Effects of Climate Variability on Grain Yield in Nigeria: An FM-OLS Model Approach

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Abstract
The study empirically explored the effects of variability in climate parameters on yield of two grain crops grown in Nigeria (millet and sorghum). This study was based on time series data obtained from various sources spanning from 1970 to 2012. Data obtained were analyzed using fully Modified Ordinary Least Square (FM-OLS) approach. The results showed that land area expansion (lnarea) exerted a significant effect on yield of sorghum in the study at a 5% level of significance within the period of study. For millet, the results indicated that climate variable (mean annual temperature), CO_2 emissions as well as land area expansion significantly impacted on the yield of the crop in the study. It is recommended that land expansion should be accompanied by intensive utilization of inputs which could help to boost the yield of sorghum and millet in the study area.

Key Words: Climate change, climate Variability, grain yield, FMOLS, Cointegration

1. Introduction

There is sufficient evidence that the world has been witnessing long term changes in climate patterns and variability with rapid acceleration in recent decades (Ahmed, Diffenbaugh and Hertel, 2009). Considerable shifts in long term temperature and rainfall averages, sea levels, frequency and intensity of droughts and floods, and their variances have been observed (Inter-governmental Panel on Climate Change, IPCC, 2007). Since temperature and precipitation are direct inputs in agricultural production, climate change can therefore be expected to impact on agriculture, potentially threatened established aspects of farming system (Hassan, 2010, Christensen and Hewitson, 2007).

The synthesis Report of the fourth assessment of IPCC stated, with high confidence, thatagricultural production and food security in many African countries and regions were likely to be severely affected by climate variability and change (IPCC, 2007). Food and Agricultural Organization (FAO, 2000) also noted that extremes of heat and cold, droughts and floods, and various forms of violent weather phenomena have wreaked havoc on the agricultural systems in African region.

Nigerian agriculture which is largely based on weather sensitive agricultural production system is particularly vulnerable to climate variability and change, as food production has been threatened by vagaries of weather (Dinar, Hassan, Kurukulasunya, Benhin and Mendelsohn, 2006). According to the report by International Food Policy Institute (IFPRI, 2012), although maize, millet, rice and sorghum are the major cereal crops in Nigeria and the West Africa region, the yields from these crops were very low compared to the world average and even other regions of Africa. Climate variability and change posed additional serious challenge in increasing agricultural productivity in Sub-Saharan Africa (IFPRI, 2012, World Bank, 2009, USAID, 2009, Von Braun, 2007). The report by IPCC AR5 posits that globally rising temperatures would make it harder for crops to thrive, perhaps reducing production over all by as much as 2 percent each decade for the rest of the century. During the period, demand is expected to rise as much as 14 percent each decade the report found, as the world population is projected to 9.6 billion in 2050, from 7.2 billion (IPCC, 2013).

Food grain production is essential in developing countries, especially Sub Saharan Africa (SSA) where agriculture is the main source of food and livelihood (Badiane and Delgado, 1995). The vulnerability of agriculture to weather in this region is evident as about 97% of agricultural land is rainfed (Rockstrom *et al*., 2004). The impact of climate variability and change on crop yield is a major concern in SSA.

Recently, international tensions and concerns are heightening over what the impact of climate variability will have on environment and agricultural production (Apata *et al.,* 2009, Building Nigeria's Response to Climate Change, BNRCC, 2008). Nigeria Environmental Study Team (NEST, 2004), Same goes, how agricultural production and food distribution system will be further stressed up by the shifting of temperatures and precipitating belts, especially if changes are rapid and not planned for (Integrated Regional Information Networks [IRIN], 2013;NEST, 2004).

Concern about potential adverse impact of climate variability and change have triggered what could be named as Impact Assessment Research since the early 1990's (Adam, Fleming, Chang, McCarl and Rosenzweig, 1995; Fischer, Frohberg, Parry and Rosenzweig, 1994; Reilly , 1994, Rosenesweig and Parry, 1994, Kane, Reilly, and Tobey, 1991). Although, some past studies have examined the effect of climate change on agriculture, at the national, regional and global scale, there is need to identify the impact of climate change on different sectors of the economy for planning and policy making.

Conceptual Framework

The study is partly anchored on the theory of production theory which is also anchored on the neo-classical economists' tradition. Neo-classical producer theory provides a prediction of how producers (farmers) make production decisions in response to exogenous factors, such as input and output prices, environmental and technological constraints. Duality theory produces a methodology for predicting those decisions from observatory on producers' cost and profits. Using neoclassical theory, the long run effects of a climate change can be estimated in one of the two ways.

