in formal schooling in years.
X_3 =Income status of processors (both off-farm and on-farm income) in naira in one year.
X_4=Households size of processors in numbers.
X_5=Processing Experience in years
X_6=Processors farm size in hectares
X_7=Processors number of 50kg of garri produced in numbers in a year.

a) logit positive value = logistic > 1 = increase in the probability of the event when you have a positive change in the independent variable.
b) logit negative value = logistic < 1 = decrease in the probability of the event when you have a positive change in the independent variable.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Garri Processors

Table1, shows that majority (70%) of the respondents who are garri processors are mostly female. This is in consonance with the findings of (Nandi, 2009). This result indicates that there were more females in garri processing in the area, while most (48%) falls between age ranges of 25-54 years. This age range has shown that most of the processors are energetic with average age of 43years.This finding is in consistent with the findings of (Henri-Ukoha,et al. 2011).

Table 1: Distributions of garri processors according to their socio –economic characteristics in the study area.

VARIABLES	FREQUENCY	MEAN	PERCENTAGE
Gender			
Male	30		30.0
Female	70		70.0
Age			
0-14	2		2.0
15-24	18		18.0
25-54	48		48.0
55-64	20	43 **Years**	20.0
65 and above	12		12.0

Marital Status			
Single	10		10.0
Married	59		59.0
Separated	4		4.0
Divorced	8		8.0
Widowed	13		13.0
Widower	6		6.0
Level of Education			
No formal education	23		23.0
Primary	41		41.0
Secondary	30		30.0
Tertiary	6		6.0
Years of Experience			
1-10	10		10.0
11-20	21	**25years**	21.0
21-30	42		42.0
31-40	27		27.0
Household Size			
0-3	26		26.0
4-6	50	5persons	50.0
7-10	20		20.0
11-13			33.0
above14	1		1.0
Income Status (₦)			
Less than 100,000			22.0
200,000-600,000	43	₦633,000	43.0
500,000-700,000	35		35.0
Above1000, 000	20		20.0
Other Sources of Income			
Trading	19		19.0
Hunting	11		11.0
Fishing	45		45.0
Artisan	13		13.0
Others	12		12.0
TOTAL	**100**		**100**

Source: Field Survey Data, 2020.

Majority (59%) are married, showing that being married is regarded very important and a source of family labor. It was also observed that majority (41%) had primary school education depicting that respondents are literate enough to embrace an innovation ingarri processing. Respondents' average years of garri processing were 25 years, showing lots of experience and innovativeness. With majority (50%) having 4-6 household size. Majority (43%) had a farm income of ₦200000-₦600000 annually due to covid-19 pandemic. Majority (45%) are involved in fishing activities as an alternative income sources.

Determinants smallholder *'garri'* processors Response to Covid-19.

Results of the determinants of smallholder *'garri'* processors Response to Covid-19

Table2: **Determinants of smallholder *'garri'* processors Response to Covid-19 in the study area.**

Variables	Coefficients	Std Error	z-Test	Probability
Age	0.411465	0.017373	1.240174	0.2149
Schooling	-0.054344	0.052982	-1.025704	0.3050
Income status	7.74E-07**	3.79E-07	2.040613	0.0413
Household size	-0.095409	0.146387	-0.651756	0.5146
Experience	0.021672	0.016735	1.295043	0.1953
Bags of garri	-0.005134	0.003666	-1.400388	0.1614
McFadden R-squared	0.054052			
Log likelihood	-57.78458			
Akaike info criterion	**1.295692**			

Source: Computer printout, (2020). ** Sig at 5%

Table 2: shows the logistic regression results depicting how respondents' socioeconomic characteristics influence their responses on covid-19 and garri-processing in the study area. The result shows that the probability of respondent's, responding to covid-19 increases with their age with a positive coefficient of (0.021546). This has shown that respondent's age is an important socio-economic parameter to responds to covid-19 pandemic in the study area. The probability of respondents, responding to covid-19 also increases with the number of years they have been into garri- processing business. But looking at schooling (-0.054344), income (7.74E-07), households size (-0.095409) and the number of processed garri bags (-0.005134) shows that their probabilities of responding to covid-19 pandemic are all negative as they increase.

Looking at the respondent's level of schooling, as it increases, the less is the probability of responding to the pandemic. This is counter intuitive as level of schooling supposed to create awareness about the pandemic. But in this situation the corona virus was alien to the whole world. It took some world powers like U.SA, Russia and Israel sometime to understand and developed vaccine against the disease. Income was terribly affected as majority of Nigerian households could not afford their basic needs during the pandemic. Most people lost their jobs and it became very difficult for most households to meet up their basic food needs. Based on this sad development processors were equally hard hit as rate of processing and patronage dropped drastically. This development affected the probability of responding to the pandemic, based on the quantity of garri processed (-0.005134). As the quantity increases the less, the response. Also as households' size increases, the less the probability of responding to the pandemic, because the disease took the world by surprised. The low akaike information criterion of 1.2957 shows a good fit of the model.

The commonest methods used in Garri processing in the study area.

Table 3: Distribution of respondents according to the commonest methods used in Garri processing in the study area.

Methods of Processing Garri	**Frequency***	**Percentage**
Traditional method	65	36.1
Fully –mechanized method	3	1.7
Traditional/Semi-mechanized method.	111	61.7
Total	180	100

Source: Field Survey, 2020. **Multiple responses recorded.**

From Table 3, it revealed that majority (61.6%) employed traditional/semi –mechanized, method only 1.7% engaged fully –mechanized method. Traditional/semi-mechanized method is when the garri is made by hand peeling fresh cassava roots with kitchen knives, then washing and grating, fermenting, dewatering or pressing, breaking of the cake, sifting, roasting, sieving or grading, and packaging (Oguntimein et al. 1995).It is important to note that the quality of garri depends mostly on the quality of the cassava variety and how adequate the processing steps were taken. It was only (1.7%) who employed fully mechanized method. They complained lack of steady power and technical know-how was their limitations. It was observed that most people are not conversant with this method due to high cost of establishment and technical know-how. Most (36.1%) of the rural women utilized traditional methods. This method involves grated cassava pulp is put into sacks and placed between wooden sticks and allowed to ferment for 3 to 4 days. After then, it will be sieved and fried. It is important to note that fermentation helps to reduce and detoxify cyanide producing compounds in many cassava varieties.

Problems encountered by the cassava processors in the study area.

Table 4: Distribution of respondents according to problems they encountered in processing garri in the study area.

Hindrances	Frequency	Percentage
Lack of Infrastructural development (Good road network, constant electricity etc).	25	7.3
Market distortions	43	12.6
Lack of technology/technical skills in operating modern garri processing machines	52	15.2
Lack of storage facilities	13	3.8
Conservative attitudes of peasant processors	49	14.4
High cost of cassava tubers/palm oil	18	5.3
Scarcity of land/lease	12	3.5
Government policies	21	6.2
Covid-19 pandemic(lockdown,etc)	65	19.1
Others	43	12.6
Total	**341**	**100**

Source: Field Survey, 2020. **Multiple responses recorded.**

From Table 4above, only (19.1%) claimed that their major hindrance was covid -19 pandemic. They complained of restrictions of movements, causing them more money to get their produce to their customers. Almost all markets where shut down during this period, making garri sellers to be monopolistic in nature whereby, sellers unilaterally impose prices on the existing market. In normal situations, major garri producing areas, garri is produced by numerous smallholder units which sell garri essentially in village markets. Big markets, which are often fewer, act as an assembly center for garri from the numerous surrounding smallholder units. Such assembly markets are generally well attended by traders from far and wide, especially those markets that are well known for the supply of top quality garri, but covid-19 caused lots of distortions in this normal garri marketing arrangement or channels. Majority of the processors were peasant farmers who cultivate on family land, it was only few who complained of land lease as their major constraints.

CONCLUSION

Farmers' socio-economic attributer are an important indicator in assessing their responses towards covid-19 pandemic. There were serious market distortions that affected processors and consumers demand/ supply gap. Conservative attitudes of peasant processors were also a problem at this period of covid-19 pandemic.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

1. Smallholder farmers should form cooperative societies in order to assess loans from financial institutions and government in order to expand their production capacity.
2. Modern processing techniques should be encouraged.

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EFFECTIVENESS OF MOTIVATIONAL FACTORS IN ENHANCING JOB PERFORMANCE OF EXTENSION WORKERS IN EDO STATE, NIGERIA

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ABSTRACT
Staff motivation can drive workers towards effective and efficient performance and attainment of organizational goals. Hence, the study examined the level and influence of motivation on job performance of extension agents in Edo State Agricultural Development Programme (ESADP). Structured questionnaire was used to collect information from 53 extension workers sampled from the three agricultural zones in the state. Data were analyzed using descriptive and inferential (spearman rho) statistics. The results showed that the overall job performance of the agricultural extension workers was rated high (58.5%), even though the proportion that fell under poor performance was moderate (41.5%); the findings of the study also showed that, of the many motivational factors perceived by the extension workers to be important, only prompt payment of salary (mean =3.6), job security (mean = 3.1) and pension / retirement benefits (mean = 3.1) were appropriately provided by the ESADP. The findings also revealed that the provision of medical facilities/ accommodation (r = 0.329) and training opportunities (r = 0.314) were found to have significant relationship with the job performance of extension agents in the study area. The study thus recommended adequate provision of motivational incentives like medical facilities, accommodation and training opportunities to the workers in order to elicit high performance from them.

Key words: Effectiveness, Motivation, Job performance, Extension workers

INTRODUCTION
The Central Bank of Nigeria (CBN) (2013) reported that in spite of increased innovation in agriculture performance and growth of the agricultural sector was lower than the projected five percent (5%) aggregated growth, the implication of which is the high level of importation of agricultural products. Evidently, this problem has resulted from the declining ability to produce enough food in the face of increasing consumption capacity (Gate, 2014). Consequently, there is real urgency among governments and multilateral agencies to boost food production and this is being pursued with different agricultural models, including the need to migrate to commercial farming in many developing countries and personnel motivation for optimum performance (Tiraieyari & Uli, 2011). The challenge is stark and inescapable - developing countries must produce more agricultural commodities to feed the teeming population. The vital importance of agriculture lies not only in being the provider of essential goods, but also, for its essential role as the crucial engine of growth for developing the economy generally (Gate, 2014). Food and Agricultural Organization (FAO) (2009) report further concluded that since 70 percent of the people of Africa live in rural areas, raising the income of rural people is a pre- requisite for improving the African standard of livings.

According to Agbamu (2005), sequel to the food situation in many developing societies, which are predominantly agricultural, finding how to raise productivity among the rural poor in these countries has become one of the most urgent question confronting the international development community today. Agricultural development implies a shift from traditional method of production to new, science-based methods of production that include new technology components such as improved varieties, cultural practice, fertilizers and pesticides, new crops and farming systems

(Ahmed, Talb , Tadeusz & Piotr, 2015). The importance of agriculture and the rural sector in the modernization of developing countries and the achievement of development goals and economic growth has been emphasized by CBN (2013). Extension service is a vital service crucial to the agricultural development of a country. A nation's agricultural research – extension system is perhaps the most important single determinant of the level of its agricultural and rural development and a yardstick of the quality of life of its people (Kagbu & Issa**,** 2017).

According to Ogunsumi (2016), Nigeria with a population of over 200 million (Worldometer, 2015) and an arable land of 71 million hectares of which only 47.0 percent is cultivated, has the most elaborate National Research- Extension System (NARES) in sub-Saharan Africa. However, for a variety of reasons, the performance and hence the output of NARES has not been commensurate with the size, scope and level of investments in the system as evidenced in farmers - poor productivity, occasional food shortages and outrageous cost of food items. A typical example is the case of garri and cocoyam, previously regarded as a poor mans' food. The research system segment of NARES in its defense had argued that "If Nigerian limited resource farmers had adopted some of the technological innovations made available by research in the last 20 years in the region, declining food security and increasing poverty would not be a major crisis today" (Ogunsumi,2016). It is imperative to note that efficiency and effectiveness of extension service delivery is determined by the level of productivity of extension workers. According to Ahmed et al, (2015), employees' attitude to work do affect their performance. Besides, their attitudes to work are influenced by their personal ability and level of motivation they receive from their employer. A careful evaluation of an employee's performance can uncover weak-nesses or deficiencies in a specific job skill, knowledge, or areas where motivation is lacking., the overall purpose of performance evaluation is to provide an accurate measure of how well a person is performing the task or job assigned to him or her. Based on this information, decisions will be made affecting the future of the individual employee. Once identified, the deficiencies may be remedied through the provision of the needed rewards.

According to Kagbu and Issa (2017), agricultural development and productivity in Nigeria is suffering and poor extension services carries a significant part of the blame. This is because, despite the long and impressive list of innovations from research institutes, the small African farmers remain relatively unaware of /or lack the skills to take full advantage of the available technologies. According to Mougbo (2013), reason for this could be that extension workers do not perform effectively because they are not properly motivated. Could this be true in Edo State ADP. It is important to note that the expected efficiency and effectiveness of the extension service delivery in Edo State in boosting food production has not been met; and possible explanation for this poor performance may be traced to the poor motivation of the staff (Muogbo,2013).
The study will be of significance in ascertaining the extent to which the extension agents in Edo State ADP are being motivated and the impact it has on their job performance. The outcome can be used by the government in Edo State to effectively derive plans for agricultural growth and development.
Against this backdrop, the study looked at the following specific objectives:
identify the important motivational factors that could influence extension agents' job performance; ascertain the rate of the provision of the motivational factors by Edo State ADP; ascertain the level of job performance of extension agents in the state; and to determine the relationship between motivational factors and job performance of extension agents.

Hypothesis of the study

The null hypothesis tested states as follows:

There is no significant relationship between motivational factors and job performance of extension agents.

METHODOLOGY

The study was conducted in Edo State. Edo State shares boundary with Kogi state in the north, Delta state in the South-East and Ondo State in the South-West, and lies between Latitudes $5^0$44'N and 7^0 37'N and between Longitude 5^0 44' E and 6^0 43' E (Edo State Statistical Year Book, 2013). The State has 18 local government areas, distributed across three senatorial/agricultural zones, namely Edo North, Edo Central and Edo South. For administrative convenience Edo State ADP is divided along the three agricultural zones which correspond to the three Senatorial districts. The Zonal headquarters of Edo North is Auchi, Edo Central is Irrua and for Edo South is Benin City which is also the State headquarters. The population of Edo State is estimated to be 4,124,835 at a growth rate of 3% per annum in 2015 (Worldometer, 2015).

The population of the study consists all the extension agents in Edo State ADP, i.e. 66 comprising 21 extension agents in Edo North, 17 in Edo Central and 28 in Edo South. Given the population size of 66, the recommended sample size based on the table of sample proportion is 56. Simple random sampling was used to select 23 agents from Edo South, 18 from Edo North and 15 from Edo Central. However, only 53 responses were retrieved and used for data analysis.

The data collected were analyzed using both descriptive and inferential statistics. The former includes frequency, percentages and mean statistics, while Spearman rho correlation, an inferential statistic, was used to test the hypothesis.

Measurement of Variables

Extension Agents Perception of the importance of job motivational factors: This was measured on a 5 point Likert-type scale of very important (coded 5), important (coded 4), average (coded 3), not important (coded 2) and very unimportant (coded 1). A mean benchmark of 3.00 was used to decide if a factor was important (mean > 3.00) or otherwise (mean <= 3.00).

Respondents Perception of regularity of provision of motivational factors: This was measured on a 5 point Likert-type scale of very regular (coded 5), regular (coded 4), fairly regular (coded 3), occasionally (coded 2) and not at all (coded 1). The mean benchmark of 3.00 was used to determine if a motivational factor was regularly provided or otherwise (if less than 3.00).

Job performance rating of extension agents: a self-rating evaluation approach was used.

The study examined 12 indices of job performance adapted from Edo State Civil Service Annual Performance Evaluation Report (ESCSAPER) and that of Edo State Unified Teaching Service (ESUTS). The indices included; attendance at T and V fortnightly meetings, punctuality to meetings, readiness to accept additional duties, respect for constituted authority, resourcefulness, level of effective communication, level of contact with farmers, reliability, cordial relationship with other staff etc.

The performance of extension agents with respect to these indices was measured on a 5 point likert-type scale of very high (coded 5), high (coded 4), undecided (coded 3), low (coded 2) and very low(coded 1). A mean score of 3.0 meant a high performance and a mean score less than 3.0 meant low performance.

The maximum score obtainable on the 12 items was 60 (5*12 indices) and the minimum score was 12 (1 * 12 indices). The score obtained by each respondent was aggregated and used to classify them into two groups, based on the average of the scores (60+12 = 72 ÷ 2 = 36) Thus, respondents

with scores less than 36, were classified as low performance while those with above 36 were classified as higher performance.

RESULTS AND DISCUSSION

Perceived Importance of Motivational Factors

Table 1: Perceived motivational factors affecting job performance of extension agents

Motivational factors	Very important		Important		Undecided		Not important		Very Unimportant		Mean	SD
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%		
Prompt payment of salary	50	94.3	1	1.9	2	3.8					4.9*	0.4
Increase in salary	48	90.6	5	9.4							4.9*	0.3
Provision of mobility	44	83.0	8	15.1			1	1.9			4.8*	0.5
Prompt promotion	45	84.9	5	9.4	2	3.8	1	1.9			4.8*	0.6
Training opportunities	40	75.5	9	17.0	1	1.9	3	5.7			4.6*	0.8
Provision of medical facilities/ accommodation	35	66.0	15	28.3	2	3.8	1	1.9			4.6*	0.7
Pension/ retirement benefit	40	75.5	9	17.0	1	1.9			3	5.7	4.6*	1.0
Job security	38	71.7	11	20.8	1	1.9			3	5.7	4.5*	1.0
Recognition of achievement	30	56.6	17	32.1	4	7.5	1	1.9	1	1.9	4.4*	0.9
Participation in decision making	18	34.0	26	49.1	4	7.5	1	1.9	4	7.5	4.0*	1.1

Source: Field Survey (2019) *Important (m ≥ 3.00)

Table 1 shows the perception of the importance of the job motivational factors that influence their job performance. It is evident from the table that the respondents ranked prompt payment of salary *(*mean = 4.*9*.) as the most important motivational factor that influenced their job performance. This was followed by increase in salary (mean = 4.9), provision of mobility (mean = 4.80), prompt promotion (mean = 4.8), exposure to training opportunities (mean = 4.6), provision of medical facilities/ accommodation (mean = 4.6), pension and retirement benefits (mean = 4.6), job security (mean = 4.5), recognition of achievement (mean = 4.4) and participation in decision making (mean = 4.0) in descending order. The result agrees with that of Muogbo(2013) , who reported that prompt payment of salary and promotion were rated as very important motivating factors by the respondents and considered crucial to productivity.

Respondents Perception of the rate of provision of motivational factors provided by Edo state ADP

Table 2 shows that extension agents perceived the provision of prompt payment of salary (mean = 3.6) by Edo ADP to be very regular. This is closely followed by job security (mean =3.1) and

pension / retirement benefits (mean = 3.1). However, recognition of achievement (mean = 2.9), training opportunities (mean = 1.9), prompt promotion (mean = 2.7), increase in salary (mean = 2.6), provision of mobility (mean = 2.1), participation in decision making(mean = 1.9) and provision of medical facilities/ accommodation (mean = 1.6) were perceived irregular by respondents.

This result corroborates the assertion of Kagbu and Issa (2017), that the public sector extension service is plagued with inadequate incentives and other motivational problems. The result also negates that of Gate (2014), that adequate staff (extension agents) remuneration and motivation generally is highly imperative in realizing the objectives of sustained growth of an efficient extension service system. This is because they believed that extension efficiency and effectiveness are directly linked to the level of job satisfaction on the job. The low-level provision of motivational factors would certainly have effects on the motivational state of the extension agents.

Table 2: Respondents perception of the motivational factors provided by Edo-ADP

Motivators	Very regular		Regular		Fairly regular		Occasionally		Not at all		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Mean	SD
Prompt payment of salary	8	15.1	23	43.4	17	32.1	3	5.7	2	3.8	3.6*	0.9
Increase in salary	8	15.1	18	34.0	10	18.9	4	7.5	13	24.4	3.1*	1.4
Provision of mobility	10	18.9	13	24.4	13	24.5	5	9.4	12	22.6	3.1*	1.4
Prompt promotion	9	17.0	8	15.1	15	28.3	9	17.0	12	22.6	2.9	1.4
Training opportunities	2	3.8	2	3.8	11	20.8	12	22.6	26	19.1	1.9	1.1
Provision of medical facilities/ accommodation	5	9.4	6	11.3	18	34.0	17	32.1	7	13.2	2.7	1.1
Pension/ retirement benefit	4	7.5	9	17.0	11	20.8	18	34.0	11	20.8	2.6	1.2
Job security	2	3.8	4	7.5	10	18.9	20	37.7	17	32.1	2.1	1.1
Recognition of achievement	2	3.8	2	3.8	11	20.8	12	22.6	22	19.1	1.9	1.1
Participation in decision making	3	5.7	1	1.9	4	7.5	9	17.0	36	67.9	1.6	1.1

Source: Field Survey, 2019; *Regular (m ≥ 3.00)

Job performance rating of respondents

Table 3 shows that respect fo**r** constituted authority (mean = 3.6) and attendance at T and V fortnightly meeting (mean = 3.5) were high. The level of credibility (mean = 3.4), punctuality at fortnightly meeting (mean = 3.4), cordiality of relationship with other staff (mean = 3.4), demonstrating improved technologies to farmer (mean = 3.4), Oral/ written expression (mean = 3.3) and contribution to discussion at meetings were rated low.

Table 3: Job performance rating of extension agents

Variables	Mean	SD
Respect for constituted authority	3.6*	0.633
Attendance of fortnightly meetings	3.5*	0.953
Level of credibility	3.4	0.633
Punctuality at fortnightly meetings	3.4	0.968
Cordiality of relationship with other staff	3.4	0.768
Demonstration of improved technologies to farmers	3.4	0.817
Oral/ written expression (communication)	3.4	0.863
Cordiality of relationship with farmers	3.3	0.902
Contribution to discussion at meetings	3.2	0.900
Empathy (i e concern about farmers welfare)	3.0	1.097
Level of contact with farmers	2.9	1.197
Readiness to accept additional duties	2.8	1.223

Source: Field Survey, 2019; ****High job performance (mean ≥ 3.5)***

Also rated low were agents concern about farmers welfare (mean = 3.0), level of contact with farmers (mean = 2.9) and readiness to accept additional duties (mean = 2.8).

Table 4: Distribution of extension agents based on job performance

Score	Frequency	Percentage
Low job performance	22	41.5
High job performance	31	58.5
Total	53	100

Source: Field Survey, 2019

Similarly, the dichotomized result in Table 4 shows the distribution of extension officers based on overall score on job performance; findings revealed that the performance of 41.5% of respondents was low, while 58.5% of the respondents fell under higher performance category. The fact that the job performance rating of many of the extension agents was low, may be linked the availability of motivational incentives. Muogbo (2013) asserted that incentives may influence job performance directly or indirectly. Ogunsumi (2016) argue in this regard, when he asserted that a set of variables can influence the direction, amplitude and persistence of an individual holding constant the effect of aptitude, skills and understanding of the task and constraints operating in the environment.

Relationship between motivational factors and job performance of extension agents.

Table 5 shows that only two motivational factors had positive and significant relationship with the job performance of the extension agents. They are provision of medical facilities accommodation (r = 0.329) and exposure to training opportunities (r = 0.314). Other motivational factors such as prompt payment of salary (r = _0.053), increase in salary(r = 0.073), provision of mobility (r = 0.071, p≤0.05), participation in decision making (r = -0.173,p), prompt promotion (r = 0.059), job security(r = 0.022), recognition of achievement (r = -0.050) and pension / retirement benefit (r = 0.108) were not. Similar results have been reported by Muogbo (2013), who asserted that physiological, security and hygiene (environmental) factors are important, but are only minimally related to worker's productivity. Exposure to training opportunities and provision of medical facilities and accommodation, as significant determinants of worker's performance, align with Herzberg motivators, that is, factors intrinsic to the work being done.

Table 5: Relationship between motivational factors and job performance of extension agents

Motivational factors	r-value
Increase in salary	0.073
Job security	-0.022
Participation in decision making	0.17
Pension /retirement benefit	0.108
Prompt payment of salary	-0.053
Prompt promotion	0.059
Provision of medical facilities/ accommodation	0.329*
Provision of mobility	-0.071
Recognition of achievement	-0.05
Training opportunities	0.314*

Source: Field Survey, 2019' **Correlation is significant at the 0.05 level, p≤0.05).*

This re-affirms the findings of Kagbu and Issa (2017), that these factors motivate workers and make them to excel. Training enhances growth, development and self-fulfillment in life. Also, provision of good medical facilities and accommodation are essential for promoting improved standard of living of the extension agents.

CONCLUSION

The findings established the fact that the job performance of the majority of the extensions agent was rated high; however, for a high proportion (45%) of the workers, the job performance was considered low. Findings from the study established the fact that extension agents perceived all the job motivational factors presently utilized by the organization to be important to in enhancing their job performance. However, the study established that only exposure to trainings and provision of medical facilities and/or accommodation significantly and positively enhanced the job performance of the workers.

RECOMMENDATIONS

Based on the findings,

1. The ADP management should ensure prompt payment of salaries, regular promotion, and provision of mobility and other necessary working materials to extension agents.
2. To enhance the job performance of extension agents in ESADP, management should provide medicals facilities and /or support staff accommodation.
3. In addition, extension workers should be exposed to training opportunities to improve their capacity.

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ADOPTION OF IMPROVED OIL PALM TECHNOLOGIES AMONG FARMERS IN OVIA NORTH-EAST LOCAL GOVERNMENT AREA OF EDO STATE, NIGERIA

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ABSTRACT
The study examined the adoption of improved Oil palm technologies among farmers in Ovia North-East Local Government Area of Edo State, Nigeria. Specifically, the study examined the production factors in Oil palm production and the constraints faced by respondents in Oil palm production. Multi-stage sampling technique comprising purposive and random sampling were used to collect data from 110 respondents selected from eleven communities in the study area. Data were analyzed using frequency count, mean and percentage. The result revealed that the respondents mostly male (87.5%), educated (92.8%), married (50%), natives (72.2%) depended on acquired land. The important factors in Oil palm production in the study area were bush burning (mean = 3.63), government policies (mean = 3.45) poor processing facilities (mean = 3.30) and poor capital (mean = 3.30). The serious constraints faced by respondents in Oil palm production were unavailability of funds (mean = 2.98) and poor extension services/contact (mean = 2.86). It was concluded unavailability of fund and poor extension contacts were the serious constraints to Oil palm production. The Friedman test result (Chi-square = 5.951, df=4) shows that significant difference existed among the constraints affecting Oil palm production. It was recommended that extension services providers should intensify efforts in the provision of extension services to Oil palm farmers.
Keywords: Adoption, Improved, Oil Palm, Technologies, Farmers

INTRODUCTION
Over the years, Oil palm have been used by man for many diverse purposes, majority of its products are utilized by man directly, while others serves as animals feeds and raw materials for industrial production. The importance of Oil palm in human diet cannot be overestimated because of its nutritional benefits; it is rich in carotenoids, which is needed to protect the eyes against certain eye diseases by increasing vitamin A in blood, moreover oil palm is rich in essential fatty acids and has long been utilized as a source for bio-fuel (Jacquacmard, 1998). A commendable feature of Oil palm is that every part of the plant can be put to advantageous use which are particularly suitable for low-cost and low-technology activities such as palm ribs and frond for roofing and thatching, brooms, baskets, and mats production while it residue can be used as fuel for cooking and heat generation for other purposes. Due to all these uses, it offers an almost unlimited scope for employment and thus a source of livelihood and income for many people (Oladipo, 2008). Industrially, the derivatives of Oil palm are globally utilized as raw materials for a wide range of purposes such as confectionary soaps, cosmetics, detergents, ink epoxy resins and animal feeds.

In Nigeria, Oil palm cultivation is part of the way of life of most people living in the southern part of the country. According to Basiron (2007), Oil palm production has been used strategically by Malaysia and Indonesia for employment creation, poverty reduction and rural development. This is so because of the adoption of improved Oil palm technologies among farmers. For example in Malaysia, the plantation sector is one of the largest employers in the country and has created

substantial livelihood improvement for millions of rural small-small-scale producers (Basiron & Weng, 2004). Moreover, the Oil palm sector has provided basic infrastructure to Oil palm producing rural areas, hence with proven track record the Oil palm industry in Malaysia and Indonesia is recognized by other developing nations as a model for poverty eradication which need to be emulated.

According to Ugwu (2009), Palm oil has been the driving force in the world of edible oil and fat as one of the most produced and consumed oil. For Palm oil production to sustain this competitive edge, continued research is very crucial in regards to appropriate production technologies to pave the way forward in shaping the future of the industry. This has become imperative because Nigeria, which was one of world's exporters of Palm oil in the 70s, can no more meet up with local demand. To this end, the target of Oil palm production should be to meet up with the domestic demand; and compete favourably with other countries. Extraction rate for traditional technologies in Nigeria has been reported low compared to other countries. It was rated 18% as against 25% in Thailand and 90% in Malaysia (World Rainforest Movement, 2001). These new production technologies cannot be adopted if the information required for necessary adoption is not passed to the producers from the right sources. Knowledge and information are basic ingredients for increased agricultural production and productivity.

It is on this background that Hassan, Kiarie, Mugo, Robin and Laboso (1998) as cited in Opara (2008) noted that communication of agricultural information is a vital factor in the change process of farming community. According to International Finance Corporation (2010), access to quality information, technical assistance and extension services is a critical factor for successful smallholder production and adoption. Nigeria Institute for Oil Palm Research (NIFOR) has made various efforts to improve Oil palm production by producing small-scale Oil palm production equipment (Ugwu, 2009) which can be used to improve the quality and quantity small scale Oil palm production. Despite these efforts, Oil palm production in Ovia North East Local Government area has to considerably improve. This study therefore examined adoption of improved Oil palm production technologies among farmers in Ovia North-East L.G.A of Edo State, Nigeria.

METHODOLOGY

The study was carried out in Ovia North-East Local Government Area in Edo State, located on Latitude: 6^{0}38' 40.7" (6.6447^0) North and Longitude: 5^{0}34' 47.6" (5.5799^0) East. (WPP, 2017) with its administrative headquarter is Okada. It is one of the 18 local government areas in Edo State, Nigeria with a land area of 2,301 km² and a population of 153,849 at the 2006 census. The inhabitants of the Local Government Area are the Edo speaking people with their major occupations being farming and trading. Questionnaires were used to collect data from respondents. To ensure the validation of data gathering instruments, it was presented to expert in the field of agricultural extension and rural sociology for assessment, criticisms and possible suggestions. The reliability of the instrument was established using the test-retest method, the reliability coefficient obtained was 0.832 and this was considered a good measure of reliability being greater than 0.700 (Okwuokenye & Onemolease, 2014).

Multi-stage sampling procedure was adopted in the selection of respondents. The first stage involved purposive selection of Ovia North East local government area because of the high intensity of Oil palm production in the area. The second stage involved the purposive selection of (11) communities; Okada, Uhen, Kokhuo, Ofunm-wengbe, Uhiere, Isiuwa, Adolor, Iguoshodin, Utoka Oghedde and Oduna because of high intensity of palm oil production. The third and final stage involved random selection of (10) respondents giving a total of 110 respondents. Data

collected was analyzed using statistical tools such as frequency, means percentage and Friedman test

The factors associated with the adoption of improved Oil palm technologies in the study area were determined using a fourpoint Likert-scale computed as follows, very important (coded 4), important (coded 3) less important (coded 2), not important (coded 1). The level of importance was determined using a mean score of 2.50 computed as follows: 4 + 3 _ 2 + 1 ÷ 4 = 2.50. Factor with mean ≥ 2.50 was regarded important while mean score with factor <2.50 were regarded as not important.

The constraints to the adoption of improved Oil palm production technologies in the study area were determined using a four point Likert-scale computed as follows, very serious (coded 4), serious (coded 3) less serious (coded 2), not serious (coded 1). The level of seriousness was determined using a mean score of 2.50 computed as follows: 4 + 3 _ 2 + 1 ÷ 4 = 2.50. Constraints with mean ≥ 2.50 were regarded serious while mean score with factor <2.50 were regarded as not serious.

RESULTS AND DISCUSSION

The socio-economic characteristics of the Oil palm farmers are presented in Table 1.

The result showed that 87.5% of respondent were male while 12.5% were female. This implies that both male and female are involved in oil production in the study area. Similar result was reported by Omoregee and Edeoghon (2014) who reported 87.9% and 12.1% for male and female oil palm farmers of Ovia North Local Government Area of Edo State. Majority of the farmers (29.1%) were above 60 years indicating that the respondents were becoming advance in age. The farmer's level of education shows that the respondents were educated with 92.8% having formal education. This literacy level among the respondents is good as this will influence their adoption of innovation and decision making. Onyemokonwu (2018), noted that farmers level of education greatly influence the decision making and adoption of innovation. 53.6% of which formed majority of respondent have household size of 6-10 persons. It therefore suggests that occasionally the farmers may depend on extra labour to cope with the required labour necessary to achieve desire result. Average proportion (50%) of the oil palm farmers were married and happily engaged in Oil palm production to cater for the needs of their families. A higher proportion (72.2%) was natives.

Table 1: Socio-Economic Characteristics of Respondents

	N = 110	% = 100
Variable	Frequency	Percentage (%)
Gender: Male	92	87.5
Female	14	12.5
Age (years): < 30	8	7.3
31 – 40	26	23.6
41 – 50	28	25.5
51 – 60	16	14.5
> 60	32	29.1

Education:	No formal	8	7.2
	Primary	12	10.8
	Secondary	2	1.8
	NCE/OND/HND	68	61.8
	B.Sc	8	7.2
	M.Sc./Ph.D	12	10.8
Household Size:	1 – 5	13	11.8
	6 – 10	59	53.6
	11 – 15	29	26.4
	> 15	9	8.2
Marital Status:	Married	40	50.0
	Single	16	20.0
	Divorced	10	12.5
	Widower	14	17.5
Residential Status:	Natives	30	27.3
	Settlers	80	72.7
Land Status:	Ownership	38	34.5
	Acquired (Lease/Contract)	72	65.5
Annual Income (₦N)	< 20,000	15	13.6
	21,000 – 30,000	47	42.7
	> 31,000	48	43.7
Farming Experience:	< 5 years	11	10
	6 – 10 years	51	46.4
	> 10 years	48	43.6

Source: Field survey data, 2018

This implies that the natives are highly involved in Oil palm production. A good proportion (65.5%) of respondents depends on acquired (lease/contact) land. This may affect their production level as the lands used are not owned by the farmers. Below average (43.7%) of the respondents earned an annual income of ₦31,000 and above. This suggests that the respondent's may depend on other activities to support the financial needs of families. A higher proportion on the farmers (46.4%) belongs to the modal class of 6-10 years of farming experience. This suggests that the respondent have appreciable years of experience in Oil palm production.

Production Factors in Oil Palm Production

The result in Table 2 shows the production factors in oil palm production.

Table 2: Production Factors in Oil Palm Production

	Very important		**important**		**Less important**		**Not important**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Mean**	**SD**
Factors										
Environmental factors (bush burning)	50	45.6	32	29.9	15	13.6	12	10.9	3.63*	3.89
Government policies	46	41.6	32	29.9	20	18.6	11	10.0	3.45*	3.87

Poor processing facilities	37	33.6	28	25.4	20	18.6	15	13.6	3.30*	3.84
poor capital	37	33.6	28	25.4	20	18.6	15	136	3.30*	3.84
Poor access to farm inputs	11	10.0	7	6.37	22	20.0	60	54.5	1.96	.95
Problem of pest and diseases	10	9.09	8	7.27	40	36.4	48	43.6	1.84	.83
Lack of improved varieties	0	0	24	21.8	34	30.0	52	47.3	1.74	.77

***Source: Field Survey data, 2018; ****important (mean ≥2.50)*

From the result, factors with mean ≥2.50 were regarded as important factors. The result indicates that environmental factors such as bush burning (mean = 3.63), government policies (mean = 3.45) poor processing facilities (mean = 3.30) and poor capital (mean = 3.30) were the important factors in palm oil production in the study area. Factors such as poor access to farm input (mean=1.96), problem of pest and disease problems (mean=1.84) and lack of improved seedlings (mean=1.74) were not important as their mean scores were less than 2.50. Okwuokenye & Onemolease (2014) reported that several factors affect food production in Nigeria; among them were insufficient capital and environmental factors. If these factors are not properly addressed oil palm farmers in the study area may not get the desired output.

Constraints Faced by Respondents in Adopting Improved Oil Palm Production Practices

Table 3 shows that the major constraints to adoption of improved Oil palm production technologies. The result shows that unavailability of funds (mean = 2.98) and poor extension services/contact (mean = 2.86) were the serious constraints faced by respondents in adopting Oil palm production technologies. Constraints such as application know how (mean = 1.68), awareness (mean = 1.51), complexity of innovation

Table 3: Constraints Faced by Respondents in the Adopting Improved Oil Palm Production Practices.

Constraints	Very serious		Serious		Less serious		Not serious		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Mean	SD
Unavailability of fund (cost of innovation)	44	40.0	33	30.0	20	18.2	13	11.8	2.98*	1.03
Poor extension services	39	35.5	33	30.0	22	20.0	16	14.5	2.86*	1.06
Application know-how	8	7.3	9	8.2	33	30.0	60	54.5	1.68	0.90
Awareness	4	3.6	5	4.5	35	31.8	66	60.0	1.51	0.75
Complexity of innovation	0	0	4	3.6	34	30.9	72	65.5	1.35	0.55
Compatibility with existing farm practices and culture	3	2.7	5	4.5	36	32.7	66	60.0	1.10	0.75

Source Field Survey data, 2018; *Serious (mean =2.50)

(mean = 1.35) and compatibility with existing farm practices and culture (mean = 1.10) were not serious constraints to adopting improved Oil palm production technologies.

The seriousness of these constraints may reduce farmers' production level as the adoption influences farmers production.

Test of Difference Among the Constraint Faced by Respondents in Oil palm Production

Table 4: Constraints Faced by Respondents in the Adopting Improved Oil Palm Production Practices.

Constraints	Mean
Unavailability of fund (cost of innovation)	2.98[a]
Poor extension services	2.86ab
Application know-how	1.68[b]
Awareness	1.51[b]
Complexity of innovation	1.35[bc]
Compatibility with existing farm practices and culture	1.10[c]

Source Field Survey data, 2018; Chi-square = 5.951, df=4

As presented in Table 4, Friedman test was used to analyze the hypothesis which states that there is no significant difference among the constraints affecting Oil palm production in the study area. The chi-square result (χ^2 = 5.951, df=4) revealed that significant differences existed among the constraints affecting Oil palm production in the study area. The post hoc test revealed that unavailability of fund (cost of innovation) (mean= 2.98) was the most significant poor extension services (mean= 2.86). However, there was no significant difference between application know-how (mean =1.68) and awareness (mean =1.51).

CONCLUSION

Based on the findings it was concluded that the farmers in the study area were educated and experienced in Oil palm farming. However, factors such as environmental factors e.g. as bush burning, government policies and poor processing facilities were important to Oil palm production in the study area. Also, unavailability of fund and poor extension contact were the serious constraints to Oil palm production.

RECOMMENDATIONS

The following recommendations were made;

1. Extension services providers should intensify efforts in the provision of extension to Oil palm farmers to encourage the adoption rate of improved technologies in Oil palm production especially among farmers with low yield.
2. Farmers should organize themselves to form cooperative societies. This is quite important for enhancing accessibility to credit facilities and farm inputs for their farm work.
3. Relevant agencies such as the Ministry of Agriculture should organize special training/workshops on the need for the adoption of improved technologies to increase Oil palm output and yield.

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THE IMPACT OF AGRICULTURAL EXTENSION SERVICES ON RURAL LIVELIHOOD OF OKRA WOMEN FARMERS IN IKA SOUTH LOCAL GOVERNMENT AREA DELTA STATE.

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ABSTRACT
The study investigated the impact of agricultural extension services on rural livelihood of okra women farmers in Ika south Local Government Area of Delta State, Nigeria. A total of 145 women farmers were randomly selected using the multistage sampling procedure. Delta North zone was selected due to high concentration of agricultural activities. Five cells out of the nine blocks in Delta north were purposely selected. The study achieved the following objective; described the socio- economic characteristics of women farmers, identify activities /services rendered to women, determine the impact of the extension programme to the livelihood of women, and examine the constraint faced by women in participating in agricultural extension activities in the study area. Data were collected using structured questionnaire. Descriptive and inferential statistics were used for data analysis. Result shows that majority were adults and agile, married, had formal education, with large household size, well experienced in farming and had less than one hectare of cultivated farm land with estimated annual income above one hundred thousand naira. A high percentage had access to extension services, service providers were co-farmers and Non-Governmental Organizations which they benefited from .They considered problems such as: lack of inadequate capital, lack of credit facilities, lack of information, lack/inadequate markets to sell their farm product, low pricing of farm produce, high transport cost , and bad roads as most serious constraints faced and had significant effect on the production of okra which affected their income as well as livelihood. It is recommended that Government should encourage and assist women farmers, by giving them special attention in terms of access to the needed farm inputs and incentives.

KEYWORDS: Women, Rural households, Livelihood

INTRODUCTION

Agricultural extension services are made to enhance farmer's knowledge and skill towards improved yield. Studies of agricultural development process have proved that education is one of the crucial variables for achieving economic growth and human progress. Extension is regarded as one of such wide educational inputs design for rural farmers to help themselves. This is because agricultural extension services were proved to be one of the most important effective means to reach farming households in the rural areas (Adekunle, 2013).

Agriculture is the main source of livelihood in Nigeria, especially in the rural areas and is plagued with various problems (Abimbola & Oluwakemi, 2013). As a result, most of the rural households are poor and are beginning to diversify their livelihoods into off and non-farm activities as a relevant source of income. Rural livelihood poses a great challenge as this population is often in a state of poverty where they lack the basic necessities for survival, in order for a rural population to strive there is need for livelihood that would sustain and support their households and communities (Barbier & Hochard, 2014). It was also reported that in the twenty-first century,

agriculture remained a fundamental tool for lifting the rural people out of poverty and this continues to dominate some discussions of rural social difference (Browne, 2011).

Many agricultural development programmers are on ground with the aim of increasing food production and improving the standards of living in the rural communities. In relation to its role in rural livelihoods, agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being (Birner et al, 2006). Since livelihood comprises the capabilities, assets and activities required for a means of living, it appears that agricultural extension intends not only to increase productivity and income but also to improve multifaceted aspects of rural life (Waddington et al, 2010).

The role of women in agricultural development has been very well recognized in the last couple of decades by international development agencies, national governments and researchers (Food and Agricultural Organisation, 2006; 2011; 2014). The role of women in Nigeria economic sector cannot be over emphasized. Women are the real driving force of the nation's economy and are therefore crucial to the sustainable development of the country. Majority of Nigerian rural woman are involved in agriculture, producing vegetables such as okra, leafy vegetables, etc. They manage mixed agricultural operations, involving crops, livestock and fish farming and are considered as part of the agricultural labour force (Food and Agricultural Organisation, 2011). Rural women are also known to be fully involved in all farming operations such as planting, tinning, weeding, fertilizer application, harvesting, storing, processing and marketing (World Bank, 2013; Mahmood, 2011). Rural women in Nigeria worked side by side with men in agricultural production with some marked division of labour among them. The men perform the tedious tasks of felling trees, gathering and burning of bush and making ridges, while women are involved in planting of seeds, harvesting, transportation, processing and selling of farm produce and products .The role that women play and their position in meeting the challenges of agricultural production and development are quite dominant and prominent, (Bill and Melinda Gates Foundation 2012). Often times, extension impacts have been associated with improvements in productivity and household income. A worldwide review of extension services shows that the impact of extension services on rural livelihoods of okra woman farmers is mixed:

Due to the limited research undertaken on the impact of agricultural extension services on rural livelihood, poverty alleviation and the resulting lack of empirical data and information on the role of the rural women towards household quality of life, the government and other pare status have tended to neglect the impact of extension activities to the overall development process in rural areas (World Bank 2007/FAO, 2011). This situation, in turn, has resulted in lack of clear policy on the promotion of rural women farmer's activities by stagnating their growth despite their great potential for alleviating poverty in rural areas. Most women who duel in these areas experience low life quality or welfare. They live in deprived and disadvantaged condition with particular regards to their economic endeavour. As a result, according to (Ibekwe et al; 2010) observed, that

most of the rural women household are poor and diversify their livelihoods into okra faming to enhance household economic survival.

Okra farming by women has been viewed as a low productivity sector which produces low quality goods, according to (Osondu, 2014), it is often expected that such view should wither away as a country develops, recent year have seen a shift away from this position towards recognition that such farming can and often does, contribute to economic growth, rural development, poverty reduction and a more specifically balanced population distribution (World Bank, 2007). Therefore, doubt lingers still on the contribution of rural women engagement in okra farming to overall household livelihood. This is because of the existing pervasive poverty in the country, which is particularly more serious in the rural areas. The study assessed the following objectives: examine the socio- economic characteristics of women in the study area, identified activities /services rendered to women in the area, determined the impact of the extension programme to the livelihood of women in the area and examine the constraint faced by women in participating in agricultural extension activities in the study area.

METHODOLOGY

This study was carried out in Ika south local government Area of Delta State, Nigeria. Ika south Local Government Area is in Delta North Agricultural Extension Zone, with its headquarter at Agbor, It is one of the 25 local government areas in Delta State of Nigeria. It has an area of 436 km² and a population of 162,594 at the 2006 census. It comprises of 22 villages. It is a narrow Local Government Area located in the northern part of the state. It shares borders with Ika Northeast and Aniocha South Local Government Areas. The predominant occupation of the people is farming which encompasses growing of arable crops and vegetables. Other occupation includes rearing of animals and trading.

A multi-stage random sampling was used in the selection of the women; first stage was the purposive selection of Delta North Zone of agricultural development programme. The second stage was the purposive selection of Ika south block, out of the nine blocks in Delta North zone, the third was the purposive selection of five cells; out of the eight cells in Ika south block, and the criterion for the selection is the high rate of women involvement in okra farming.

The fourth stage was the random selection of (11) villages from the twenty 20 villages that made up the five cells of agricultural extension services in Ika south block and finally was the random sampling of 10 women from four villages, and another 15 women from seven villages making a total number of (145) women.

Table 1 Sample Distribution

Agric. zone	L.G.A	Cells	Villages	Sample of Women
Delta North	Ika south	Udomi cell	Abavo	15
			Egbogi	15
			Ekuoma	15
		Alihamie Cell	Oki	10
			Alihagwu	15
		Alifikede Cell,	Omumu	10
			Alifikede	15
			Idumuoza	15
		Oyoko cell	Oyoko	10
		Alishimie cell,	Oza-Nogogo	10
			Alishimie.	15
		Total		145

Source: Field Survey, 2018

Descriptive statistics such as mean, frequency distribution tables and percentages were employed to analyse the socio-economic characteristics and to identify activities rendered to the women, Likert-type scale was also used to elicit information on the impact of the programme to their livelihood and on the constraints face in participating in extension activities. As regards to the impact of the programme on the farmers' livelihood, a five-point Likert scale was used and coded as follows: Strongly agree (5), Agree (4), disagreed (3), strongly disagreed (4),Undecided (5), Also, a four-point Likert scale was used to elicit information from the farmers on the constraints face in participating in extension activities in the area. This was coded as Very serious (4), Serious (3), little serious (2), and Not serious (1).

The inferential statistics (t-test) was used to test the difference in the activities / services render to women and the actualization of their livelihood Outcomes, impact of extension programme and livelihood of women and the constraints faced by women in extension activities in the area.

RESULTS AND DISCUSSION

Socio Economic Characteristics of women farmers

The socio-economic characteristics of the women is presented in Table 2

The results in Table 2 shows that majority of the women were within the age of 56-65 years (35.9%), 46-55 years (30.3%), 36-45 years (13.1%).66 years above (13.1%) and 35 years (7.6%) with an average age of 52.9. The average age of the women okra farmers implies that they were in their active and productive years and would be able to participate actively in farming thereby enhancing production and productivity. It was observed that majority of the women okra farmers were (65.5%) married, 15.9% were widow, (9.0%) single, divorced (6.2%), and engaged (3.4%). This implies that the married predominates. Similar result has been reported by Akinwumi *et al* (2006), who noted that majority of rural women farmers were married. The fact that majority of the women okra farmers were married, suggest a sense of family responsibility and the need for them to engage in economic enterprise in order to contribute to their family quality of life.

Table 2 Socio economic characteristics of women okra farmers

Variables	Categories	Frequency	Percentage
Age categories	35 below	11	7.6
(mean=52.9)	36-45	19	13.1
	46-55	44	30.3
	56-65	52	35.9
	66 above	19	13.1
Marital status	Single	13	9.0
(mean-29.0)	married	95	65.5
	Divorced	9	6.2
	Widowed	23	15.9
	Engaged	4	34
Formal education	Non formal	56	38.6
(mean=6.0)	primary	27	18.6
	Secondary	23	15.9
	NCE/OND	19	13.1
	HND/BSC/ED	20	13.8
Household size	Less than 4	51	35.2
(mean= 6.0)	5-8	70	48.3
	9-12	18	12.4
	Above 12	6	4.1
Farming experience	Less than 1 year	19	13.1
(mean=7.4)	1-3	20	13.8
	4-7	16	11.0
	8-10	18	12.4
	10 years above	72	49.7
Farm size	Less one hectare	49	33.8
(mean= 2.9)	1-2	40	27.6
	3-4	25	17.2
	5-6	13	9.0
	7-10	12	8.3
	10 above	6	4.1
Estimated income	Less 30,000	15	10.3
(mean= #2,015,833)	40,000- 50,000	17	11.7
	60,000 – 70,000	13	9.0
	80,000 -90,000	24	16.6
	Above 100,000	76	52.4

Source: Field Survey, 2018

The results show that majority (38.6%) of the women had- formal education, primary education (18.6%), secondary education (15.9%). N.C. E/OND (13.1%) and H.N.D/BSC/ED (13.8%). The result reveals that majority of the women are illiterate which implies that level of education does not play an important role in promoting farmer's involvement and utilization of agricultural extension services while a higher level of education of farmers is assumed to increase the ability to use agriculture related practices in a better way. However, if the low level of literacy among the

women in the area did not negatively influence their participation in agricultural extension service, then high rate of literacy would have make them do better in terms of farm operations and techniques, than this level that they are operating now, there will be more improvement in agricultural production and nutrition. This is also in agreement with a research conducted by (Adekunle, 2013).

The average household size of women okra farmers was 6 persons. A household size of 5-8 predominate (54.0%). This suggests that the women have more mouth to feed and the management of the household will not be easy, and probably, more hands for farming activities. The household will depend less on hired labourers. This result is in agreement with the opinion that suggested household with higher heads might be more advantageous than household with small family size in terms of participation in agricultural extension services (Adekunle, 2013).

An investigation on farming experience shows, that (49.7%) of the women had more than 10 years of farming experience followed by (13.8%) had 1-3 years , (13.1%) less than one year ,8-10 years (12.4) and only (11.0%) had 4-7 years of farming experience. This result shows that the women have above ten years of experience in the area, representing (49.7%). This implied that the farmers were experienced in farming. Okwuokenye and Onemolease (2011) confirmed the finding, indicating that having good farming experience in enterprise activities will enable the farmers to be better positioned to know the needs and problems associated with farming activities with farming activities.

Table 2 shows that majority of the women (33.8%) had less than one hectare of cultivable land, (27.6%) 1-2 hectares of land. 25(17.2%) had 3-4 hectares of land, 5-6 had (9.0%), 7- 10 (8.3%) and 10 and above (4.1%). This shows that the area was therefore dominated by small holder farmers which correspond to FAO, (2014), Manfre, (2010), and Leavens et al, (2011) findings that women have less access to land.

The result revealed that the estimated annual income was above #150,000 with an average mean of (₦83,414). This implies that the income level of all the farmers was very high which was about ₦ 2,015,833 per annum and ₦167,000 monthly, this is weighing above the national minimum wage of ₦18, 000 in Nigeria. This is related to a study carried out by (Adekunle, (2013) were agricultural extension services were proved to be one of the most important effective means to reach farming households in the rural areas."

Services rendered to women farmers and the actualization of their livelihood outcomes.

Analysis from the table shows that majority (71.1 %) of the women had access to extension services in the area and majority of these services were provided by Co-Farmers (44.8%) and Non–Governmental organization (NGO) (39.3%) while Extension workers provided (15.2%). It therefore implied that sources of information to the farmers were mostly through Co-Farmers and Non-Governmental organization.

The result also revealed that the services were rendered most often (47.6%) Very Often (21.4%), services rare (15.9%), never obtain any of the extension services (15.2).

Women having access to asset acquisition shows that majority of them obtained knapsack sprayer (53.8%), Obtained storage facilities (33.1. %), (9.0%) obtained irrigation facilities. (1.4%) wheel barrow and (2.1%) protective wear. The distribution of the women, according to rural infrastructures shows that about (55.9%) of them benefited from marketing facilities, (22.8%) benefited from rural access road to their farm land, (21.4%) benefited from potable water.

Table 3 Services rendered to women farmers and the actualization of their livelihood outcomes.

Category of benefits	**Benefits derived**	**Frequency**	**Percentage**
Access to extension services	yes	103	71.0
	No	41	28,3
	Invalid	1	.7
Extension service provider	Extension officer	22	15.2
	NGO	57	39.3
	CO-Farmers	57	44.8
	Invalid	1	.7
How often do you get the service	most often	69	47.6
	Very often	31	21.4
	Rare	23	15.9
	Never	2	15.2
Asset acquisition	storage facilities	48	33.1
	Irrigating facilities	13	9.0
	Knapsack sprayer	78	53.8
	Wheel barrow	2	1.4
	Protective wear	3	2.1
	Invalid	1	.7
Rural infrastructure	Marketing facilities	81	55.9
	Rural access road	33	22.8
	Portable water	31	21.4
Input Support	Fertilizer	86	59.3
	Agrochemical	30	20.7
	Improved seed	23	15.9
	Invalid	6	4.1
Advisory service	Agronomic practice	33	22.8
	Soil Management	14	9.7
	Sustainability land Mgt	15	10.3
	Pest and diseases	83	57.2
Capacity building	Conflict resolution	28	19.3
	Savings & recording	26	17.9
	Market channels	90	62.1
	Invalid	1	.7
Relationship with extension officers	poor	85	58.6
	Moderate	31	21.4
	Good	29	20.0
Explanation to above answer	Inadequate publicity	30	20.7
	Lack of exposure	33	22.8
	Unfavorable attitude of officers	38	26.2
	Non commitment of officers	28	19.3
	Poor attitude of users	16	11.0
Rate quality of services received	Poor	46	31.7
	Moderate	30	20.7

	Good	68	46.9
	Invalid	1	.7
Explanation to above answer	Increased production	71	49.0
	Not uniformly accepted	28	19.3
	Too complex to understand	19	13.1
	Unwillingness to adopt new ideas	24	16.6
	Invalid	3	2.1

Source: Field Survey, 2018

According to Input supports, the result showed that (59.3%) obtained fertilizer, (20.7%). obtained Agrochemicals while (15.9%) obtained improved seed for planting. This indicated that majority of the farmers received fertilizer as an input support.

According to advisory services, (57.2%) were trained on pest and disease control measure, (22.8. %) were trained on sound agronomic practices, (10.3%) were trained on sustainable land management while (9.7%), were trained on soil management techniques. This indicated that majority of the women received advisory service on how to control pest and diseases.

Distribution to Capacity building Shows that (62.1%) of the women had access to marketing channels, (19.3%) were trained on conflict resolution while (17.9%) were trained on how to save and keep proper records of their farm produce.

Result according to their relationship with the agricultural extension agent shows that (20.0%) agreed that their relationship with extension officers were Good, (21.4%) indicated Moderate while (58.6%) indicated Poor relationship which constituted the highest frequency.

Result on explanation of the relationship with the agricultural extension agents explain that (26.2%) believed that the relation is not always available due to the unfavourable attitudes of officers, (19.3) non commitment to duty by the officers affect the relationship,(20.7%) lack of interest and exposure, (22.8%) said lack of exposure, (11%.0) said that poor attitude of the users devices affect relationship.

According to the quality of agricultural extension services received, (31.7%) indicated poor, (20.7%) indicated moderate while (46.9%) indicated Good quality which constituted the highest frequency. The result therefore means that the majority of the farmers received good quality service from co- farmers and NGOs.

As regards to their explanation to quality of extension service received, (49.0%) agreed that the extension services increased production which constituted the highest frequency. (19.3%) said not uniformly accepted, (16.6%) said too complex to understand and (13.1%) said it is their unwillingness to adopt new idea. Belonwu (2010) reported a rather low contact and quality of extension services between farmers and extension agents which the farmers believe the low contact was effective. This implies that an increase in frequency of contact between farmers and extension agents will definitely translate into increase quality of extension services between the farmers and extension personnel.

Table 4 Impact of extension services to the Livelihood of Women farmers in the area

S/No	Benefits from extension Program	Mean ($\overline{X}$) Response	Decision
1.	Availability of quality food intake	4.06	Accepted
2.	Increase social interaction	3.97	Accepted
3.	My family can afford good health care	3.74	Accepted
4.	Children attend good schools	3.61	Accepted

5.	Have quality household facilities	3.58	Accepted
6.	Increase own productive assets	3.81	Accepted
7.	Living in comfortable house	3.64	Accepted
8.	Have means of transport	3.83	Accepted
9.	Have sufficient savings	3.77	Accepted
10.	Increased income	3.74	Accepted

Source: Field Data, 2018

Result on the perceived impact of Agricultural extension service on their livelihoods.

Showed that majority of them (mean = 4.06) strongly agreed that they had availability of quality food intake in their homes, (mean = 3.97) strongly agreed that the service increased social interaction within women folk, (Mean = 3.74) strongly agreed that they can afford good health care, (Mean = 3.61) strongly agreed that they were able to enroll their children in good school, (Mean = 3.58) had quality household facilities, (Mean =3.81) agreed that their productive assets increased, and that they are living in comfortable houses, had good means of transportation, had sufficient saving and increased income. More so they eat 3 square meals daily. It showed that the women had a positive response to all the items because the mean ($\overline{X}$) is above 3.0. It showed that the extension program had improved the livelihood of okra women farmers in the area.

The livelihoods of rural women in the area were completely dependent on agricultural incomes. For the agricultural works women have a lion's share in the area which is performed by all able-bodied household members. Despite the fact that women have extra-load than men because they participate in all activities, these efforts do not reflect into the quality of their lives in terms of income and social status due to cultural taboos.

Table 5 Constraints faced by women in participating in agricultural extension activities in the area

S/No	Constraints	Mean($\overline{X}$) Response	Decision
1.	Lack or inadequate capital	3.17	**Accepted**
2.	Lack of input	2.99	Rejected
3.	Lack of improved planning materials	2.91	Rejected
4.	Small farm size	2.86	Rejected
5.	Lack of credit facilities	3.08	**Accepted**
6.	Pest and disease	2.91	Rejected
7.	Theft	2.72	Rejected
8.	Lack of information	3.20	**Accepted**
9.	Lack/inadequate markets to sell	3.10	**Accepted**
10.	Low pricing of farm produce	3.21	**Accepted**

11.	High transport cost	3.23	**Accepted**
12.	Bad roads	3.16	**Accepted**
13.	Incompetency of every service providers	2.70	Rejected

Source: Survey Data 2018.

The result revealed that the women were faced with numerous problems in farm business. The most serious problems were: lack or inadequate capital (mean=3.17), lack of credit facilities (mean=3.08), lack of information (mean=3.20), lack/inadequate markets to sell their farm product (3.10), low pricing of farm produce (3.21), high transport cost =3.23), and bad roads (3.16). These were considered to be serious base on mean value above 3.0. This implies that the constraints had significant effect on the production of okra and thus affect income as well as livelihood. This is related to the study of Agada Mary Ojotule *et al* (2017), Their findings, showed that " rural women farmers were constrained by poor access to farm equipment and farm inputs, implying that farmers would only be able to cultivate a small portion of land since agriculture is labour intensive and requires use of inputs for enhanced productivity."

T-TEST RESULT OF THE SERVICES RENDER TO OKRA WOMEN FARMERS AND THE ACTUALIZATION OF THEIR LIVELIHOOD OUTCOMES

T-test of the activities / services render and the actualization of their livelihood Outcomes are presented in table.

Table 6 T-test of the activities / services rendered to okra women farmers and the actualization of their livelihood Outcomes

Variables	N	Mean ($\overline{X}$)	SD	df	t-cal	t-crit	Decision
Activities /services rendered.	72	24.9444	3.66133	143	-2.548	1.96(.012	Rejected
Livelihood outcomes	73	26.3973	3.19174		-2.546		

Source: Survey Data 2018.

The table showed that the t-calculated value of (-2.548) was higher than t-critical 1.96(.012) value at 0.05 level of significant. Therefore, the hypothesis was rejected. It implies that there was significant differences between the activities/services render to okra women and the actualization of their livelihood outcomes.

Agricultural activities /extension service significantly affect the level of women participation and actualization of their livelihood outcomes. These activities /services rendered were significant determinant in actualizing their livelihood outcome and access to agricultural extension services increased production and help them in the actualization of their livelihood outcomes. This is related to a study carried out by (Waddington et al., 2010), "Since a livelihood comprises the capabilities, assets and activities required for a means of living, it appears that agricultural extension intends not only to increase productivity and income but also to improve multifaceted aspects of rural life" and the role that women play and their position in meeting the challenges of agricultural production and development are quite dominant and prominent, (Bill et al, 2012).

T-test of the impact of extension programme and livelihood of women farmers

T-test result on the impact of extension programme and livelihood of women was presented in table

Table 7: T-test on the impact of extension programme and livelihood of women farmers

Variables	N	Mean ($\bar{X}$)	SD	df	t-cal	t-crit	Decision
Extension programme	72	36.3611	10.02013	143	-1.658	1.96(.099	Accepted
Women farmers	73	39.1370	10.13563				

Source: Survey Data 2018.

The table showed that the critical value was 1.96(.099) and t-calculated value of -1.658, was lower than t-critical value, therefore the null hypothesis was accepted. This implies that there is no significant difference between the impact of extension program and livelihood of women farmers**.** The result revealed that the extension program had impacted on the livelihood of okra women farmers in the area since there was availability of quality food intake, increase social interaction, affordable good health care, good schools, quality household facilities, increase own productive assets, comfortable house, had means of transportation, had sufficient savings and increased income. And through the income realised from farming activities, their families were able to eat three square meals daily, eat quality food, afford good health care, children attained good schools, had quality household facilities, had good furniture in their house, living in a comfortable house had means of transport like cars and bike and sufficient savings.

Hypothesis tested revealed that there was no significant difference between the impact of extension program and livelihood of women farmers**.** This indicates that the livelihoods of rural people in the area were completely dependent on agricultural incomes". This is because agricultural extension services were proved to be one of the most important effective means to reach farming households in the rural areas (Adekunle, 2013). This implies that Women play a large part in agricultural activities especially to provide food to sustain the physical and nutritional wellbeing of their families, in the study area.

Table 8 T-test on the constraints faced by women farmers and agricultural extension activities in the study area.

T-test on the constraints faced by women farmers and agricultural extension activities in the study area

Variables	N	Mean ($\bar{X}$)	SD	Df	t-cal	t-crit	Decision
Constraints	72	36.5972	8.63608	143	-3.308	1.96(.001)	Rejected
Women farmers	73	41.8767	10.48007		-3.312		

Source: Survey Data 2018.

Since the critical value was 1.96(.001) and t-calculated value of -3.308, was higher than t-critical value, the null hypothesis was rejected. This implies that there is significant difference between the constraints faced by women farmers and agricultural extension activities in the study area. The result showed that the women farmers are faced with the numerous problems: inadequate capital: this is one of the serious constrained which serves as impediment to agricultural productivity, lack

of credit facilities, lack of information, less access to loans, other agricultural grants, subsides and other training services to get the information, on how to credit facility.

This report correspond with the report of Lerman (2004), which promoted credits as an important engine to enhance farmer's skills and knowledge, linking of farmers with modern technology through the purchase of inputs and investment on agricultural technology and then boosting household's agricultural production.

CONCLUSION

Many agricultural development programmers are on ground with the aim of increasing food production and improving the standards of living in the rural communities. In relation to its role in rural livelihoods, agricultural extension encompasses the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being. The study confirms that agricultural extension services impacted on the livelihood of the women in the area and this impact was made by non - governmental organizations (NGOS) and Co farmers. The impact of the service was felt by the rural women and thus realized that the services were essential tools for getting the information they require for increasing their farm production and productivity.

RECOMMENDATIONS

From the findings, the following recommendations were made:

1. Government should encourage and assist women farmers by giving them special attention in terms of access to needed farm inputs and incentives. New farming implements should be made affordable and available to the women.
2. Women adult literacy education programme is required to help women farmers acquire basic skills and abilities to seek and receive agricultural information through extension agents. This will make them to participate more in reading extension leaflets, bulletin, newsletter among others

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TECHNICAL EFFICIENCY IN VALUE ADDITION TO CASSAVA AMONG SMALL-SCALE *FUFU* PROCESSORS IN ABIA STATE, NIGERIA

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ABSTRACT
The study evaluated the technical efficiency in value addition to cassava among small-scale fufu processors in Abia State, Nigeria. The specific objectives were to: estimate the profitability of small-scale fufu processors; determine the technical efficiency of small-scale fufu processors in the study area. Multi-stage sampling procedure was applied in the random selection of 60 fufu processors for the study. Data collection was accomplished through interview schedule with the aid of questionnaire. Farm Budgetary Technique and Stochastic Frontier Production Function were adopted as the analytical tools. Findings on profitability of fufu processors revealed that the net income of the fufu processors is estimated to be ₦15,920.9 per tonne while the return on investment is 0.3. Investigations from the stochastic production frontier show that the variance parameters (σ^2 and γ) are statistically different from zero, signifying that the Maximum Likelihood model is the adequate one. However, the variance ratio (γ) of fufu processors (0.11) is indicative that the inefficiencies among the fufu processors accounted for 11% variations in the output of fufu. Concerning the determinants of fufu output, cassava tuber (0.9547) and quantity of water used (0.0511) were found to be significantly different from zero. Equally, technical efficiency of fufu processors is attributed to age (0.0013), level of education (0.0022) and extension contact (-0.0534). The fufu processors varied slightly in their technical efficiency with an estimated Mean Technical Efficiency of 0.91 suggesting the need for improvement through effective co-ordination of the available resources without additional cost involvement. The study concluded that fufu processing is a very lucrative venture with guarantee for higher profits through consistent efforts that would overturn the shortfalls in technical efficiency by producing at the maximum output levels expected.

Key Words: Cassava, Profitability, Small-scale Processors, Technical Efficiency, Value Addition,

INTRODUCTION
Cassava holds an important place in developing countries especially, in Africa where its products are consumed daily as a cheap source of carbohydrate. In comparison to other food crops, cassava produces more weight of carbohydrate under different agro-ecological conditions thus, its usefulness as an energy-dense food as it is ranked high in energy content (Onyenwoke & Simonyan, 2014). Cassava plays a major role in poverty alleviation as well as cushioning the effect of food crisis in Africa because of its ability to tolerate adverse weather stresses and its significant contribution in the food supply among producing and consuming households (Food and Agriculture Organization, 2009). Due to the increasing rate of urbanization, cassava has become one of the most essential staple foods consumed by over 70 million Nigerians with an estimated per capita consumption of cassava found to be more than 238 calories per person per day (Phillip *et al*., 2010). Also, studies show that cassava can thrive under poor fertile soils and drought conditions without being affected as much as other crops (International Institute of Tropical Agriculture, 2012; Apata, 2019). This makes it a hardy crop that can survive relatively wide range

of biotic and ecological factors that could otherwise hamper the growth of other tuber crops such as yam and potato.

Cassava is recognized as a low cost staple food in Nigeria and holds an important place as a raw material in the manufacturing of processed food, animal feeds and industrial products. It also provides enormous income generating potentials for farmers especially when improved upon through processing (Abass, Olarinde, Okoruwa, Amaza, Awoyale, Alabi & Ndavi, 2019). The diversity in the usefulness of cassava alongside the growing population has increased the demand of processed cassava products in both domestic and international markets (Olekunrin & Sawicka, 2019). This is attributable to its use as a composite element of wheat flour used in making confectionaries, and food for humans and livestock.

In the work of Apata (2019), value chain is explained as a means of gaining competitive control of products by performing a set of activities that enhance the product for the market and in turn, generate income for the participants. However, given that most government initiatives and interventions are geared towards the integration of poor rural farmers into the mainstream economy (Coulibaly, Arinloye, Faye & Abduloye, 2014), diversification by way of adding value to the produce of these farmers will not only increase foreign exchange but also lead to the production of agricultural products for the growing population. Adeniyi and Akande (2015) stated that value chain actors are positioned at different nodes of value addition which include: input suppliers, extension workers, producers/farmers, processors, transporters, marketers and end users. Generally, these actors assume important roles in maintaining the value chain. However, among these actors are the processors whose roles are very vital in ensuring that the highly perishable cassava roots are processed to improve its shelf life. Literature described that the shelf life of cassava tuber can be elongated by processing it into *fufu* by boiling peeled cassava roots and pounding. The peeled cassava are soaked in water to ferment for four days; washed into a basin, filtered using a colander which presses the water out while the filtrate is molded in big lumps, steamed and pounded (Denton, 2006; Abass, *et al*., 2016).

In Nigeria, cassava processing is characterized by small-scale farmers who undertake primitive methods of processing (Food and Agriculture Organization, 2013), hence undermining the efforts to offset the deficit in domestic food demands and industrial level demand in the country. Despite the numerous comparative advantages that are found in cassava industry as the world leading producers of cassava with a share of 20.4% of the global output (Food and Agriculture Organization Statistics Database, 2019), Nigeria spends annual fortunes amounting to $680 million on importation of intermediate and finished products of cassava such as: flour, starch, glucose, animal feed (United State Agency for International Development, 2013). The study by Harris and Koomson (2011) found that processing of cassava into other intermediate and consumable products is a form of value addition which aids in preserving the highly perishable tubers through the reduction of moisture and the cyanogenic content of the cassava tuber. Proper processing of cassava tubers is an integral aspect of cassava value addition as it increases the market opportunities for farmers and serves as an incentive to enhance more production of cassava and

guarantees supply of food and raw materials for household and industrial utilization (Otekunrin & Sawicka, 2019). However, the study by International Institute for Tropical Agriculture (2012) shows that poor shelf life, low protein content and poor post-harvest facilities limit increased cassava utilization into several value added products. Correspondingly, Philip *et al.* (2010) found that the traditional method of cassava processing in Nigeria is affected by susceptibility to spoilage, drudgery and low productivity, thus significantly affecting the cost of the final product of cassava due partly to competition with other substitute products. Also, cassava products such as *fufu* require an additional cost of transportation and packaging prior to marketing (Adeniyi & Akande, 2015). This may have implication on the realizable profit of the processors since the value of the processed product may not compensate for the additional cost incurred.

Efficiency is an integral factor of productivity growth, especially in under-developed economies where few newly developed technologies are not widely adopted and/or not suitable to their existing farming system and environment (Anyanwu, Kalio, Olatunji & Akonye, 2014). In order for the cassava processors to effectively perform their functions, efficient use of the available resources is imperative. Efficiency studies are therefore required to ascertain the possibility to increase productivity by raising the efficiency without necessarily developing new technologies or employing additional inputs. With respect to *fufu*, literature review (Denton, 2006; Partnership Initiatives in the Niger Delta, 2011; Abass *et al*., 2016) indicated that research on Technical Efficiency on *fufu* processors is scanty in the study area. In view of this, the study specifically aimed at estimating the profitability of small-scale *fufu* processors as well as determining the technical efficiency of small-scale *fufu* processors in the study area.

METHODOLOGY

The study was conducted in Abia State, Nigeria. The State is geographically placed within Latitudes 5º 31' 29.68ºN of the Equator, and Longitudes 7º 29' 40.60ºE of the Greenwich Meridian. It shares boundaries with Cross River State in the North, Ebonyi State in the North West, Imo State in the West, Akwa Ibom State in the East and Rivers State in the South. Abia State is also one of the five States that made up the South-east zone under the six geo-political zones in the country, and one of the nine constituent States of the Niger-Delta region. Abia State has a projected population of 3,727,300 persons occupying a land area of 4900 square kilometers (National Bureau of Statistics, 2016). It is situated within the rain forest belt with annual mean temperature of 27.5ºC, average annual rainfall of 1980mm and mean annual humidity of 72% (Chukwu & Okeke, 2015). Abia State is endowed with enormous human and natural resources. The main occupation of the people is farming, even though the State harbors some artisans and traders. Its fertile soil enables farmers to grow: cassava, yam, rice, oil palm, cucumber, egg plant, plantain, cocoyam, banana, cocoa, maize and cashew. The State consists of three agricultural zones, namely: Aba, Umuahia and Ohafia agricultural zones.

The study adopted multi-stage random sampling procedure in the selection of *fufu* processors. In stage one, two agricultural zones were randomly selected from the three agricultural zones in the study area. Stage two involved random selection of three Local Government Areas from each of

the two agricultural zones, thus comprising a total of six Local Government Areas selected. Stage three involved random selections of two communities from each of the six Local Government Areas chosen. This amounted to 12 communities that were used for the study. Finally, in stage four, 5 *fufu* processors were randomly selected in each of the 12 selected communities from the list compiled by the extension agents operating in the selected areas, giving rise to 60 *fufu* processors that were interviewed. The objectives of the study were analyzed using Farm Budgetary Technique and Stochastic Frontier Production Function. Farm budgetary technique can be expressed as:

$$\prod = TR - TC \quad (1)$$

$$TC = TFC + TVC \quad (2)$$

$$TR = PyQ \quad (3)$$

Gross Margin is expressed as thus: $GM = TR - TVC$ (4)

Net Income is given as: $NI = TR - TC$ (5)

Return on Investment is given as: $ROI = NI/TC$ (6)

Where
P_y = Price of *fufu* output, $\prod$ = Total Profit, TC = Total Cost, TR = Total Revenue, Q = Output of *fufu,* P_y = Price per unit of *fufu* output, TFC = Total Fixed Cost, TVC = Total Variable Cost

The concept of efficiency is important in agriculture as it determines the relative performance of the processes involved in transforming a given unit of inputs into output (Abass *et al*., 2019). Economic theory classifies efficiency in three types namely: technical efficiency, allocative efficiency and economic efficiency. The main focus of the study is on technical efficiency, which according to Onoja (2004) is defined as the proper utilization of farm resources in such a manner that output is maximized without waste. Technical efficiency is normally estimated using parametric or non-parametric approach. This study adopted the parametric approach. Although, the choice of the parametric approach entails that any of the econometric methods of either deterministic or stochastic is applied (Kumbhakar & Lovell, 2000). According to Olukosi and Erhabor (1972), the deterministic model aggregates all deviation in output to be attributable to technical inefficiency effect while the stochastic frontier model estimate deviation in output to accommodate factors beyond the control of the farmer, thus specifying the distribution of the composite error term.

The explicit Stochastic Frontier Cobb-Douglas Production Function that specifies production efficiency of the *fufu* processors can be expressed as:

$$\text{Ln } Y = \beta_0 + \beta_1 \text{Ln} X_1 + \beta_2 \text{Ln} X_2 + \beta_3 \text{Ln} X_3 + \beta_4 \text{Ln} X_4 + V_i - U_i \quad (8)$$

Where:

Y = Output (Quantity of *fufu* produced in kg)
X_1 = Cassava tubers (kg)
X_2 = Labour used (man-days)
X_3 = Firewood used (bundles)
X_4 = Quantity of water used (litres)
β_0 = Constant parameter
β_1 - β_4 = Parameter coefficients to be estimated

Ln = Natural logarithm

V_i = Symmetric error term which represent random variation in output due to factors outside the farmers control.
U_i = Non-negative random variables accounting for inefficiency in production relative to the stochastic frontier.

The relationship between technical inefficiency of *fufu* processors and the socio-economic characteristics can be expressed as:

$$\sum[\exp(-U_i)] = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 Z_5 + \beta_6 Z_6 + \beta_7 Z_7 + \beta_8 Z_8 \quad 9$$

Where:
$\sum [\exp(-U_i)]$ = Technical inefficiency of *fufu* processors
Z_1 = Age of the *fufu* processors (years)
Z_2 = Number of years of formal education
Z_3 = Household size (no of persons)
Z_4 = Processing experience (years)
Z_5 = Off farm activities (full time farmer = 1; part time = 0)
Z_6 = Marital status (married = 1; single = 0)
Z_7 = Processors' belonging to co-operative societies (members = 1; non- member = 0)
Z_8 = Extension Contact (Yes = 1; No = 0)
β_0 = Constant
β_1 - β_8 = Estimated parameters

RESULTS AND DISCUSSION

Costs and Return of *Fufu* Processors

Table 1: Costs and Return of *Fufu* Processors in the Study Area

Items	Quantity	Unit Price (₦)	Value (₦)/tonne
Revenue from the sales of *fufu* (1 wrap of *fufu* = 0.53kg)	1000	69.18	69180
Total Revenue			**69180**
Cassava tubers (1bag of cassava tuber = 48.8kg)	1000	22.54	22540
Firewood (bundles)	30	300	9000
Water in litres (@ ₦15 per 50 litres)	1242	0.3	372.6

Labour (man-day):			
Peeling/Washing	10	600	6000
Soaking	10	200	2000
Sieving/Pressing	20	200	4000
Boiling/Pounding	4	600	2400
Cooking	7	600	4200
Total Cost of Labour			18600
Palm oil (litres)	-	-	-
Transportation cost(₦)	-	-	2213.52
Total Variable Cost			**52726.12**
Depreciation value of equipment			532.98
Total Fixed Cost			**532.98**
Total Cost			**53259.1**
Gross Margin			**16453.88**
Net Income			**15920.9**
Return on Investment			**0.3**

Source: *Field survey, 2018*

The costs and return of *fufu* processors in the study area is presented in Table 1. Total revenue for *fufu* processors is estimated to be ₦69,180/tonne of cassava tuber while the total variable cost is ₦52,726.12. The Table shows that cost of cassava tubers (₦22,540), labour cost (₦18,600) and cost of firewood (₦9000) accounted for the greater proportion of the total cost component of *fufu* processing. The result also reveals ₦532.98 and ₦52726.12 as the estimates of total fixed cost and total variable cost respectively. The Table further shows that the Gross Margin estimated is ₦16,453.88/tonne of cassava tuber while the Net Income is ₦15,920.9/tonne of cassava tuber. However, the return on investment of *fufu* processors is estimated to be 0.30. This is indicative that the *fufu* processors will make a profit of 30kobo in every ₦1invested in processing cassava tuber into *fufu*.

Estimate of the Stochastic Frontier Production Function for *Fufu* Processors

The Maximum Likelihood Estimation (MLE) and its associated Ordinary Least Square (OLS) results are presented in Table 2.

Table 2: Estimates of the Stochastic Frontier Cobb-Douglas Production Function for *Fufu* Processors in the Study Area

Variables	OLS		MLE	
	Coefficients	**Standard error**	**Coefficients**	**Standard error**
Constant X_0	0.0584 (-0.2941)	0.1964	0.1445 (0.2155)	0.6707
Cassava tuber X_1	0.9445 (35.17)*	0.0375	0.9547 (29.98)*	0.0318
Labour X_2	0.0531 (1.910)***	0.0278	0.0172 (0.6332)	0.0271
Firewood X_3	-0.0115 (-0.5615)	0.0205	-0.0223 (-1.2402)	0.0180
Water X_4	0.0380 (1.6869)***	0.0226	0.0511 (2.5325)**	0.0201

Diagnostic Parameters				
Sigma squared (δ^2)	0.0027	-	0.0020 (5.9117)*	0.0003
Gamma (γ)	-	-	0.1100 (5.4726)*	0.0201
Log-likelihood	106.8	-	115	-
LR Test	-	-	16.42	-

Source: *Field Survey (2018) using Statistical Software (Frontier Version 4.1c)*
Figures in parenthesis are t-ratios
* ; ** ; *** represent levels of significance at 1%, 5% and 10% respectively.

The Ordinary Least Square (OLS) result and the Maximum Likelihood Estimation (MLE) of the parameters of the Stochastic Frontier Production Model of *fufu* processors are presented in Table 2. The significance of the sigma-squared from the MLE suggests the appropriateness of the model in preference to the OLS model. The sigma squared (δ^2) and the variance ratio (γ) from the MLE are statistically different from zero at 1% level of significance. The significance of the sigma-squared (δ^2) implies that the model (MLE) gives credibility to the goodness of fit and also shows the correct representation of the inefficiencies among the *fufu* processors in the study area. The estimated gamma (γ) is 0.11 which thus infers that 11% of the variation in *fufu* output was attributable to the inefficiency effects among the *fufu* processors.

The result from Table 2 also reveals that cassava tuber and the quantity of water used are directly related to output (*fufu*) and are statistically significant at 1% and 5% levels of significance. These signs are in conformity with the *a priori* expectation which agrees that cassava tuber and water significantly contribute to the output of *fufu*. It means a percentage increase in the use of cassava tuber and water will add 0.95% and 0.05% respectively to the overall mean elasticity of *fufu* output. The positive relationship between the significant inputs (cassava tuber and quantity of water used) employed in the production and the resulting output of *fufu* might be due to the fact that these inputs constitute the major raw materials that could contribute to the quantity of the output of *fufu*.

Estimates of the Determinants of Technical Inefficiency of *Fufu* Processors

The parameter estimates of the determinants of technical inefficiency of *fufu* processors are presented in Table 3.

Table 3: Estimates of the Determinants of Technical Inefficiency of *Fufu* Processors in the Study Area

Varables	Coefficients	Standard error
Constant Z_0	0.0060 (0.0095)	0.6288
Age Z_1	0.0013 (1.8571)***	0.0007
Level of education Z_2	0.0022 (2.000)**	0.0011
Household size Z_3	0.0025 (1.1050)	0.0022

Processing experience Z_4	-0.0005 (-0.4823)	0.0010
Off-farm activities Z_5	0.0137 (0.8669)	0.0158
Marital status Z_6	0.0060 (0.3793)	0.0159
Co-operative membership Z_7	-0.109 (-0.7313)	0.0148
Extension contact Z_8	-0.0534 (3.4223)*	0.0157

Source: *Field Survey (2018) using Statistical Software (Frontier Version 4.1c)*
Figures in parenthesis are t-ratios
* ; ** ; *** represent levels of significance at 1%, 5% and 10% respectively.

Table 3 shows that extensions contact, level of education and age are the variables that explained technical inefficiencies among *fufu* processors at 1%, 5% and 10% levels of significance respectively. These variables carry the expected signs apart from the level of education which is positive. The plausible explanation for the wrong sign of education attainment could be that more educated processors substitute *fufu* processing for less laborious jobs as *fufu* processing is labour intensive thereby bringing about technical inefficiency. This counters the opinion of Atagher and Okorji (2014) which states that higher education level encourages better combination of productive resources and efficient input utilization.

The coefficient of extension contact is negative, indicating that *fufu* processors are more technically efficient as they increase their frequency of contact with extension personnel and *vice versa*. This corroborates the assertions of Awerijie and Rahman (2014) which states that extension contact facilitates easy adoption of innovation for increased productivity. However, the positive sign of the coefficient for age implies that the predominance of young farmers in *fufu* processing tends to increase technical efficiency. This might be that the aging processors do not have strength as much as the younger ones to undertake all the rigorous activities that are associated with *fufu* processing. This finding is supported by Sadiq, Sanusi and Singh (2015) who reported that aging farmers are less energetic in comparison to the contemporary younger ones.

Technical Efficiency Indices of *Fufu* Processors

Table 4: Distribution of *Fufu* Processors according to their Technical Efficiency Indices in the Study Area

Efficiency range	**Frequency**	**Percentage**
0.86 – 0.90	32	53.3
0.91 – 0.95	24	40
0.96 – 1.00	4	6.7
Total	**60**	**100**
Minimum	**0.86**	
Maximum	**0.96**	
Mean	**0.91**	

Source: *Field Survey (2018); Computed from Statistical Software - Frontier 4.1c*

Table 4 presents the distribution of *fufu* processors according to their technical efficiency levels. The result shows a narrow magnitude of variation among the *fufu* processors' technical efficiencies which ranges from 0.86 to 0.96, thus leaving efficiency gap of only 10% between the least and the most efficient processors. The result further reveals that, 46.7% of the *fufu* processors produce above 91% efficiency level whereas 53.3% produce within the levels of (86 - 90) %. Also, to arrive at the level of the most efficient *fufu* processor, the least and average *fufu* processors require making output (*fufu*) increases of 10% and 5.2% respectively given the same set of inputs and production technology. From the Table, a Mean Technical Efficiency of 91% was obtained indicating that 9% was lost due to inefficiencies among the *fufu* processors. This means there is a little room for improvement in order to achieve the maximum expected level of output.

CONCLUSION

The study evaluated the profitability and technical efficiency of *fufu* processors in the study area. Cassava processing is profitable in the study area as deduced from the positive net-income and return on investment of *fufu* processors. Also, *fufu* processors are technically inefficient in the study area, producing at efficiency levels of narrow margin of variation among them. In other words, *fufu* processors have potentials to maximize output levels through better management of their available resources without increasing the cost of production. However, age, level of education and extension contact are the factors that significantly influenced technical efficiency among the *fufu* processors.

RECOMMENDATIONS

Based on the findings from the study, the following recommendations were proffered:

1. Government and Non-governmental Organizations should venture into partnership with *fufu* processors through the provision of processing and storage facilities This will spur the attention of farmers, especially; the educated among them towards increased participation in *fufu* production at the same time stimulate increase in efficiency as they take advantage of the opportunity.
2. The result indicated cassava tuber as the chief raw material for the processors because it constituted the largest part of the total cost component. Therefore, stakeholders in agriculture should encourage *fufu* processors to form co-operative societies that will enable them procure this input at affordable price and obtain timely information about market situations as it concerns their business.
3. Relevant agencies in agriculture such as the Agricultural Development Programme should frequently educate the *fufu* processors on the modern techniques of processing by organizing training sessions and workshops. This will increase the efficiency of conversion of cassava to *fufu* and in consequence reduce wastages associated with post harvest deterioration of the cassava tuber due to delay.

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COMMUNICATION CHANNELS PREFERENCES BY YOUTHS ENGAGED IN AGRIBUSINESS ACTIVITIES IN OHIONMWON LOCAL GOVERNMENT AREA, EDO STATE, NIGERIA

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ABSTRACT

When preferred communication channels are not in place, relevant agricultural information may not reach the target audience, consequently, renders the message worthless. This study assessed the communication channels preferred by youths engaged in agribusiness activities in Orhionmwon Local Government Area, Edo State, Nigeria. A two-stage sampling procedure was used in the simple random sampling of 120 respondents for the study. Data were analysed using frequency counts, percentages and mean scores while Spearman Rank correlation was used to determine relationship between variables. Results showed that while television (80.8%) was prominently used by the youth in agribusiness, the phone call ($\underline{x}$ = 2.57) was the most preferred channel of communication by them. Improved household food sufficiency($\underline{x}$ = 3.57) was the most significant benefit perceived by the respondents for engaging in various agribusiness activities who were seriously constrained by poor access to capital($\underline{x}$ = 4.44). However, there was a significant and negative relationship between constraints encountered by the youth and their preferences for communication channels in the study area. The need for an initial identification of communication channels based on users' preferences was recommended by this study, as this will ensure the successful engagement of key actors in any agricultural programme and accomplishment of desired goals.

Key words: Activities, Agribusiness, Communication channels, Preferences, Youth

INTRODUCTION

A good understanding of the working and practice of an ideal business environment is pertinent for the successful engagement of farmers in any agribusiness enterprise (Onubuogu & Onyeneke, 2012). According to David (2016) agribusiness refers to the application of theories and practices of business administration to organizations engaged in agriculture and agriculturally related products and services. It covers the entire value chain, including the supply of agricultural inputs, the production and transformation of agricultural products, and their distribution to final consumers (FAO, 2017). In the light of this definition Aphunu and Atoma(2010) asserted that agribusiness development will not occur without engaging young farmers who account for the overwhelming majority of the most active segment of the Nigerian population and the engine that perform most of the productive works. Specifically Adesugba and Mavrotas(2016)pointed that young people in the age range of 15 to 34 are estimated to constitute more than one-third of the Nigerian population accounting for 51.6% female and 48.4% male in gender distribution. It is therefore unarguable that agriculture holds considerable potential to provide gainful employment opportunities to a large number of youth if it is supported with increased investment, conducive legal and policy frameworks (Koira, 2014).

Recently, youth engagement in agribusiness activities is becoming a prominent issue as they have become disenchanted with agriculture worldwide (Phyo, 2018). This notion has to be strongly addressed in other to effectively explore the huge potentials of the teeming young people in the agricultural sector. With the large number of unemployed youths in Nigeria and ageing farmers producing most of the food we eat, it is imperative to get more youthful energy into food production, processing and their associated industries, to reduce hunger and poverty in the world and give our youth a viable and meaningful future**(**Global Forum on Agricultural Research and Innovation (GFAR), 2018**)**.This is because agriculture has the capacity to provide the main source of income to the citizens of developing countries and it is vital that young people are well engaged in farming (Phyo, 2018).

This present scenario according to Koira (2014) provides a wide implication for extension workers who are charged with the responsibility of communicating relevant agricultural technologies to the teeming youth to improve on the existing knowledge. Okoedo-okojie and Oriakhi (2011) asserted that any improvement in youths' technical knowledge alone is not sufficient. It needs to go hand-in-hand with the development of business and managerial abilities. However, efforts aimed at the full realisation of this goal has triggered a significant shift from merely providing technical solutions to production problems by extension agents towards a broader approach of understanding farmers' goals, preferences and business opportunities in farming. For the information providers to effectively respond to the new challenges that young people are now facing, they need to ensure the skilful combination of different communication channels preferred by them (Okoedo-okojie & Oriakhi, 2011).

Communication channels are vehicles through which information is transferred or received with relevance, timelessness, accuracy, cost effectiveness, reliability, usability, exhaustiveness and aggregation level (Muriuki, Munyua &Wanga, 2016). According to Agbarevo and Obinne (2010) different communication channels perform different functions in the transmission of information in agriculture. The audience socioeconomic differences may compel extension agent to choose among communication channels (Licht & Martin, 2007). The use of preferred communication channel is usually emphasised due to notable disparities prevalent among people in different times, location, age and sex. For any channel to be of preference by the user, it should be suitable in terms of language, culture, technical level and content for it to be appropriate (Opara, 2010). Unless the clients' needs, interests and problems are addressed, they would not be willing to be part of the communication process. In such cases, understanding the target audience, including the methods by which they prefer to receive information, allows information providers to select communication channels accordingly and to transfer information efficiently.

However, while several studies had concentrated attention in the contributions of youth in agricultural primary production, there seems to be noticeable neglect on the aspect of disseminating information to them considering their preferred channels of communication. This situation needs to be ascertained for youth in Orhionmwon Local Government Area, Edo State. The probable questions that call to mind are: What are the communication channels used by youths for agribusiness activities? Which of these channels do they prefer? What are the respondents' perceived benefits for engaging in agribusiness activities and what are the constraints encountered by youths engaged in agribusiness activities in the study area? An attempt to provide answers to the following questions generated the need for this study. This study was broadly designed to assess the communication channels preferred by youth engaged in agribusiness activities in Orhionmwon Local Government Area, Edo State, Nigeria. The specific objectives were to: identify

the communication channels used by youths for agribusiness activities in the study area; identify the respondents' preferred communication channels in the study area; examine the respondents' perceived benefits for agribusiness engagement in the study area and to; identify constraints encountered by youths engaged in agribusiness activities in the study area.

METHODOLOGY

The study was conducted in Orhionmwon Local Government Area (LGA) of Edo State, Nigeria with headquarters at Abudu. Orhionmwon LGA has a population of about 182,717 persons with a land area of 382 km^2 and lies between Latitude 50 44' 19.151"N and 6° 25' 45.776'N of the equator and Longitude 50 43' 6.403'E and 6° 16' 20.982 'E of the Greenwich meridian. The people of the area are predominantly farmers whose major crops include yam, cassava, maize, plantain, and cocoyam. A two-stage sampling procedure was used in sampling of respondents for the study. Stage one involved a purposive sampling of Six (6) communities in Orhionmwon Local Government Area, due to their significant engagement in agribusiness ventures. While the second stage was a simple random sampling of 20 youths from each of the 6 selected communities, giving a total sample size of 120 respondents for the study. Data were analysed using frequency counts, percentages and mean scores while the spearman rank correlation was used to determine relationships between variables.

RESULTS AND DISCUSSION

Communication channels used by youth in agribusiness activities

Distribution of the youths according to communication channels used by them is as presented in Table 1 below.

Table 1: Information channels used in Agribusiness activities

Information channels	Used		Not used	
	Freq.	%*	Freq.	%*
Television	97	80.8	23	19.2
Whatsapp	91	75.8	29	24.2
Radio	89	74.2	31	25.8
Family and friends	89	74.2	31	25.8
Phone calls	86	71.7	34	28.3
Facebook	85	70.8	35	29.2
Newspaper	46	38.3	74	61.7
Google	38	31.7	82	68.3
Workshops	33	27.5	87	72.5
Web pages	33	27.5	87	72.5
Extension agents	20	16.7	100	83.3
Telegram	19	15.8	101	84.2
Conferences	18	15	102	85
Magazine	17	14.2	103	85.8
Newsletter	11	9.2	109	90.8

Source: Field Survey, 2018*Multiple responses recorded

Result in Table 1 shows that the majority (80.8%) of the youths made use of television as their major channel for obtaining agribusiness information in the study area. This was closely followed by the use of Whatsapp (75.8%), radio as well as family and friends (74.2%) respectively as their main channels of information. However, magazine (14.2%) and newsletter (9.2%) were the least

used channels by respondents in the Orhionmwon LGA, Edo State. This result implies that the most prominently used channel by youth in the study area was television. According to Ogola (2015) the television is one of the powerful channels of the mass media, which transmit information very fast about agricultural technology within the farming community. The reason for the popularity of television as the most used channel of communication among youth may not be unconnected to the submission by Lutkewitte, (2013) that television combines multiple symbol systems, such as visual images, sounds, music, spoken and written language, and present them simultaneously. By implication, the multiple symbol systems effect of the television has the capacity to arouse interest of the youth by attracting their attention by creating the awareness for the adoption of modern agribusiness principles Agbarevo and Obinne(2010) maintained that the television can be used to motivate, develop and promote change in attitude of the farmer. This result also compares favourably with the findings of the Media Council of Kenya (2012) where the majority at (83.0%) made use of television but contrary to Asogwa (2014) where only 5.4% of the respondents sourced information via the television. However, the decline in the use of the magazine and newsletter by youth corresponds to the views of Ogola (2015) that every quarter the print media loses one percent of their readership, who are migrating either to radio and television or are receiving content in other ways such as the internet, Whatsapp, and breaking-news alerts issued by the same print media.

Preference for communication channels by the youth in the study area

Presented below were communication channels which the respondents indicated to have preferred in the study area.

Table 2: Preference for communication channels by the youth

Channels	Mean	Std. Deviation	Rank
Phone calls	2.57*	0.63	1st
Television	2.56*	0.62	2nd
Family and friends	2.47*	0.61	3rd
Radio	2.43*	0.59	4th
Whatsapp	2.42*	0.67	5th
Facebook	2.40*	0.72	6th
Newspaper	2.22*	0.61	7th
Google	2.11*	0.55	8th
Workshops	2.11*	0.58	9th
Web pages	2.09*	0.58	10th
Conferences	2.04*	0.56	11th
Ext agents	2.00*	0.50	12th
Newsletter	1.99	0.49	13th
Magazine	1.96	0.47	14th
Telegram	1.81	0.51	15th

Source: Field Survey, 2018. ***Preferred channels:** $\underline{x} \geq 2.5$

Result presented in Table 2 shows that the most preferred channel of communication by youth engaged in agribusiness activities in the study area was phone calls ($\underline{x}$ = 2.57) and was ranked first in position. Next in ordering were television ($\underline{x}$ = 2.56), family and friends ($\underline{x}$ = 2.47), radio ($\underline{x}$ = 2.43), whatsapp ($\underline{x}$ = 2.42) among others and were ranked 2nd, 3rd and 4th positions respectively. This result indicates that the phone call was the most preferred channel of communication by youth in the study area. According to Ogola (2015) the present age of information revolution and application of the Information Communication and Technologies (ICTs) has encouraged the use of the telephone as the most convenient and preferred medium of communication due its portability and possibilities of immediate feedback by end-users. However,

Sikundla, Mushunje and Akinyemi (2018) criticized that high cost of airtime is a major barrier to the frequent use of telephone calls by youth in agriculture and the primary reason for the use of alternative media.

Perceived benefit of youth engagement agribusiness activities in the study area

Distribution of the respondents according to their perceived benefits for engaging in agribusiness activities is shown in Table 3 below.

Table 3: Perceived benefits of youth engagement agribusiness activities

Perceived benefits	Mean	Std. Deviation	Rank
Improved household food security	3.59*	0.558	1st
Provision of employment opportunities	3.52*	0.608	2nd
Improved standard of living	3.48*	0.673	3rd
Alternative source of income	3.38*	0.724	4th
Improved educational training for children	3.24*	0.767	5th
Improved medical treatment for household	3.23*	0.783	6th
Enhanced Participation in social activities	3.08*	0.832	7th
High risk venture	2.70*	0.885	8th

Source: Field Survey, 2018. *** Beneficial:** $\underline{x} \geq 3.0$

The most significant benefit perceived by youth as shown in Table 3 was improved household food security ($\underline{x}$ = 3.57) and ranked first in order of positions. Others were provision of employment opportunities ($\underline{x}$ = 3.48), provision of employment opportunities ($\underline{x}$ = 3.52), improved standard of living ($\underline{x}$ = 3.48), alternative source of income ($\underline{x}$ = 3.38), (improved educational training for children ($\underline{x}$ = 3.24), improved medical treatment for household ($\underline{x}$ = 3.23), enhanced participation in social activities ($\underline{x}$ = 3.08), high risk venture ($\underline{x}$ = 2.70) and were ranked accordingly. The implication of the foregoing suggests that the youth views agriculture as a dependable source of household food security in the study area. This result agrees with the submission of the Nigeria Youth Policy (2009) that youth engagement in the agriculture sector especially in the fields of production, preservation, processing and marketing of farm produce will certainly combat malnutrition among young people. However, pointed that food insecurity and hunger are forerunners to nutritional, health, human and economic development problems and connote deprivation of basic necessities of life.

Constraints encountered by the youths in agribusiness activities engagement

Shown in Table 4 below were the constraints faced by youths engaged in agribusiness activities in the study area.

Table 4: Constraints in Agribusiness activities

Constraints	Mean	Std. Deviation	Rank
Poor access to capital	4.44*	0.87	1st
High tax rate	3.93*	1.23	2nd
Theft/pilfering	3.49*	1.46	3rd
Inadequate manpower	3.46*	1.35	4th
Government policies	3.46*	1.32	5th
Bad road network	3.41*	1.34	6th
Disease outbreak	3.38*	1.40	7th
Low crop yield	3.15*	1.30	8th
Inadequate technical assistance	2.77	1.20	9th

Poor access to agribusiness information	2.53	1.47	10th
Poor access to market	2.14	1.34	11th
Low training on agriculture	2.11	1.26	12th
Inadequate business know-how	2.03	1.28	13th
Poor mentorship	2.01	1.23	14th
Unfavourable customs and traditions	1.77	1.37	15th

Source: Field Survey, 2018**. Constraints:** $\underline{x} \geq 3.0$

Result in Table 4 shows that access to capital ($\underline{x}$ = 4.44), high tax rate ($\underline{x}$ = 3.93), Theft/pilfering ($\underline{x}$ = 3.49), inadequate manpower ($\underline{x}$ = 3.46), Government policies ($\underline{x}$ = 3.46) bad road network ($\underline{x}$ = -3.41), disease outbreak ($\underline{x}$ = 3.38), low crop yield ($\underline{x}$ = 3.46), were the identified factors militating against youths engagement in agribusiness activities. This result however, infers that poor access to start-up capital was the most significant constraint encountered by youth engaged in agribusiness activities in the study area. According to Ude (2020), one of the major problems of farmers in general is insufficient capital and particularly acute among the youth as new entrants in the sector. Farming as a business requires adequate capital necessary to create, maintain, and expand a business, increase efficiency, and to meet seasonal operating cash needs (Gashu, Demment & Stoecker, 2019). For this reason, resource-poor young farmers are unwilling to risk their small capital to adopt a new technology. Unfortunately, Agbarevo and Obinne (2010) noted that banks and other insurance firms are not too keen to on farm lending and insurance because they consider agriculture a high-risk venture. This however further attributes to reasons why young farmers are unable to approach commercial banks for investment in farming. As a way out Barzola (2019) suggested that extension workers can assist young farmers by reaching them through communication channels preferred them. They should educate them on the modalities of having access to credit, by linking them to banks and assisting them in producing feasibility reports, keeping good farm records, valuation of assets and other requirements contingent to acquisition of bank loans or credits.

Relationship between agribusiness activities and constraints encountered by youth in the study area.

Table 5 below shows the result of the Spearman rank correlation analysis between agribusiness activities engaged in and constraints encountered by respondents in the study area.

Table 5: Relationship between constraints encountered and preferences for communication channels by youth in the study area.

Variable	Coefficient (r)	t – ratio	P – value
Constraints	-0.300**	-3.5802	(p<0.001)

Source: Field Survey, 2018.** *Significant at 1% Level*

As shown in Table 5, result indicates that there was a significant and negative relationship between constraints (-0.300; p<0.001) encountered by the youth and their preferences for communication channels in the study area. This result implies that the more the constraints experienced by the youth, the lesser their expressed interest in the use of communication channels. It therefore corresponds with the assertion in a separate study by the American Society of Agricultural Engineers (2005), that when preferred communication channels are not in place, available technologies will not reach the target audience. This suggests the reason for the low preference for the use of available channels due to the prevailing constraints encountered by them. As a means of remedy to the above, Muriuki, Munyua and Wanga (2016) submitted that prior identification of

farmers' preference is important before initiation of any project since it can help to design more acceptable and cost-effective development intervention programs. It is therefore expected that the application of appropriate communication channels the meets the youth socio economic backgrounds will enhance their preferences of use in the study area.

CONCLUSION

Early recognition of farmers' preference for communication channel is important before initiation of any project since it can help to design more acceptable and cost-effective development intervention programs. This study therefore established that while television was prominently used by the youth in agribusiness, the phone call was the most preferred channel of communication by them. Improved household food sufficiency was the most significant benefit perceived by the respondents for engaging in various agribusiness activities who were seriously constrained by poor access to capital. However, there was a significant and negative relationship between constraints encountered by the youth and their preferences for communication channels in the study area.

RECOMMENDATION

The need for an initial identification of communication channels based on users' and preferences was recommended by this study, as this will ensure the successful engagement of key actors in any agricultural programme and accomplishment of desired goals.

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EXPLORING INDIGENOUS KNOWLEDGE FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE CASE OF AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEM (AKIS) IN NIGERIA

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ABSTRACT
There have been progressively growing concern on how indigenous knowledge of Africans could be incorporated into agricultural development process for endogenous development. While considering the implications of these concerns in the agricultural sector, this paper articulates the possibility of exploring indigenous agricultural knowledge in agricultural extension teaching and learning process of Agricultural Knowledge and Information System (AKIS) for sustainable agricultural development in Nigeria. Specifically, it discusses the rationale for agricultural extension education, the place of Indigenous Knowledge System (IKS) in sustainable development and how it could be used to enhance agricultural extension delivery content; thereby producing trained farmers; and ascertain the relevant indigenous knowledge for agricultural development. Among others, it is suggested that the country's agricultural extension delivery process should be enriched with the identified indigenous agricultural knowledge content and methods to make agricultural extension agents and farmers appreciate and adopt indigenous knowledge system.
Keywords: Indigenous knowledge, agricultural knowledge and information system; sustainable development.

INTRODUCTION
Erosion of indigenous knowledge in agriculture and resource management knowledge is the result of the development and dissemination of new agricultural innovations (Gilles *et al.,* 2013). Before the present era, this situation was not viewed as a problem, but with climate change problems being witnessed, it is now seen as a problem (Ofuoku & Albert, 2014). There is presently an increasing awareness that indigenous agricultural system proves to be more advantageous in terms of sustainability than the conventional agricultural system (Alteri, 2004). Many indigenous practices that will ensure sustainability when adopted include rotational cropping, crop varieties, organic agriculture and shifting cultivation.

There is currently an upsurge in studies on Indigenous Knowledge Systems (IKS) in Africa (Ofuoku & Albert, 2014; Mapara, 2009). This recent development is mainly prompted by the desire for sustainable agricultural development. Emanating from this are concerns for synergy between traditional ideas that have become of great importance in Nigeria because of transformative constraints witnessed by the citizens. These challenges are rooted in critical areas such as management of biodiversity, technological advancement, food security, articulation of traditional values and social inclusion. Indeed, the advocacy for the integration of IKS in agricultural extension service delivery in agricultural development process is an idea that will be beneficial to the economy. This is sine qua non for making agricultural development process meaningful, enduring and acceptable to the target stakeholders (Kothari, 2007; Haverkort, 2009).

With the recent rise in interest in the integration of indigenous knowledge into agricultural extension service delivery, for sustainable development the need arises to articulate the relevance of integration of indigenous knowledge in agricultural extension services delivery. This paper articulates the potentials of integrating indigenous knowledge system into agricultural extension service delivery for promotion of sustainable agricultural development in Nigeria. Aligning with this, the paper was conceived with four specific objectives to: examine the nexus between indigenous agricultural knowledge and sustainable agricultural development; review the dimension of IKS in Nigeria against the backdrop of issues relating to the environment in Nigeria; draw out the interface of IKS and agricultural knowledge and information system (AKIS); ascertain the relevant indigenous agricultural knowledge; and highlight the implications for the content of AKIS in Nigeria. A general summary serves as the conclusion of this paper.

Indigenous knowledge and sustainable agricultural development: A conceptual overview

As currently a business term, indigenous knowledge has been referred to as traditional knowledge, local knowledge, community knowledge, indigenous knowledge systems and locally evolved knowledge system (Rahman, 2000; Chigora*et* et al. 2007; Haverkort, 2009; Gupta, 2011; Ndwapi, 2012). However, the diverse terms used to describe indigenous knowledge do not remove the issue of focus in indigenous knowledge (IK) which is the necessity of factoring the target beneficiaries into the process of their own development.

Indigenous knowledge is the sum of experience and knowledge of a given ethnic group that forms the basis for decision making in the face of familiar and unfamiliar problems and challenges (Warren & Cashman, 1988). Mapara (2009) also defines indigenous knowledge systems (IKS) as a body of knowledge, or bodies of knowledge of the indigenous people of particular geographical locations that they have survived on for a very long time. Recent interests for endogenous development have placed crucial emphasis on the re-vitalization of local and indigenous knowledge as well as inter-science dialogues (Haverkort, 2009). The indigenous knowledge system is oral, undocumented and simple. It is highly dependent on the values, norms and customs of the folk life carrying out informal experiments by trial and error, accumulation of generation wise intellectual reasoning of day-to-day life experiences, loosed and rediscovered, practical rather than theoretical, in addition to being symmetrically distributed (Gupta, 2011).

The upward progressive focus on the nexus between indigenous knowledge and sustainable agricultural development is prompted by the failure of the previous natural resource management policies. These policies promoted a top-down approach to agricultural development whereby local people were not involved in the process. ENDA (2012) observes that the growing advocacy for the indigenous people's rights to be included in decision making process for issues relating to local development raises consciousness regarding the need for bottom-up approach policies, in order to encourage local participation in agricultural developmental activities and projects. This is more so when there is the realization that indigenous and western knowledge systems are (ENDA, 2012). Indigenous knowledge system emerges from the local people's culture and traditions. This calls for the suggestion that it should therefore provide the base for meaningful formal scientific enquiries and agricultural development in any given country. Indigenous knowledge is unique to the culture or society to which it applies and it has been transmitted from generation to generation, tried and tested over time and has proved to produce the desired results (Raselimo, 2003; Mosothwane, 2007). Agricultural development process can only be possible or successful when the knowledge-base of the people forms the bedrock for new activities and programmes. Like other aspects of human life, any agricultural knowledge system that is deficient in relevance would be lacking appropriateness for the people it is designed to benefit.

Nigerian context for integration of indigenous knowledge in agricultural knowledge and information system

The history of agricultural extension in Nigeria is intertwined with that of general agricultural development (Jibowo & Ajayi, 2011). This is not unconnected with the fact that agricultural extension focuses on all areas of agriculture. During the pre-colonial era, efforts were consciously made to select, introduce and teach practices needed to produce encouraging varieties of crops and animal breeds. Farmers would select the best of seeds which they manipulated and from which they selected the best for transplanting to their farms.

Extension teaching/learning process was carried out mainly by apprenticeship. Families taught succeeding generation crop, animal husbandry and soil management through observations and participation by learners (Jibowo & Ajayi, 2011). Neighbours and friends also exchanged new knowledge of improved farm practices.

In the colonial era, in order to increase agricultural production, some development initiatives were carried out. The first step led to the establishment of Botanical Research in 1893 with the headquarters sited in Olokemeji in the former Western Region of Nigeria (Williams, 1978). It had the mandate to conduct research in both agriculture and forestry. In 1905, the British Cotton Growing Association acquired a large expanse of land which ran into tens of kilometers at the current site now known as Moor Plantation, Ibadan for the cultivation of cotton to feed the British Textile Mills. In 1910, Moor Plantation became the headquarters of the Department of Agriculture in Southern Nigeria, while the Department was also established in the North in 1912.

After the amalgamation of Northern and Southern Nigeria, the Department of Agriculture was unified. The major policy then was to raise production level of export crops for British market which was ready to take everything for its industrial use. Extension activities were driven towards enhancing production efficiency of crops and marketing. The colonial government likewise established some agricultural development schemes to improve the skills of farmers and produce agricultural commodities. The Kwara irrigation scheme was established in 1926. It was established with the purpose of increasing rice yield and provide experimental data on production during severe drought period and flooding during the rainy season.

In the colonial period, the Niger Agricultural Project was established in 1949, for the purpose of producing groundnut for export and guinea corn for consumption locally (Adesimi, 1995). Demonstration of better farming techniques to increase productivity of agriculture was adopted. Demonstration of better farming techniques was the extension technique used for teaching farmers. Some farmers learned by such demonstrations. The project was suitable for mechanized agriculture as it was sited at an area close to Mokwa.

In 1951 – 1956, 163 families were settled as farmers in an area of land of about 3,888 hectares (Jibowo & Ajayi, 2011). However, the labour needed was very enormous and they could not cope with it. The settlers found it strange to live on new settlement, yield was not encouraging, machines often broke down, coupled with epileptic water supply and lack of participation in decision making by the settlers were the main problems. The problems led to frustration of the settlers and management. Settler turnover was high and as stated by Adesimi (1995), in 1954 the Central Government relinquished the project in favour of Northern Nigeria Government as a training and experimental farm. In the post-colonial era, remarkable efforts have been made to organize and conduct agricultural development and extension programmes since 1960 when Nigeria gained independence from British colonial masters. Post-Colonial agricultural extension in Nigeria can be classified into two categories: (i) Extension programmes organized and funded by governments;

(ii) extension agents sponsored by private agencies. However, the first category forms the more extensive of the two.

African agriculture and indigenous knowledge system

The heart of indigenous knowledge system in Africa and Nigeria in particular is the traditional agricultural extension education. African societies have always had one form of traditional or indigenous agricultural extension education or the other, like other societies in the World. However, unlike the western extension system, which is organized by formal bodies and institutions, indigenous extension is not organized, but deliberately carried out on demand or by observation of farmers who often exchanged knowledge and ideas. It was also extended to their children through such non-formal apprenticeship as they are conscripted to work in the farm by their farming parents. In the process, children often asked a lot of questions as to why "this is done this way and why the result this". In pre-colonial Nigeria, the traditional African extension delivery provided a platform for cultural transmission and encouragement of indigenous knowledge systems. UNICEF (2006) opines that traditionally, children working with their farming families acquire skills which are needed by them in their future lives as adults. ILO (2010) argues that children's engagement in agricultural operations leads to positive consequences of enhancing inter-generational transfer or transmission of social and technical skills and knowledge to ensure the child's food security in the future on attainment of adulthood. Ofuoku and Emodi, 2016; Ofuoku and Ugbechie, (2017) points to the fact that traditionally, children's engagement in agriculture is considered as a way of imparting farming skills on the children. This is based on the biblical proverb which says "train up a child in the way he should live and when he is grown, he will not depart from it".

The organized AKIS is a colonial heritage which does not take adequate account of the indigenous or traditional knowledge system in its knowledge content. In pre-colonial period in Nigeria, the purpose of AKIS was functionalism and enhanced productivity of agriculture. Indigenous knowledge provided the philosophy, content and practices of traditional agriculture which are focused on serving the food and nutritional needs as well as economic needs of the society. The content of indigenous knowledge in agriculture systems encompasses the wisdom, knowledge and teachings of the communities relating to food and cash crops production. In many cases, valuable indigenous knowledge in agriculture has been orally and practically passed on for generations. This could be harnessed to enrich current organized AKIS. Some forms of traditional knowledge are expressed through involvement in field/farm practices, stories, legends, folklore, songs and communal laws.

Most likely, the critical nexus between indigenous knowledge system and agricultural knowledge and information system, which is organized for agricultural extension services delivery content, is culture. Every agricultural knowledge system gains relevance from the cultural values of the people it is designed for. According to Ogunyemi (2000), every education system derives relevance from the cultural values of its society. Our knowledge of the world accessed the modes by which we enter into relations with the object of knowledge in our environment. Comprehension or knowledge of world cultures is not enough in itself, since our experience of other cultures should take place through our own cultural lenses. Indigenous agricultural knowledge system, being the means through which societies have transmitted their values from generation to generation, remains the battleground for cultural globalization.

For Africans and indeed Nigerians, sacred sites and non-material culture are tenaciously woven together and will be difficult to separate. These allow the people to balance developments in the environment which they have been occupying from time immemorial. This knowledge is indeed

corner stone of their culture and the beacon that gives them sustainable survival. Deviation from the people's traditional knowledge has great dangers for the world and mankind (Ndwap, 2012). Therefore, an imperative exists not to divorce western acquired agricultural knowledge system from the indigenous agricultural knowledge. This is seen to be so because, IK in agriculture is the basis for traditional farm decision making process, which affects the lives of people within it and it is the symbol of cultural identity (Warren, 1991; Flavier *et al.,* 1995).

However, Nigerian people cannot restrict themselves to only their own agricultural knowledge. The aim is to complement their agricultural heritage with the best of western traditions. This would be of quality in the true sense. Our cultural specifications are also to contribute to the universal culture and are not just relics of a past that is disappearing. This implies that rudiments from traditional cultures and knowledge should be included in AKIS for other people as well as their own use. By doing this, they ensure the transmission of agricultural culture and knowledge through generations and further showcase their agricultural IK and connect with similar or dissimilar IKS. This will guarantee growth and development of peoples' agricultural IK beyond their borders.

In reality, it is a matter of necessity in the Nigerian context to adapt western agricultural knowledge system into the people's cultural context. This is owing to the fact that cultural neutrality between cultures is a mirage. Once a cultural element is borrowed from one culture to another, modifications are sure to occur. These modifications could assume the shape of restructuring in order to align with the new. LeBaron (2003) suggests that cultural fluency is the ability to express or exercise cultural choices with the awareness that all behaviour and interpretation is cultural and subjective. Emphasizing indigenous cultural values within organized agricultural knowledge system makes better meaning because it builds on the people's way of economic life to further develop them.

Discussing and comprehending indigenous agricultural knowledge and beliefs afford change agents and their clientele the opportunity to review the interaction of indigenous knowledge epistemologies with western epistemologies (Semalis & Kincheloe, 1999). In order to access new agricultural methods and formulate new agricultural knowledge, both epistemologies need to be put into consideration in terms of how they relate and influence each other. To comprehend and effectively teach a Nigerian farmer for instance, extension agents require a comprehension of the philosophical foundation of Nigerian agricultural extension education. This approach can be regarded as Nigecentric, as it explains that a Nigecentric agricultural education has its major objective as the construction of a social reality of Nigerian agricultural worldview, framework, culture and history.

Apart from the philosophical interface of agricultural IKS and Nigerian Agricultural Extension Education, Freire and Faundez (1987) explained that indigenous knowledge is a rich source for any justice-related attempt to institute change. The multi-dimensional perspectives of agricultural extension professionals and researchers enables them to understand the knowledge base of their clientele. Thus, engaging in variety of approaches is more empowering than a monolithic approach of organized agricultural extension services delivery tailored according to Western Agricultural Extension System. AKIS in Nigeria enriches the work of an extension agent and farmers while planning farm training experiences based on the basic principles of the known and unknown, simple to complex and immediate to remote. This is the reason comprehension of both indigenous agricultural knowledge and indigenous agricultural extension practices is needed for an insightful agricultural extension professional to integrate such curricular understanding in interaction with the farmers.

Integrating indigenous agricultural knowledge system into AKIS

Agricultural extension is as old as the history of agriculture in Nigeria. Objectives of agricultural extension are unveiled as statement of goals that our efforts are directed to. The major objective of agricultural extension is to develop the rural people economically, socially and culturally by means of education (Ray, 2016). Agricultural extension function is to achieve changes in human behavior through education. The desired changes may be affected in their knowledge, skill, attitude, understanding, goals, action and confidence. Globally, the rationale for agricultural services delivery lies in its promotion of appropriate and relevant knowledge, skills and values for effective agricultural practice in a dynamic world.

The principles of agricultural extension include the principles of cultural difference, grassroot, indigenous knowledge, learning by doing, adaptability and satisfaction. Culture simply put, means social heritage. There are differences in habits, customs, values, attitudes and way of life. Extension work will achieve success when carried out in harmony with the people's cultural pattern. This underscores the need for integrating cultural IKS into AKIS. People everywhere possess indigenous knowledge systems which they developed and transmit from generation to generation through farming experience and farm related problem solving in their specific situations. The IKS cover every aspect of their life and they regard it as being essential for their survival. Without the integration of agricultural IK into AKIS, much success will not be achieved in the bid to develop agriculture. This is because every society is in continuous search for relationships between their IK and AKIS. Thus, instead of ignoring the indigenous knowledge system as outdated, extension agents need to comprehend their implications in the people's life before either recommending something new or integrating them with AKIS.

The principle of grassroots development implies starting from where the people are. In other words, change should start from the existing situation (Ray, 2016). In the light of this, instead of totally discarding the IK, integration of IK into AKIS should be sought and implemented. In such situation they will take pride in the use of the innovation since the IK is not regarded as inferior to the Western oriented AKIS. The principle of learning by doing posits that learning will not be perfect until people participate in doing the work. Without the integration people will not learn what to do, why to do and how to do and what result.

Participation of the people is very crucial to the success of an extension programme (Ray, 2016). This implies that people must share in developing and implementing the programme and feel that it is their own. In order to achieve this ownership attitude in them, integration of the IK into AKIS is desirable and required. This will motivate them as they will feel that their IK is equally of quality with that of the west AKIS. With this kind of integration much higher success will be achieved. The principle of adaptability means agricultural extension methods must be as flexible as possible and adapted to suit the local condition (Ray, 2016). This implies also that method adopted should recognize the IK and integrate it with AKIS. This is necessary because their situation, resources and constraints will be better taken care of through integration. In the principle of satisfaction, the result of extension work should be satisfying for the people. It is known that integration of traditional knowledge and the western world produce better results. Better results promote satisfaction.

Integration of indigenous knowledge into AKIS will ensure conservation of traditional farm practices. Gilles *et al* (2013) suggest that what diffusion of innovations considers is the extinction of traditional or indigenous practices as a natural consequence of modernization. Indigenous knowledge approach seeks the potential value of traditional practices. These indigenous practices are often remembered by most farmers and there is need to salvage them (Nazarea, 2005) for

conservation and preservation. Western scientific knowledge through AKIS, has many advantages and favourable attributes as well as disadvantageous. Consequently, if the issue of replacing or integrating indigenous knowledge into AKIS is left unaddressed it will result in extinction of local cultures. While supporting indigenous knowledge Lefale (2008) argues that there is the possibility that scientists are probably losing some valuable insights into climate change, climate change prediction and strategies for adapting and mitigating climate change by not taking this knowledge on board. This implies that despite the high value accorded western knowledge, there are other forms of knowledge which need to be taken into consideration to make the study and prediction of weather and climate easy and more localized. Gilles *et al* (2013) asserts that farmers utilize observation of natural phenomena – stars, winds, plants and animals as a component of strategies in dealing with risks related to weather. These observations guide farmers when deciding when, where and when planting operations should be done and productivity of the crops. They use bio-indicators to forecast weather.

Traditional soil conservation practices such as use of manure, rotational cropping and shifting cultivation have proved to be more environmentally friendly than the western soil conservation practices. Altieri (2004) asserts that many traditional agricultural practices are sustainable than conventional ones. This implies that, indigenous practices are more environment friendly, sustainable and potentially reduce climate change impact than modern agricultural technologies that contributed to climate change (Ofuoku & Albert, 2014). Melkote (1991) suggests that development should integrate the old and new ideas, the traditional and modern systems, and the endogenous and exogenous elements to constitute a unique blend suited to the needs of the particular community. This will promote effectiveness of agricultural extension teaching/learning process and efficacy of solutions to farmer's challenges. This is so because it will lead to motivating farmers to willingly follow up with application of the old and new ideas, traditional and modern systems and methods in the process of solving their problems.

Implications for agricultural extension Services, Content and teaching

Indigenous knowledge system in Nigeria has some implications for agricultural extension curriculum and teaching. In the first place, it could be regarded as an attempt to make improvement in the overall quality of extension services delivery in the country. Quality in extension service is not an absolute and static concept because agricultural extension community has an interface with the culture and the farming community it is supposed to serve. It is important to comprehend that Africans have a rich knowledge base that need to be preserved and developed over time. Indigenous cultural heritage involves a holistic approach where traditional knowledge is expressed in songs, stories and designs as well as in the land and environment; the intangible interlink with the tangible (Tlou & Campbell, 1993). This calls for urgent efforts to review the curricula for extension service delivery in order to enrich them through integration of agricultural IKS.

Another implication of integrating IKS into AKIS is using the non-formal and informal approaches to enhance its teaching so as to harvest the farm experiences of the farmers for agricultural extension learning. When extension agents understand farmers' perspectives on agriculture, their traditional knowledge and history, they are better placed to assist them by the integration of the two. The comprehension also helps farmers to develop multiple perspectives towards agriculture and how those different perspectives can create a critical consciousness that single perspective cannot be effective in agricultural extension teaching and learning process. It is only when the farmers develop focus, critical sense and progressively become informed that they can contribute meaningfully to sustainable agricultural development in their society.

The integration of IKS and AKIS poses the challenge of reconceptualization of the objective of AKIS to make it deeper within the Nigecentric sense. According to Adereti and Ajayi (2011), as an educational process, the concern of agricultural extension education is to help farmers to make a decent living, to master the best way to handle farmers with the aim of helping them to improve their standard of living. The foundation of extension education is from indigenous knowledge in agriculture transmitted through generations and transformed over the ages by human needs and changes in lifestyles.

The gap between indigenous knowledge and modern knowledge can only be closed by the integration and infusion of indigenous knowledge into western knowledge. Extension delivery process is a phase in the life of the farmer's education, and then indigenous knowledge is a lifetime process. Given this perspective, it is important that the time spent in extension delivery process is well spent on well planned informal and non-formal instruction. It could be well spent and planned when farmers identify and learn from it. This tasks the policy makers and extension programme planners on the need to involve local interest groups such as the farmers and farmers' group leaders as partners at critical points of extension programme review.

CONCLUSION

The western oriented AKIS tends to emphasize acquisition of knowledge to the detriment of indigenous agricultural knowledge indigenous agricultural knowledge system and its structure should be represented and supported so that future generation can trace their cultures through it. Indigenous agricultural knowledge may not have been documented by African fore fathers. However, they dance, draw, narrate, sing and practice it.

RECOMMENDATIONS

1. There is therefore the need for a deeper understanding of what knowledge and learning is and the many paths to knowledge.
2. It should be encouraged in our livelihood activities, especially in the agricultural livelihood activities of our societies.

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CUTTING EDGE TECHNOLOGY: A RISK MANAGEMENT STRATEGY IN POULTRY PRODUCTION IN IMO STATE, NIGERIA

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ABSTRACT
This study revealed the place of cutting edge technology as a risk management strategy to ensure better productivity in poultry enterprise in Aboh Mbaise local government area of Imo state Nigeria. Multistage sampling procedure was used in sample selection. Primary data were collected using structured questionnaire while secondary data and information were collected using explorative literature gathering approach. Data were analysed using descriptive statistical tools as appropriate. Results revealed that 52.5% of the respondents were females, with mean age of 47 years, and mean per capita daily income of ₦128. Most of the respondents were literate and smallholders with a mean level of education of 15years, farming experience of 15years too and mean farm size of 300birds/run. The study further showed that only 28.6% of the respondents have known and used just 9.82% of the potential technologies meant to enhance efficiency in risk management in broiler production. Among the notable risk factors in broiler production were high costs of operation, incidence of pest and diseases, lack of power/storage facilities, lack of credit facilities among others. Some of the cutting edge technologies found to be useful in mitigating the above risk factors include, sensors, alarming devices, imaging technologies and analysis and mathematical modelling etcetera. It was concluded that the high poverty rate due to poor risk management capacity observed in the area could be ameliorated if farmers would make use of the available cutting edge technologies identified in the cause of this study. Therefore, it was recommended that extension education should be intensified on increasing the awareness of farmers about these technologies. Finally, government should concentrate on the provision of social overhead capital to facilitate the operation of private investors (farmers) by making these technologies readily available and affordable.

KEY WORDS: Cutting edge technology, Risk, Poultry, Production, Sensors, Efficiency

INTRODUCTION
The poultry industry in Nigerian still remains a viable source of protein through its healthy meat as against beef that has heavy cholesterol content. It has been reported by the United States Department of Agriculture (2013) that commercial poultry production in Nigeria was estimated at about USD 800 million. In fact according to Cable News (2019), the poultry sub-sector is of highest commercial value in relation to all other Nigeria's agricultural sub-sectors with a current net worth of N1.6 trillion. The USDA (2013) also rated Nigeria as the leading country in Africa with respect to egg production, but fourth in broiler production. CableNew (2019) also reported that the poultry industry contributes about 25% of agricultural GDP to the Nigerian economy. It further explained that the population of chickens in Nigeria was about 165 million, which produce approximately 650,000 Metric Tonnes of egg and 300,00MT of meat altogether; whereas, the demand situation is estimated at over 200 million birds, with the demand for eggs and meat at about 790,000MT and 1,500,000MT respectively, leaving a huge demand gap which, unfortunately, is met through smuggling. It was further estimated that over 1.2 million MT of poultry meat is smuggled into Nigeria from Benin Republic. This implies that Nigeria still has to improve on her production with respect to broiler birds to close the obvious demand-supply gap.

Poultry are domesticated avian species that are kept for eggs, meat and/or feathers. It covers a wide range of birds, from indigenous and commercial breeds of chickens to Muscovy ducks, mallard ducks, turkeys, guinea fowl, geese, quail, pigeons, ostriches and pheasants (Food and Agriculture Organization, 2020). Poultry are also known as birds kept by man because of their economic value either for food, aesthetics or satisficing value. Broilers are the brand of poultry kept for its meat production and the enterprise has short production cycles (Ibekwe et al. 2015). Studies have it that numerous farmers in Nigeria rear birds yet the local demand still surpasses the supply leading to massive importation of frozen chicken with its attendant losses in foreign exchange. Some of the factors that have bedeviled the success of the industry in Nigeria include, high production cost, technical constraints in production, processing and marketing, disease infestation and lack of access to low cost and long tenured finance. According to JASPAFARM, (2016), the challenges faced by poultry farmers include, financial, lack of information, pest and diseases, access to the right birds, feed quality and type, water, drugs and management related issues.

There has been myriads of studies aimed at unravelling and tackling some of these challenges in poultry production (Akintunde and Adeoti (2014); Aromolaran, Ademiluyi and Itebu (2013); Obike, Amusa, and Olowolafe,(2017), yet the problems appeared persistent. Little or none of these studies has dwelt on the relevance of technologies on tackling the observed challenges and as well as mitigating the associated risk in poultry production. This study is structured to narrow that gap in knowledge by identifying the prevalent risks associated with poultry production, knowledge and use of technologies in the study area, possible measures to mitigate risks in poultry production and the special place of cutting edge technology in this regard.

Cutting-edge technology refers to technological devices, techniques or achievements that employ the most current and high-level IT developments; in other words, technology at the frontiers of knowledge. Adoption of cutting edge technologies is viewed as a gateway towards effectiveness and efficiency in broiler production in Nigeria.

The over concentration of attention regarding digital transformation with respect to internet banking, e-commerce and electric vehicles in the Far East, has made people not to realize that one of the largest areas of digitisation has been taking place in the poultry sector. According to McDougal, (2018) Charoen Pokphands floods (CPF)'s Nakhon Ratchasima broiler complex is among the most innovative in the world, producing millions of broilers per week for consumers in Thailand and across the world. It is designed in compartment model in line with the World Organisation of Animal Health (Office International des Epizooties, OIE, 2015). The concept of compartmentalization is to isolate all facilities within the complex from each other under common biosecurity to avoid infection and epidemics. This innovative model is a sample of cutting edge technology in practice.

This brings us to Precision Livestock Farming (PLF) which is defined as the organization of livestock production using the ethics and technologies of process engineering (Wathes, Kristensen, Aerts & Berkmans, 2008). It is based on automatic data acquisition, access, and processing (Mollo, Vendrametto & Okano, 2009). Data from various sources are collected through smart sensors and assembled to a central databank, where they will be later analysed to create an automatic management system based on real-time monitoring to control animal performance, health, and welfare (Berckmans.2014). According to Mollo et al. (2009), PLF must be able to automatically manage commercial poultry farm equipment (including feeders, fans, heating systems, and sprinklers) based on the collected information. Different studies on broiler chickens and laying hens have shown the importance of technology and PLF to study birds' behaviour and welfare (Corkery, Ward, Kenny and Hemmingway,2017). Even though some of the technologies are still in the experimental phase, some are already available and being used on commercial poultry farms Marchewka, Estevez, Vezzoli, Ferrante and Makagon (2015) with good results.

METHODOLOGY

The study was conducted in Aboh-Mbaise Local Government Area of Imo State, Nigeria. Its coordinates are 5° 27'N and 7°14'E. It has a total area of 184km² and a total population of 195,652 as at the 2006 census (National Population Commision, 2006).

The study employed multistage sampling procedure to select the survey sample. In the first instance, ten (10) communities were purposively selected from the existing 29 communities owing to ease of accessibility and availability of poultry farmers. From these communities, ten (10) villages were also purposively selected following the guidance of the community leaders on the preponderance of poultry farmers. In view of the sample frame of one hundred and twenty (120) broiler farmers as contained in the list compiled with the assistance of some community leaders and village extension agents, ten (10) household broiler farmers were randomly selected from each of these villages to get a total of one hundred (100) poultry farmers from whom primary data were collected using structured questionnaire. However owing to incompleteness of data and invalid data given in some of the questionnaire, only eighty (80) household broiler farmers' data were used for analysis. Secondary data and information used in the study were got through explorative literature search. Data were analysed using descriptive statistics and analogies were critically made with respect to the subject matter and special reference to the study area and Nigeria as a nation.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Broiler Producers

Table 1 shows the distribution of respondents according to their socio-economic characteristics.

Table: Summary of Socio-economic Characteristics of Broiler Producers

Characteristic	Feature	
Sex	Male	female
	47.5%	52.5%
Age	47 years	
Level of education	15years	
Farming experience	15 years	
Household size	9 persons	
Farm size	300 birds	
Annual household income	₦ 420,000.00	

Source: Field Survey Data, 2019.

Table.1 shows that the mean age of the respondents is 47years. This implies that the broiler producers are within the economic productive age which is in agreement with the findings of Bamiro et al. (2006) ho reported that farmers within this age bracket are in their productive age and they will be able to make fast management decisions as well as taking risks in expectation of profit. The result further revealed that the mean years spent in acquiring formal education was 15 years. This implies that majority of the respondents were literate. Education helps to increase one's intelligent quotient and hence his ability learn and adopt useful skill and technologies that would help mitigate any form of risks and uncertainties thereby increasing productivity. This is because studies have revealed that education influences the adoption of practices of modern agriculture. The reason is that more educated person is likely to adopt innovations easier and quicker than the less educated. This finding is in line with that of Apantaku (2006) who reported that majority of his respondents had post-secondary education which is evident in their knowledge to take good decisions in their businesses.

Given the respondents' mean age of 47 years and a mean farming experience of 15 years implies that they have acquired reasonable knowledge in terms of length of practice. Besides, they have stayed beyond a decade in the poultry industry. They are expected to be in the position to adopt cutting age

technologies that would enable them take meaningful risks in the business with less casualties. The result in Table 1 also shows that the mean household size is 9 persons. It is opined that the larger the family size, the greater would be the labour on the farm, and thus, the greater the output from the farm. This is in conformity to the findings of Bose et al. (2015) whose result indicated that about 48.15% of the respondents had the highest family size of 6 – 10 persons with an average household size of 9 persons. The result also showed that greater proportion (77.5%) of the farmers fall into small-scale operation of less than 500 birds with a mean number of birds kept of 300. This is in contrast to the finding of Bose et al. (2015) which showed that cumulatively 61.12% of the farmers were operating on the flock size ranging between 500 – 6502 chickens. The average flock size was 6,465 chicks which indicated that the farmers were operating on a large scale because greater proportion (78.0%) had access to credit. The mean household annual income is ₦420,000.00. This implies that the per capita income for the family per day is approximately ₦128. This categorizes the household as one in extreme poverty given that it is below the World Health Organizations standard of less than one dollar per day (World Health Organization, 2019).

Risk factors associated with Broiler Production

Table 2 shows the distribution of respondents' perceptions according to the risk factors associated with broiler production

The major and significant risk factors with broiler production enterprise as opined by the respondents in Table 2 were problem of higher price of feeds (Mean=3.79), competition with foreign frozen chickens (Mean=3.72), high labour cost (Mean= 3.71), electricity problem (Mean=3.65), high cost of construction of poultry house (Mean=3.64), lack of credit (Mean=3.51), land/space inadequacy (Mean=3.39), lack of capital (Mean=3.25), storage problem (Mean=3.18), high price of day-old chick (Mean=3.12) and inadequate veterinary(Mean=3.05). Higher price of feed was viewed as a major constraint by respondents. Recently feed prices went up which reduced poultry production capacity in the area. Farmers usually buy feed from local agents who provide these feeds at exorbitant prices. This makes the farmers concentrate only on fewer birds due to the cost of feeding large number of birds to maturity stage is very high. Constraints associated with feeding could be a major problem in broiler production especially in areas where farmers don't have alternative feeding source (compounding feeds themselves) but total reliance on market commercial feeds. These findings in relation to constraints affecting layer production is in accordance to the findings of Bose et al. (2015) whose results showed that majority 74.04% of the producers confirmed that high cost of feed was the most serious constraints affecting their enterprises followed by 66.67% of them who complained of inadequate capital as the problems militating against their operations in the enterprises. The results also agreed with the finding of Bappa (2008) who observed that high cost of feeds was the most serious problem affecting the broiler producers.

Another crucial constraints associated with broiler production is competition due to importation of frozen chickens from outside the country. This makes the market less attractive and lowers the profits the indigenous farmers make from their sales. The government's next level programme is meant to discourage food imports while encouraging local production. This entails reforms in the input supply regime, a targeted region-specific increase in the output of priority commodities, post-harvest systems development, a strong orientation towards agri-business and promoting value-addition in the product chain (Audu, 2016). Only 27.78% of the respondents acknowledged seasonality in production among the constraints affecting their services in the farms. The standard deviation scores of the mean distribution of respondents' perception on the constraining factors in broiler enterprise production were less than 1 in all cases except one.

Table 2 Risk factors associated with Broiler Production

Risk Factor	Mean	Std. Deviation
Higher price of feed	3.79*	0.412
Competition with frozen chickens	3.72*	0.477
High labour cost	3.71*	0.455
Electricity problem	3.65*	0.480
High cost of construction of poultry house	3.64*	0.557
Lack of credit	3.51*	0.503
Land/space inadequacy	3.39*	0.703
Lack of capital	3.25*	0.540
Storage problem	3.18*	0.632
High price of day-old chick	3.12*	0.736
Inadequate veterinary	3.05*	0.692
Housing problem	2.89*	0.711
Lack of production facilities	2.49*	0.574
Seasonality of poultry business	2.36*	0.534
Technical problem	2.22*	0.746
High cost of day old chicks	2.20*	0.999
Outbreak of diseases/pests	2.16*	0.878
High mortality rate	2.16*	0.514
High cost of drugs	2.12*	1.011
Environmental pollution	2.12*	0.487
Predator animals	2.07*	0.591
Distance from market	2.01*	0.584
Poor technical services	2.00*	0.934
Lack of training opportunities/facilities	2.00*	0.000
Poor breeds of chicks	1.86	0.497
Theft	1.60	0.756
Growth problem	1.51	0.616
Uncertainty of profit	1.45	0.913
Pollution of environment	1.25	0.684
Production facilities	1.14	0.347
Water problem	1.02	0.157
Low price of broiler	0.95	0.913
Rumor	0.10	0.467

Source: Field Survey Data, 2019; Perceived risk (mean ≥2)* significant.

This shows that the responses of the respondents did not vary much from the mean except in one variable which is insignificant.

Cutting Edge Technologies Available to Mitigate Risks Associated with Broiler Production

Sensors

It has been said that over the recent decade, significant successes have been recorded in sensing technology in terms of diversity, accuracy, and affordability. Wireless sensors have a wide range of applications in civil and environmental engineering, emergency management and agriculture (Meyer, 2005; Ruiz-Garcia, Lunadei, Barreiro & Robla, 2009). It has been applied in farming in recent times to reduce management costs and improve animal health which constitute major risks to animal production (Ruiz-Garcia, *et.al*.2009). Following the progressive affordability and applicability of sensing technology, research interest into potential applications to assess, control, and improve animal welfare and mitigate risks is expanding and it is expected to increase with time.

Environmental Sensors

Adverse weather conditions, in particular inappropriate temperature, relative humidity, and the length of exposure negatively affect broiler welfare, mortality, and performance (Dawkins, Donnelly & Jones, 2004). Presence of excess gases like carbon dioxide and ammonia in the pen is also known to reduce growth, feed conversion, and immunological response (Wang, Meng, Guo, Wang, Wang and Shan 2010). When day old chicks are exposed to high carbon dioxide concentration even for two weeks, it leads to late mortalities and also alter heart characteristics (Olanrewaju, Dozier, Purswell, Branton, Miles Lott Pescatore & Thaxton 2008). Thus, any efforts to better monitor and control environmental conditions will have a direct impact on bird welfare, risk management and overall productivity.

Although real-time multi-sensor monitoring and control of the environmental conditions (besides temperature) is not commonly applied in commercial poultry farms, current advances in sensing technology, with higher capabilities at affordable prices, will permit the development of systems for a precise control of the production environment. Some examples of current developments include multi-sensing systems to monitor environmental temperature, differential indoor atmospheric pressure, and air velocity in broiler flocks Bustamante, Guijaro, García-Diego, Balach, Hospitaler and Torres (2012) to automatically assess the adequacy of the ventilation system design and functioning, which is highly relevant to provide a comfortable environment to poultry. Using sensors to simultaneously collect temperature, relative humidity, carbon dioxide, and ammonia concentrations, Jackman, Ward, Brennan, Corkery and McCarthy (2015) developed a good prediction model to calculate final mean bird weight in broiler flocks. The model showed excellent, house specific prediction ability ($r^2 = 0.89$) between the predicted and observed bird weight based on the conditions of the rearing environment. The development of continuous real-time environmental monitoring combined with advanced modelling tools could be used to provide a warning system to potential deviations from targeted weight gains which may also be a good indication of health or welfare risks; thus, having real potential to assure the optimal and sustained environmental conditions.

Acoustic Sensors

The study of the features and the biological significance of sounds emitted by living organisms is known as bioacoustics (Tefera, 2012). Birds in particular, depend on acoustic communication for their social relations and for alarm signaling (Corkery et al. 2017). Some forms of acoustic signaling can also be considered as dependable stress pointers SCAHAW (2000) and, thus, is an interesting method when looking for reliable well-being assessment indicators.

Movement Sensors

An intrinsic element of animal welfare is freedom of movement thus; to assure optimal welfare, animals should be able to move freely. However, rearing conditions may impede movement in poultry due to

high density, housing space availability, and design or health condition, among other factors (Newberry & Hall 1990)

Sensors for Health Status Detection

Chickens infected with highly pathogenic avian influenza have been detected under experimental situations using wireless systems equipped with body temperature sensors and accelerometers (Okada, Itoh, Suzuki & Tsukamoto, 2009). Even though this sensing equipment can prevent economic losses and welfare issues due to disease spread, it would be unpractical and too expensive to fit all individuals with surveillance equipment in a typically large poultry flock. Hence it is not sustainable on its own . However, sensors could be fit to a subpopulation of sentinel birds, which may be as effective for prevention or as an early detection strategy at least in high risk-areas. In addition, as variation in temperature and reduced activity are common general symptoms for many diseases, this basic equipment could be used as a warning for other health risks as well.

Alarm Device or System

Warren (2011) defined an alarm as a device which gives an audible visual or other form of alarm signal about a problem or condition. According to Farmalarm (2013), alarm system in the poultry farm is a unique monitoring system designed specifically to help protect your poultry barn from mortality loss. Farm alarm can monitor; power, temperature, water ventilation controller, curtain, feed over run, generator, and customized settings by the farmer (Adejo & Haruna, 2009). It can even monitor the advent of human and animal pests who may come to ravage the birds.

Image Technology and Analysis

According to De Jong, Berg, Butterworth and Estevez (2012), skeletal disorders and contact dermatitis are major broiler risk and welfare issues that are still a matter of concern from the welfare and the economic stand point. Farm management and a good use of original technology may be of great relevance in the upcoming years to reduce such problems

Optical Flow

Optical flow analysis (OF) is a particular type of image analysis that has been used in many applications including traffic flows Bellomo, Bianca and Delitatla (2009) movement of glaciers Giles, Massom and Warner (2009)], cell and sperm motility Cheng, Koh, Ahmed and Rajapakse (2009) and, lately, in the analysis of movement in confined broilers Dawkins, Cain and Roberts (2012). One of the main advantages of OF is that it allows the automatic and nonstop assessment of moving images comprising hundreds of individuals Sonka, Hlavac and Boyle (1999) and, thus, could be a practical approach for the assessment of movement related welfare issues in commercial poultry.

Infrared Thermal Imaging

Preventing heat stress is crucial to poultry welfare as it may impact behaviour, immunity, and physiological processes and can cause major mortalities (Lara & Rostagno, 2013). Therefore, a good understanding of the temperature regime in broiler pens could go a long way in fashioning strategies for mitigating associated risks. Infrared thermal imaging (IRTI) technology creates infrared images showing the body's superficial temperature distribution from the infrared radiation emitted by objects that is converted into electrical signals. In the thermal image, each colour expresses a specific temperature range related to the defined scale Naas, Garcia and Caldara (2014), thus it is a practical, non-invasive tool to study welfare aspects related to thermoregulation.

Yahav, Straschnow, Luger, Shinder, Tanny, and Cohen (2004) used IRTI to determine optimal air velocity (AV) for broilers' thermoregulation, while maintaining adequate temperature and relative humidity. Body weight, feed intake, and faecal excretions were collected to estimate the energetic demands for body maintenance, while body heat loss was calculated by radiation and convection using IRTI.

Kinematic Analyses

According to Beggs, (1983) kinematics is a branch of classical mechanics that describes the geometry of motion without consideration of the masses and the forces that may have caused the motion. The main advantage of the kinematic technology is that it offers the possibility to perform a three-dimensional (3D) evaluation of the motion in a rapid and non-invasive way. Kinematic analysis has been used in broilers to identify gait abnormalities (Caplen, Hothersall, Murrell, Nicol, Waterman-Pearson, Weeks & Colborne, 2012)

Close Circuit Television Camera (CCTV Camera)/Surveillance Camera

CCTV Camera is defined by Smith (2007) as a television system in which a signal is transmitted from a television camera to the receiver by cables or telephone links forming a closed circuit as used in security system. It is a telecommunication system that transmits images of object (stationary or moving) between distant points (Smith, 2007). In agriculture, according to Harris (2011), a comprehensive system of surveillance cameras can help protect your farm, protect costly farming resources, livestock, your poultry and equipment, reduce security cost, stop unauthorized access and ensure workers safety as well as help you remain competitive in a growing market. Over time theft or damage of facilities, equipment or livestock can mean a huge set back financially to you but surveillance cameras can be placed around the farm to help monitor your employees and to ensure operations run smoothly in the farm enterprise (Harris, 2011).

Mathematical Modelling

Application of technology in commercial poultry farms can be enhanced with the aid of modelling approaches. Indeed, large sets of data produced by sensors and video recordings can be analysed by complex modelling or artificial intelligence algorithms to generate predictions or risk assessment models. Interpretation of data from real time monitoring devices in order to develop control systems or to establish risk alert can be done perfectly well using modelling techniques.

Knowledge and Use of Cutting Edge Technology in the study area

Table 3 shows the distribution of respondents according to knowledge and Use of cutting edge technology in the study area.

Table 3 Percentage distribution of respondents according to knowledge and use of cutting edge technology

S/no	Cutting edge technology	Awareness use Freque	Percentage *
1	Contact sensors	10	12.5
2	Vaccines	40	50
3	Mobile phones	30	37.5
4	Weighing balances	30	37.5
5	Close Circuit Television Camera (C Camera)/Surveillance Camera	0	0
6	Alarm Device or System	0	0
7	Imaging technology	0	0
8	Modelling	0	
	Infrared Thermal Imaging	0	0
9	Kinematic Analyses	0	0
10	Acoustic Sensors	0	0
11	Sensors for Health Status Detection	0	0
12	Non-contact Sensors	0	0
13	Optical Flow	0	0
14	Precision Feeding	0	0

Source: Field Survey Data, 2019; Mean percentage 9.82%

***Multiple responses hence frequencies and percentages not additive**

Table 3 shows the percentage distribution of respondents according to their knowledge and use of cutting edge technologies in the study area. Out of the fourteen (14) technologies outlined, only 28.6% of the respondents have known and used just 9.82% of these technologies. In other words, 71.4% of the respondents are completely ignorant of the existence of these technologies while 90.18% of the available technologies have never been utilized by any farmer in the study area. This shows very poor level of technology adoption and low capacity to manage the myriads of risks and uncertainties in poultry production using available technologies. Therefore, this could be one of the reasons of low productivity and hence high poverty status experienced by broiler producers in the study area.

CONCLUSION

The Poultry industry especially broiler production occupies a very crucial place in the economic growth and development of Nigeria. Broiler enterprise employs a majority of the agrarian population and a source of vital component of nutritious and healthy food (protein). Research findings have revealed that broiler production is far below supply following a lot of inherent bottlenecks and risks. This study has showcased how cutting edge technologies could help mitigate or totally eradicate some of the observed logjams in poultry production.

Amongst the challenges or risks associated with broiler production in the study area include, high cost of production, incidence of pest and diseases, attack of predators, lack of power or electricity, stiff competition from importation of frozen chicken etc. Technologies such as the use of contact and non-contact sensors, close circuit television cameras, mobile phones, alarming devices, infra-red thermal imaging etc. have been found to be useful in ameliorating some of these risks and challenges. However, the observed scenario was that most of the farmers in the study were not aware nor used most of these technologies thereby making them suffer the risks more hence low productivity and mass poverty. Therefore, it was concluded that technologies to ensure more efficient broiler production are in place but there still exist very poor knowledge and use of these technologies in the study area. This could be because of lack of extension services to educate farmers of the availability and use of these technologies or due to unaffordability of these technologies by the farmers.

RECOMMENDATIONS

Following these foregoing issues, it was recommended that:

1. Extension education should be tailored to informing farmers on the use of some of the outlined cutting edge technologies as a way of mitigating associated risks in the business.
2. Government should provide some of the infrastructural facilities that would encourage the adoption of these technologies in the study area.
3. Finally, poverty eradication programs should be intensified because only when the farming households leave above poverty line that they would be in the economic position to adopt appropriate technologies.

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COMPARATIVE ANALYSIS OF FOOD SECURITY STATUS OF MALE AND FEMALE HEADED FARMING HOUSEHOLDS IN IMO STATE, NIGERIA

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ABSTRACT
The lingering problem of food insecurity especially among farming households in Nigeria is a major challenge to achieving agricultural and rural development. This study analyzed the food security status of male and female headed farming households in Imo State, Nigeria. Specifically, the study compared the quantity of food produced and the factors influencing the food security status of the farm households. Primary data used for the study were collected from 64 farm households in the study area. Data were analyzed using descriptive statistics, t test and logistic regression model. Results showed that the female headed households had higher food intake than male headed households; however, male headed households were more food secured. Key variables that positively influenced the food security status of male headed households were farm size, educational level, farming income and total depreciation of capital assets including farm implements, while key variables that positively influenced the food security status of female headed households include farming experience, farm size, extension contacts and membership of social organizations. The study recommended the review of existing land policies so as to give farmers easier access to land for food production. Also, agricultural extension services should be revived and made more proactive and effectively service oriented.

Key Words: Food Insecurity, Male, Female, farming, Imo State

INTRODUCTION
The agricultural sector in Nigeria has over time remained the hub of the economy and the sector remains the predominant economic activity in most of the zones in the country (Adebayo & Olagunju, 2015). The Country also has abundant land, human and natural resources which give it an advantage in agriculture. Agricultural production in Nigeria is typically labour intensive, with more than 90 percent of the population being small scale farmers who cultivate less than two hectares and utilize unpaid labour as a major source of farm labour supply (Arikpo et al. 2009). The rich natural resources, climatic conditions, geographical landscape and rich biodiversity of flora and fauna in Nigeria have not been effectively and efficiently harnessed to be able to ensure sustainable food supply which undoubtedly has led to food insecurity entirely in the country.

Agriculture is the most important sector of the economy from the standpoint of rural employment, sufficiency in food and fibre, and export earning prior to the discovery of oil (Nchuchuwe & Adejuwon, 2012). The farming system dominant is the rural, traditional and mostly private farming system. It is also noticed that the rural or traditional or private farming system is characterized by small scale, poor subsistence and semi-subsistence farmers. Farmers cultivate small land holdings which are often in fragmented plots. Changes in physical conditions, including erratic rainfall, marginal soil fertility, and unconducive policy environment are exerting immense pressure on the sector and diminish its capacity to cater for the rapidly growing population and cope with unexpected shock. Hence, farmers have been obliged to diversify their livelihood with incomes from outside the agricultural sector.

Gender has often been misunderstood as being about the promotion of women only, but gender focuses on the relationship between men and women, their roles, access to and control over resources, division of labour and needs (Mohammed *et al*., 2012). Gender can be described as a socio-economic parameter that is useful in analyzing the roles, responsibilities, opportunities and constrains of both men and women along different ethnic, religion and ecological lines. The term ''gender'' can also be viewed to economic, social and cultural attributes and opportunities associated with being a male or female.

The population of Nigeria is about 180 million people. Men constitute about 50.4 percent and women 49.6 percent (National Population Commission, 2017). Both sexes are responsible for producing the nation's food. Males and females play different most time clearly delineated roles in the production of food. Despite the contribution of both sexes in food production, and unlike their male counterparts, women's role in promoting economic growth and social stability continues to be inadequately recognized and under-valued. It is often argued that women's lower level of human and physical capital results in lower productivity or inability to respond to economic incentives. An evaluation of male-female productivity differences should ideally be based on estimates of total factors of production, in which an index of output is divided by an index of inputs, aggregated over all types of outputs and inputs, respectively.
The single most important factor affecting women's situation is the gender gap in command over property (Agarwal, 2010). All these when put together tends to affect the food security of women negatively in that their food security status tend to be reduced when compared with that of males.

The World Food Summit of 1996 defined food security at the individual, household, national, regional and global levels when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Food and Agricultural Organization, 1996). Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life (FAO, 2004). Food security includes at a minimum the ready availability of nutritionally adequate and safe foods in socially acceptable ways that is without resorting to emergency food supplies, scavenging, stealing or other coping strategies (Suresh et al. 2014).

Food security is a situation where people have access to sufficient, stable and safe food to meet their dietary needs for an active and healthy life (Kumba, 2015). According to Food and Agricultural Organization of the United Nations, the average minimum daily energy requirement is about 1800 kilocalories (7500 kj) per person (FAO, 2014). Food security has remained a problem in different countries of the world and the case of Nigeria is not likely to be different. However, the need to increase food crop output in Nigeria for food security requires that the gender role in food security be examined with a view to pointing out gender characteristics that can increase food security. In view of the foregoing, this study addressed the following objectives; describe the socio-economic characteristics of smallholder farming household's heads by gender; estimate the quantity of food produced by farming households by gender; determine and compare the magnitude of household food security in the area by gender and identify and determine the determinants of household food security by gender in the study area.

METHODOLOGY

The study was carried out in Imo State. The State is one of the 36 states of Nigeria and it lies in the South-east geopolitical zone of the Country. The Capital of the State is Owerri which is also

the largest city in the State. The State is bordered on the East by Abia State, in the West by River Niger and Delta State, to the North by Anambra State and to the South by Rivers State. The State lies within latitude 4°45[1]N and 7°15[1]N, and longitude 6°50[1]E and 7°25[1]E. The State has an area of around 5,100 sq km. The population of the State is put at 3.93 million people comprising of 1.98 males and 1.95 females (National Population Commission. 2016).
Imo State is situated within the humid tropics ecological zone with the rain forest being the major vegetation belt. About 80 percent of the people are involved in Agriculture (Imo Agricultural Development Programme, 2010). They produce food crops like cassava, cocoyam, yam, maize, melon, vegetables, etc. and livestock such as poultry, sheep, goat, and rabbits at subsistence levels. A small percentage of the population also engages in commercial agriculture.

Multistage sampling procedure were used to select the farm households for the study. First, two agricultural zones were selected from the three agricultural zones in the State for the study. Second, one Local Government Area (LGA) was selected from each agricultural zone, giving a total of two LGAs for the study. Third, four communities were selected from each Local Government Area giving a total of eight communities for the study. In the fourth stage, two villages were then selected from each community giving a total of eight villages for the study. Lastly, 64 farm households comprising 29 females and 35 males were selected for the study.

Data were analyzed using descriptive statistics, z test, the food security index and logit regression model. The food security model is specified as follow:

$Zi = Y_i/R$ …….1 (Babatunde et al,. 2007)

Where Zi = food security status of ith household

Households with food security index of less than 0.5 were considered food insecure while households with food security index of greater than or equal to 0.5 was considered food secure.

Yi = daily per capital Calories intake of the ith household

R = Recommended Daily per capital calories intake.

The model for the Z test as specified by Ibeagwa (2012) is given as:

$$\text{t-test} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \text{…….. 2}$$

$\overline{X_1}$ = mean food security index of male headed households
$\overline{X_2}$ = mean food security index of female headed households
S^2_1 = variance of the food security index of male headed households
S^2_2 = variance of the food security index of female headed households
n_1 = number of male headed households.
n_2 = number of female headed households.

Decision Rule:

Reject the null hypothesis, Ho, if tcal > ttab.

Accept the Alternate hypothesis, H_A, if otherwise.

The Logit regression model is stated as follows:

The model is stated as follows:

$$P = E\left(yi = \frac{1}{x_{ij}}\right) = \frac{1}{1+e^{-2i}} \quad equation\ 1 = \frac{1}{1+e^{-(\propto+\varepsilon_j B_j x_{ij}+e_j}} \ldots\ldots\ldots\ 3$$

Where Z_i = The food security index.

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12} + e)$ ……..4

Where:

Y = probability of household being food secured as computed in objective iii, ($Y_i = 1$ when $Zi \geq 0.5$; $Y_i = 0$ when $Z_i < 0.5$)

X_1 = Age (years)

X_2=Gender (Male =1, female =0)

X_3= Level of education (years spent in school)

X_4= Farming experience (years)

X_5= Household size (number of persons)

X_6= Farm size (hectares)

X_7= Number of extension visit (No of visits in the last year)

X_8= Marital status (Dummy married 1, Single =0)

X_9= Membership of social organizations (Number of social organizations)

X_{10} = Depreciated value of household farm implements (Naira)

X_{11} = Non-farm income (Naira)

X_{12} = Farm income (Naira)

e= error term.

RESULTS AND DISCUSSION

Socioeconomic characteristics of the farm households

The result of the analysis of socioeconomic characteristics of the heads of farm households is presented in Table 1

Table1: Socioeconomic characteristics of farming households in the study area

Variable	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Age	10	28. 57	2	6.90
30-39	9	25.71	13	44.83
40-49	12	34.29	6	20.69
50-59	3	8.57	7	24.14
60-69	1	2.86	1	3.45
70-79	**35**	**100**	**29**	**100**
Mean	**16**		**20**	
Marital Status				
Single	4	11.43	1	3.45
Married	22	62.86	12	41.38
Widowed	9	25.71	16	55.17
Total	**35**	**100**	**29**	**100**
Household Size				

1-2	5	14.29	7	24.14
3-4	11	31.43	11	37.93
5-6	18	51.43	9	31.03
7-8	1	2.86	1	3.45
9-10	0	-	1	3.45
Total	**35**	**100**	**29**	**100**
Mean	**4**		**4**	
Years spent in School				
0	7	20.00	4	13.79
1 - 6	15	42.86	14	48.28
7 – 12	8	22.86	6	20.69
13 – 18	5	14.29	5	17.24
Total	**35**	**100**	**29**	**100**
Mean	**8**		**8**	
Farm Experience				
1-9 years	10	28. 57	2	6.90
10-19 years	9	25.71	13	44.83
21-29 years	12	34.29	6	20.69
30-39 years	3	8.57	7	24.14
40-49 years	1	2.86	1	3.45
Total	**35**	**100**	**29**	**100**
Mean	**16**		**20**	
Membership of Social organizations				
Non-Members	26	74.29	24	82.76
Members	9	25.71	5	17.24
Total	**35**	**100**	**29**	**100**

Source: Field Survey, 2017.

The result in Table 1 shows that 60% of males and 51% of females were between 40-59 years. This result could be an indication that most of the heads of faming households were still in the active age bracket and will be able to carry out those farming activities and other economic activities that will enhance their food security. The average age was 54 years for males, 55 years for females respectively. The mean age reinforces the premise that most of the respondents were still very active. This result agrees with the findings of Ojeleye *et al.* (2014) and Ahmed *et al.* (2015) whose works on non-farm income and food security status of small scale farming households in Nigeria reported that the farmers were still very active and productive.

The result also reveals that 62.86% of the males and 55.1% of females were married. The implication of this result is that majority of the respondents in the study area were married. Thus, even though they will have additional responsibilities to perform to their spouses and their households, the married person may also receive help from his spouse and household members on the farm and this may tend to make him/her produce more food and thereby become more food secured. This supports the findings of Adebayo (2012) who noted that majority of the respondents in Oyo State were married.

Majority of the males headed households (51.43%) had household size of between 5-6 persons. Also, 68% females had household sizes of between 3-6 persons. The average household size of both male and female headed farming households was 4 persons. This result is an indication that the respondents had moderate household sizes. It may imply that the household heads may have

family labour to help on their farms. This will lead to increased output even at a reduced labour cost and enhance food security in the household. This finding disagrees with the findings of Mohammed *et al.* (2013) who stated that the average of household size of smallholder farmers in Kaduna state was 7 persons.

Also, majority of male household heads (66%) and female household heads (69%) spent between 1 -12 years in school. This may be an indication that the respondents are literate. High literacy level may be an advantage to them since they will be able to adopt modern technologies, acquire useful information and access important inputs like credit which could enhance their farm output and improve their household food security status. The mean of number of years spent in school for both male headed households and female household heads was found to be 8 years. This is in contrary to the findings of Babatunde *et al.* (2007) who noted that majority of the households in Kwara state had no formal education with a percentage of about 47.9%.

The result in Table 1 also shows that majority of the male and female headed households (about 60% and 64% respectively) had farming experience of between 10-29 years. This is an indication that most of the respondents had been into farming for more than a decade. The wealth of experience gathered by these farmers would serve as reservoir of knowledge from which they would draw when making crucial decisions about their farming activities. An experienced farmer would be in better position to take informed decisions concerning production activities especially concerning land preparation and cultivation as well as pest and disease control on the farm such that it would lead to better output and enhanced food security for the household. This result differs from that of Ojeleye *et al.* (2014) who reported that the mean farming experience of farmers in Kaduna state, Nigeria was 23 years.

Majority of the household heads (about 74% of males, about 83% of females) in the area did not belong to any social or cooperative society. This implies that the farmers may not obtain benefits that membership of such organizations confers on an individual. Such benefits as collective bargaining, economies of scale and access to grants and improved inputs from government and other developmental partners may elude these farmers. The implication of this also is that their food output and food security status may be adversely affected. This result agrees with that of Babatunde *et al.* (2007) who noted that majority of the respondents in Kwara state do not belong to any cooperative society and with about 93.6% as their percentage.

Quantity of Food Consumed

The quantity of food consumed by farming households by gender was analyzed and presented in Table 2.

Table 2: **The per capita food intake by farming households by gender.**

Quantity of food	**Male**		**Female**	
consumed. (Kcal)	Frequency	Percentage	Frequency	Percentage
0 - 1,999,999	13	37.14	18	62.07
2,000,000 - 3,999,999	14	40.00	6	20.68
4,000,000 - 5,999,999	4	11.43	2	6.90
6,000,000 - 7,999,999	4	11.43	1	3.45
>8,000,000	0	-	2	6.90
Total	**35**	**100**	**29**	**100**

Mean	**3,085,123.314**	**3,185,648.69**

Source: Field Survey 2017.

The result in Table 2 shows that majority of males and females (about 77% and 83% respectively) had per capita food intake of not more than 3,999,999Kcal. The mean per capita food intake for male and female headed households was 3,085123.314 Kcal and 3,185,648.69Kcal respectively, implying an annual average per capita food intake of 105280.11Kcal and 91018Kcal for female and male farming households respectively. When considered in the light of the FAO recommended daily per capita food intake of 2260Kcal, this result is an indication that the food intake of the households is quite low. It may also be an indication that these farming households may be facing food security challenges. The result however indicates that females produce slightly more quantity of food than males. This result agrees with the finding of Ukeje (2004) who noted that in females in rural farming communities are more involved in food production hence tend to produce more food than male headed households.

Household food security in the area

The magnitude of household food security in the area was analyzed and the results were presented in Table 3.

Table 3: Magnitude of household food security in study area.

Parameters	**Males**		**Female**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Food insecure	18	51.43	15	51.72
Food secure	17	48.57	14	48.28
Total	35	100	29	100

Source: Field survey, 2017.

The food security index (the ratio of per capita household food intake to the recommended FAO food intake) was used as a proxy for food security status of the households. The indices ranged from 0-1. A bench mark of 0.5 (the mid-point) was used to classify the farm households into being food secure or food insecure. The result in Table 3 indicates that the proportion of male headed households who were food insecure was slightly greater than the females. The implication of this finding is that efforts aimed at stemming food insecurity among rural farming households have not yielded the required results. It may also be a sign of declining productivity and declining food output in the study area in particular and the nation in general. This finding agrees with that of Adebayo (2012) who stated that majority (54.3%) of the farmers studied in Oyo state were food insecure.

Comparison of food security status of the male headed households and the female headed households in the Area.

t- test was used to compare the food security status of male and female headed farming households in the study area.

Table 4: Result of t -test comparing the food security status of male and female farming households in the study area.

Gender	Mean of food security status indices	Zvalue
Male	1.258	2.878***

Female	1.117

The result of the t-test showed that there is significant difference in the food security status of male headed households and the female headed households. Male headed households appear to have a higher level of food security than the female headed households. This seemingly contradictory result may be explained by the fact that female headed households are usually larger and thus there are more mouths to feed. This result reveals how though female produce more food; they still tend to be vulnerable to the scourge of food insecurity. This finding underscores the importance of giving females more access to productive access and cheaper inputs so as to help boost their food output.

Determinants of Household Food Security by Gender.

The results of logit regression is presented in Table 5. This method was adopted in line with other studies by Anyanwu (2010).

Table 5: Determinants of household food security status among farming households in the study area.

Explanatory Variables	Males Coefficient	Z-value	Females Coefficient	Z-value
Age	-0.0195***	-5.86	-0.00621***	-2.81
Educational level	0.848*	1.72	0.113	0.59
Farm Experience	0.138	1.64	0.216**	2.06
Household size	-1.127**	-2.40	0.272	0.49
Farm Size	4.669**	2.07	0.0849**	2.75
Extension Visits	-0.397	-0.34	0.0000284***	3.46
Marital status	0.499	0.48	0.985	0.56
Membership of social organizations	-1.498	-0.85	4.243*	1.73
Total depreciation	0.000121**	2.03	-0.0000162	-0.64
Farm income	0.0697*	1.97	5.20e-06	0.57
Non-farming Income	2.79e-06	0.77	-1.28e-06	-0.25
Constant	0.558	0.15	0.588	0.11
Number of Observations	35	29		
LR Chi2 (11)	19.28	19.36		
Prob > Chi2	0.0562	0.055		
Pseudo R^2	0.4034	0.4852		
Log likelihood	-14.259656	-10.268087		

Source: Field Survey, 2017. Asterisk*** =significant at 1%, **=significant at 5%, * significant at 10%.

The results showed that for the male headed households, the estimated coefficients for the likelihood ratio chi-square was significant at ($p<0.01$) for the households with chi-square values of 19.28. The model accounted for 40% of the variation in food security statue of male household heads in the study area ($R^2 = 0.4034$).

The coefficient of age of the male headed households was significant at one percent level and negatively related to the food security status indicating that the older the households head, the higher the likelihood of his household being food insecure. This implies that old age may translate into low or reduced productive activities on the farm which in turn may affect household livelihood improvement strategies and food security. This result agrees with the findings of Abdullahi *et al.* (2013) who reported that most of the farmers in North Western Nigeria had a negative correlation with age in respect to food security and so tend to be food insecure as the household heads gets older.

The coefficient for the number of years spent in school (educational status) of the household heads was found to be positive and significant at 10% level. This implies that more educated the male head of the households, the more likelihood of his household being food secured. This result is in agreement with the findings of Fawehinmi *et al.* (2014) who worked on gender dimension of food security status of households in Oyo and who also noted that households with more formal education are more food secured compared with households having a head with none or few years of formal education.

The coefficient of household size of the male household heads was negative and at five percent significance level. This implies that as the household size of the respondents increases, the probability of the household being food insecure increases that is, larger households are more likely to be food insecure than smaller households. This may be attributed to the presence of more non-productive or large number of dependent members of the household like children and the elderly who are unproductive and yet take a big proportion of household income in terms of clothing, medical bills, food, school fees, etc. This result agrees with that of Anyanwu (2012) who reported the same relationship between household size and poverty which is synonymous with food insecurity.

The coefficient of farm size was positive and significant at five percent level of probability. This implies that as farm size increases, the probability of the household being food secure also increases. This may be attributed to the larger output that cultivating a larger area of land portends. This result agrees and is consistent with that of Adebayo (2012) who in his work on farmers in Osun State reported that farm size had a positive effect on household food security.

The coefficient of depreciation of capita assets including farm implements was positive and significant at five percent level of significance. This implies that households who own productive and improved assets are more likely to be food secured than those households without access to modern and improved assets. It also means that these assets could be pledged as collateral and used to access loans which could in turn be invested into productive activities on the farm. This is result is in agreement with the findings of Fawehinm *et al.* (2014) worked on gender dimensions of food security status of households in Oyo State and found that asset ownership had a positive effect on household food security.

The coefficient of farm income was positive and was significant at 10%. This implies that the higher the farm income, the higher the probability of the household being more secured. This also implies that households that engage in large scale highly productive farming stand higher chance of being food secured than households which do not. This is as a result of the households producing more food from their farm which they feed from and also sell the excess in the market to make extra income which they use for their use too.

The results also showed that for the female headed households, the estimated coefficients for the likelihood ratio chi-square was significant at ($p<0.01$) for the households with chi-square values of 19.36. The model accounted R^2 (0.4852) for 49% of the variation in food security statue of female household heads in the study area.

The coefficient of age of the head of household was negative and significant at one percent level of significance. This implies that the probability of the female headed household being food secure decreases with increase in age The large number of aging females involved in agricultural production make this findings a poignant pointer to the fact that there is a grave impending food security crises looming if proactive steps are not taken to forestall it. This result agrees with the findings of Babatunde *et al.* (2007) who reported that age had a negative significant relationship on the food security status of farming households in Kwara State.

The coefficient of farming experience was positive and significant at five percent level of significance. The implication of this finding is that the probability of the household being food secured increases with increase in years of farming experience of the household head. This may be attributed to the farmers relying on his experience and skills gathered over time to improve on her productive activities on the farm.

The coefficient of farm size was positive and significant at five percent level of significance. This implies that the larger the farm size, the higher the probability of the household being food secured. This may be attributed to higher yield resulting they bring more land under cultivation. This result is in agreement with the findings of Ojeleye *et al.* (2014) who reported significant positive relationship between farm size and food security of farmers in Kaduna State.

The coefficient of extension visits was significant and had a positive effect on household food security. This implies that increase in the number of extension visits will also increase the likelihood of the household being food secure. This could be as a result of the improved breeds and technologies brought by extension agents during their visits .This result underscores the importance of a proactive, responsive and need oriented extension service in the fight to ensure food security in the nation. This finding is in agreement with that of Bala (2016) who reported that extension visits increased the likelihood of the women ginger farmers in Kaduna State being food secure.

The coefficient of membership of social group was positive and significant at 10% level of probability. This implies that the probability of the household being food secured increases with the membership of social group. This may be due to the advantages membership confers on members which include easier and cheaper access to inputs, credit and grants from government and other stakeholders as well as economies of scale in procuring inputs and sale of output. This result agrees with that of Fawehnmi *et al.* (2014) who in his work on gender dimension and food security status of households in Oyo State reported that membership of cooperative societies increased the chances of being food secured.

CONCLUSION

The study analyzed and compared the food security status of male and female farming households in Imo State, Nigeria. The study revealed that though female headed households produced more food, the male headed households were more food secured. Also, the per capita food output of farming households in the area is low and may be an indication that the households face food security challenges. Level of education, farm size, income and total depreciation of assets are key

variables that influenced positively the probability of male headed households being food secured. Farming experience, farm size, extension contacts and membership of social organizations are key variables that influence positively the probability of food security among female headed households.

RECOMMENDATIONS

Based on these findings the study recommends that:

1. Efforts should be made to review existing land policies so as to make farmers have easier access to land for food production.
2. Good educational facilities should be provided in the rural areas to give farming families access to quality and affordable education. This will boost literacy and enhance productivity
3. The extension services should be revived and made more proactive and service oriented. There is need for increase in the number of trained extension agents to make the service more effective.
4. Farmers should be encouraged to form social groups such as farmer producers' cooperative societies and thrift and credit societies. The members of these organizations should also be trained so as to make them more effective.

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POLICY BRIEF

December 2020

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Strengthening Climate Change Adaptation Capacity of Farmers in Nigeria: Path to Attaining Agriculture Promotion Policy (APP) and Nation's Food Security Agenda

Source: https://media.ifrc.org/ifrc/2018/09/25/80-nigeria-affected-floods-disaster/

Summary

Despite conscientious efforts and improvements made by the Federal Government of Nigeria to attain sustainable development goal of zero hunger, Nigeria is yet to meet the domestic food requirements. Major gaps still exist between the demand and supply of major crops and activities. Climate change ranked high among major factors militating against agricultural development in the country. While the Nigerian government make appreciable effort to tackle food insecurity in the nation, it is important to note that the goals of achieving food security, promoting sustainable agriculture (SDG2), and taking climate action are connected and need to be addressed simultaneously for the desired result to be achieved. Adaptation remains the major response to climate change effects since occurrence of the change in climate cannot be possibly controlled by man. Amidst efforts by farmers to successfully adapt to climate risks and threats, varying challenges are met. Strengthening their climate change adaptation capacity is crucial to achieving food security goals.

KEY MESSAGES

Nigeria will in the long run experience huge reduction in crop yield as a result of the distortions caused by the shift in atmospheric temperature and rainfall

Food security problems cannot be tackled without addressing the risks and uncertainties occasioned by climate change

Strengthening farmers climate change adaptation capacity is a sure path to attaining food security in

Introduction

Climate change refers to variations in the state of climate that persists for an extended period, typically decades or longer[5], it could be due to natural variability or as a result of human activity. It has generated global concern in the recent time as its devastating effects is felt in almost all sectors of the economy with the agriculture sector as the most hit especially in developing countries like Nigeria. The agricultural sector in Nigeria relies heavily on weather signals for their agricultural activities for instance, the onset of rain marks the beginning of planting season for most farmers. Technological and infrastructural development is still low hence heavy reliance on rain-fed agriculture. Approximately 9 out of 10 Nigerian farmers own small family farms [6] with 70% still living below poverty line of USD1.9 a day hence operate on subsistence level. This explains further the heavy reliance of most farmers on rain-fed agriculture and wide use of crude technologies as well as difficulty in adopting improved crop and livestock varieties by majority of the farmers. Unfortunately, Nigerian climate is experiencing dramatic changes manifesting in varying adverse weather situation with changes in temperature and rainfall as the most prominent[7]. The Nigerian Meteorological Agency report of 2010 and 2012[8,9] noted that if the present trend of climate variability continues, it is likely that the frequency and intensity of weather-related disasters may increase in the years ahead. Observations and the numerous weather events in the country have shown that the climate variability trend has not only continued to progress but has become even worse over the years. The agricultural sector is experiencing huge losses which will intensify if commensurate adaptation effort is not made. Programmes and policies to improve agricultural productivities may be rendered futile if planned without integrating climate change adaptation measures.

The Agricultural Transformation Agenda (ATA) was introduced in 2011 with the aim of rebuilding the agricultural sector. The intervention succeeded in helping refocus Nigerian attention on agriculture but the domestic food demand as well as export value at quality levels required for market success is yet to be attained. The Agricultural Promotion Policy (APP) was introduced to address this gap. This policy brief recognizes the fact that farmers are key to achieving the goal of the APP and emphasized that failure to strengthen their climate change adaptive capacity will cripple all efforts towards the realisation of the policy agenda.

Key issues

❖ Effects of climate change on agricultural activities in Nigeria

Climate change continues to exact varying levels of effects on agricultural activities. Nigeria according to Intergovernmental Panel on climate change Report[10] is a climate change "hot spot" with a projected average temperature rise of 1-2ºC by 2050[11] and major shifts to be experienced in temperature, rainfall, storms, sea levels[12]

The country is already experiencing severe heat occasioned by the increase in atmospheric temperature. Rainfall has become more erratic with reduced period of rainfall starting later than the usual time thereby reducing planting season. Heavy windstorms, more torrential rains and consequent flooding has become more frequent leading to loss of the few available arable land[12].

The country will in the long run experience 20% to 30% reduction in crop yield as a result of the distortions caused by the shift in atmospheric temperature and rainfall[13]. This situation could get worst as global rainfall is predicted to drop by 10%[10]. In addition, insect, pests and weed infestation triggered by high temperatures and erratic rainfall pattern have become a frequent occurrence. This could be a serious challenge in crop production. Post-harvest losses heightened by severe heat manifesting mainly in speedy crop deterioration and rot are indices of the change in climate. There is increase in the number of water bodies shrinking while sand dunes are increasing annulling production by irrigation among rural farmers who depend on these water bodies for their irrigation. The level of uncertainties resulting from climate change that is experienced in the agricultural sector is high. These challenges if unaddressed will further stressed the already scare resources jeopardising efforts to enhance food production in the nation. Adaptation remains the major response to these extreme weather events since man has little/no control over the fast-changing weather.

❖ Climate change adaptation and challenges to adaptation

It is no longer debatable that African agricultural system including Nigeria is affected by climate change. Failure to address the issue of climate change effects may lead to agricultural losses of up to 4% of GDP[17]. Countries such as Nigeria that experienced soil erosion and operate rain-fed agriculture could experience declines in agricultural yields of up to 50% within 2000-2020 due to increasing impact of climate change[10]. Farmers in Nigeria are making conscientious effort to adapt to climate change. Research has identified major climate change adaptation strategies used by the farmers to include cultivation of improved/drought resistant varieties, multiple planting date, fertilizer application and use of organic manure, mixed and multiple cropping, increased mulching, weeding and cover cropping, crop diversification, application of indigenous knowledge, increase in the use of fallowing[14,15,16,18,19,]. Though some adaptation strategies like use of irrigation facilities, afforestation, information from extension agent etc. were accepted by farmers to be viable, limited resources and capital militate against scaling up the use of some of these viable strategies. There is need to support farmers effort in tackling climate change effects if the expected results will be achieved. Other major constraints experienced by crop farmers in adapting to climate change include poor access to information on climate change, irregular extension services, inadequate production inputs, high cost of improved farm inputs, land and labour constraints, ineffectiveness of cooperatives, lack of/poor access to fund and credit facilities, poor government support, poor infrastructural capacity and technology know-how and transportation constraint. These constraints if not addressed will continue to jeopardise the efforts of farmers and government to enhance agricultural production in the country. Since agricultural system is still majorly dependent on weather variables, issues of climate change must be given top priority if the agricultural agenda of improved food production will be realised.

Table 1. Gaps in Nigeria demand and supply across key crops and activities

S/N	Crop	Demand (Tons)	Supply (Tons)
1	Rice	6.3 million	2.3 million
2	Wheat	7.5 million	0.06 million
3	Maize	7.5 million	7 million
4	Soya Beans	0.75 million	0.6 million
5	Chicken	200 million birds	140 million birds
6	Fish	2.7 million	0.8 million
7	Milk/Diary	2 million	0.6 million
8	Tomato	2.2 million	0.8 million
9	Yams	39 million	37 million
10	Oil Palm	8 million	4.5 million
11	Cocoa	3.6 million	0.25 million
12	Cotton	0.7 million	0.2 million
13	Sorghum	7 million	6.2 million

Source: Federal Ministry of Agriculture and Rural Development, (FMARD), Agriculture Promotion policy, 2016-2020

Policy options and Recommendations

Food security and nutrition problems cannot be addressed without simultaneously addressing climate change effects and other stressors. There is need for increased and consistent effort by all key actors in climate change scenario including government and private sectors in the following areas:

1. Strengthened coordination among key climate change actors as well as in the delivery of climate change advisory services to farmers. There are so many actors in climate change scenario in the country ranging from researchers from diverse areas, private institutions to government parastatals. Unfortunately, all of these actors work in isolation resulting in duplication of efforts, waste of resources and incoordination of efforts to better tackle climate change. The climate change department under the Federal ministry of Environment could take the lead in developing a framework or platform to bring these actors together and synchronize their efforts. Better insights and ideas to tackle climate change effects more effectively could be generated from this.
2. Enhanced capacities of agricultural extension agents (AEAs) who are the key drivers of agricultural advisory service delivery in the nation. There is need for upgrade both in the knowledge of climate change adaptation as well as in the use of simple, accessible and cost-effective digital tools for easy and faster information and knowledge delivery. Climate change issues are contemporary issues in the agricultural system which the extension agents may not have encountered during their training. In addition, mode of information dissemination in the advent of mobile phones and increased internet facilities continue to experience drastic changes. Upgrading the climate change knowledge and Information Communication Technologies (ICT) skill of AEAs will facilitate effectiveness in climate change adaptation information dissemination. The Forth Nightly and monthly review

meetings of Subject matter specialists and AEAs organised by the Agricultural Development Programme (ADP) is a good avenue for this training.

3. There is need for farmers to go beyond awareness to proper knowledge of climate change. This is pre-requisite to readiness to adopt effective adaptation measures. When farmers have sound knowledge of climate change, its casual activities and proper adaptation measures, they will be better disposed to adopt environmentally sustainable strategies in their farming activities hence contributing less to Green House Gas emission as well as experience less losses resulting from climate change effects. Climate change workshops and trainings supported by both government and private agencies administered through research institutes and ADPs would go a long way in educating these farmers. Also, universities in Nigeria through the community service of their faculty of agriculture could play significant role in educating these farmers.

4. Furthermore, climate change adaptation plan should be mainstreamed and embedded in all activities and programme targeted to enhance agricultural productivity in the country. Failure to integrate climate change adaptation plan into such will significantly militate against achievement of the goals of such interventions as the adverse weather events occasioned by the change in climate would certainly disrupt the effectiveness of such programme. In addition, consistency in government policies and efforts towards climate change adaptation is of utmost important. Discontinuance of existing programme during change of administration causes distortions in progress and waste of already invested resources.

5. Provision of infrastructural facilities is paramount for effective climate change adaptation. Two key infrastructures that are of priority in this regard is irrigation system and functional weather stations. There is need for a shift from total reliance on rain-fed agriculture if food security goals will be achieved in the country. Fluctuations in rainfall pattern has made dependence on weather signal for farming activities unrealistic. Government through the FADAMA programme and other intervention agenda must consider prioritizing provision of irrigation facilities in farming communities. Farmers can avert many extreme weather events if they have access to early weather signals and warnings. Their planting activities could be better planned with the needed weather information. This cannot be possible without a functional and accessible weather station. Even the agricultural extension agents may not be able to help farmers much if they do not have access to functional weather stations. Building well-equipped weather station in all the research institutes spread across the geopolitical zones of the country will improve access to weather information which is fundamental to climate change adaptation.

6. Women constitute significant proportion of the labour force in agricultural sector hence play pivotal role in the development. Ironically, this key stakeholders in the sector still suffer difficulties in accessing needed resources and information[20]. Agriculture is underperforming in many developing countries due to the fact that women lack the information and opportunities they need to improve their production[21]. To ensure effectiveness, Climate change adaptation plan must be holistic and more inclusive, integrating all stakeholders and recognizing women's role in the sector.

7. Upscaling use of indigenous knowledge and organic farming. Indigenous knowledge includes all wisdom, knowledge and practices of indigenous people gained over time through experience and orally passed on from generation to generation. This knowledge has over the years played significant part in solving problems, including problems related to climate change and variability. Indigenous people live close to natural resources hence often observe the activities around them and are the first to identify and adapt to any changes. Some of these indigenous knowledges are known to be environmentally friendly hence are more sustainable ways of adapting to climate change. On the other hand, organic agriculture is a regulated system of production that exploits the benefits of ecological cycles for sustainability, it excludes the use of synthetic agrochemicals which could be harmful to health or the environment now or later. It integrates cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and preserve biodiversity. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Climate change adaptation requires to follow environmentally sustainable path in order not use today's adaptation option to endanger future environment. It is important for government, agricultural research institutes, university teaching and demonstration farms to intensify efforts in upscaling the use of indigenous knowledge and organic system of agriculture as this holds great prospects for the future.

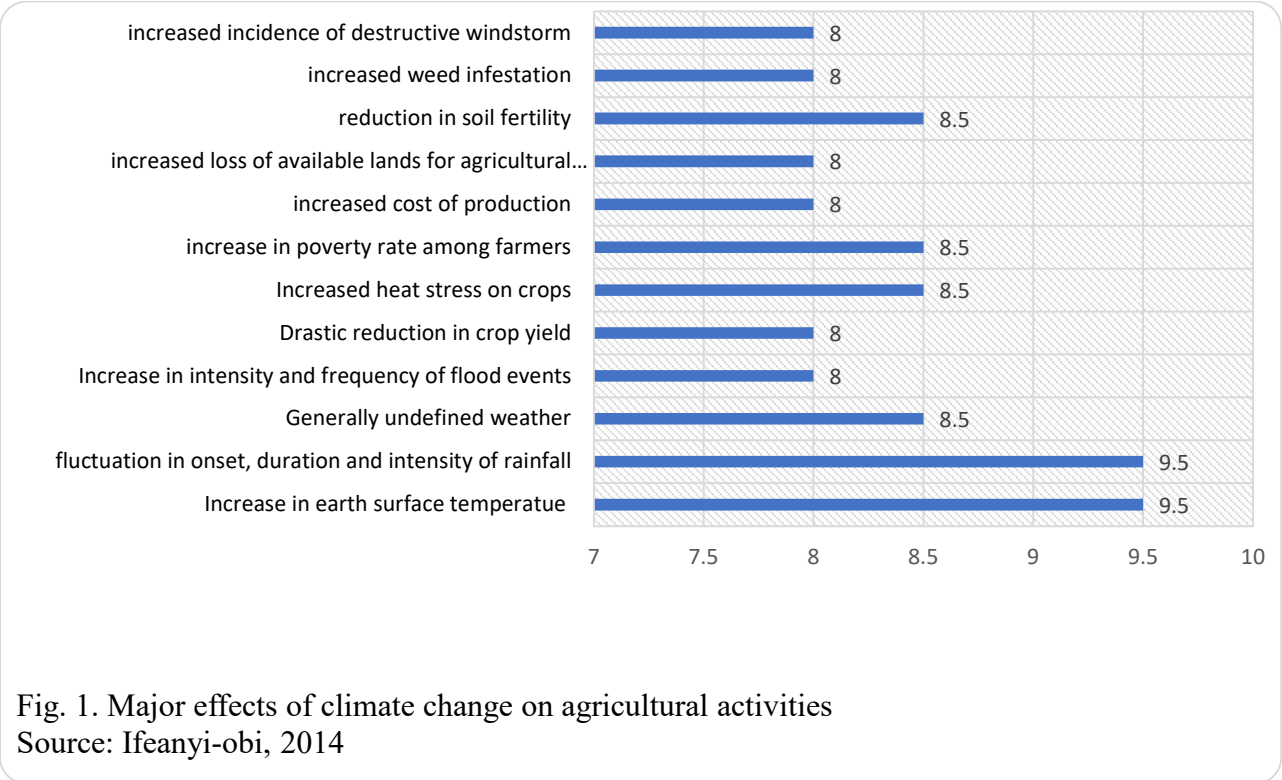

Fig. 1. Major effects of climate change on agricultural activities
Source: Ifeanyi-obi, 2014

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