First, a supply or yield function can be estimated directly with a data set containing observations on yields, input and output prices, soil characteristics and climate variables. Alternatively, the economic impacts can be predicted from as estimated profit or cost function.

The two main techniques mostly used in evaluating the effect of climate change on yields include: (1) crop growth models and (2) regression analyses. Crop growth models are widely used and produce precise crop yield responses to weather events. In their study, Rosenzweig and Parry (1994) provided a global assessment of climate change on world food supply and predicted grain yield losses of up to 10% in several SSA countries between 1990 and 2080. However crop growth models require daily weather data and are calibrated under experimental conditions. Alternatively, regression analyses allow the quantification of weather changes on crop yields in an actual cropping context.

Ayinde, Muchie and Olatiyi (2011) estimated the impact of weather changes on agricultural productivity in Nigeria. Among the few regression based impact assessments of future climate change on grain yield in Nigeria, Aye and Ater (2012) focused on maize and rice and Ayinde, Ojehomon, Daramola and Falaki (2013) studied the effect of climate change on rice production in Niger State Nigeria. They all applied econometric approaches to model the impact of climate change and variability on the grain yields. Similarly, this study applied the econometric approach to grain production and supply in Nigeria.

The broad objective of this study was to explain how variability in climate parameters has impacted on grain yield in Nigeria over time, particularly, millet and sorghum. These are among the most important cereal grains grown in Nigeria.

2. Research Methods

The study was carried out in Nigeria. The Federal Republic of Nigeria is in West Africa, located between latitudes 40 to 140 North and between longitudes 202' and 14030' East. To the North, the country is bounded by Niger Republic (1497km) and Chad (853km) to the West by Benin Republic (773km) to East by the Cameroon Republic (1690km) and to the South by Atlantic Ocean. Nigeria has a land area of about 923,769km2 (FOS, 1989; World Fact book ,2014), a north south length of about 1450km and west east breath of about 800km. Its total land boundary is 4047km while the coastline is 853km.

Data Source and Collection Procedure

This study was based on time series data obtained from various sources spanning from 1970 to 2012. The aggregate national data on production of selected grains like millet and sorghum were collected from Food and Agricultural Organization statistical website (FAOSTAT), other sources of the data collection include various editions of the Bureau of statistics (NBS), Central Bank of Nigeria statistical bulletin, United Nations and World Bank climate data bases. The study made use of agronomic, input and climate data. The input and agronomic data were collected from FAOSTAT and NBS while climate data was obtained from UNDP and World Bank Climate data base. Aggregate annual data on production, yield, Area harvested, and fertilizer quantity applied were collected.

Empirical Model

In other to find out if the relationship between economic variables is spurious or nonsensical. Philip Perron (pp) test was used to examine each of the variables for the presence of a unit root. The pp test is a non-parametric test, but it was found to produce a superior result that corrects for serial correlation and heteroscedasticity. The pp test is also known to be better in the presence of regime shift which is a problem usually encountered with Africa macroeconomic data (Yusuf and Yusuf, 2007). On application of pp test variables

attained stationarity after differencing once and thus, one may conclude that the variables are integrated of the order one, 1(1). Stationarity is confirmed when the test statistic is greater that the critical value in absolute terms

The main objective of the study was analyzed using Fully Modified Ordinary Least Square (FM-OLS) Regression. The FM-OLS estimation method is an approach to regressions for time series taking advantage of data non stationarity and cointegrating links between variables approach. It produces reliable estimates for small sample size and provides a check for robustness of the results. The FM-OLS method was originally introduced and developed by Philips and Hansen (1990) for estimating a single co-integrating relationship that has a combination of I(1). This method could be preferred to the Engle Granger techniques in introducing appropriate correction to overcome the inference problem in Engle Granger method and hence, the t-test for long-run estimates is valid (Himansu and Lester, 2007). The Fully Modified Ordinary Least Squares (FM-OLS) method utilizes "Kernal estimators of the Nuisance parameters that affect the asymptotic distribution of the OLS estimator. In order to achieve asymptotic efficiency, this technique modifies least squares to account for serial correlation effects

Table 1: Unit Root Test Result

and test for the endogeneity in the regressors that result from the existence of Co-integrating Relationships" (Rukhsana and Shahbaz, 2008).

The model is specified as follows, following Philips and Hansen (1990):

y_{it} = f(Ait, Tt, P, CO2, fert) …….....1

Where

yit= yield for crop i at time (tonne/hectare)

Ait= Area harvested for crop i at time t (hectare); T = mean annual temperature (Oc degree centigrade); P= total annual rainfall (mm); CO2 = total annual CO2 emission (kt)

Fert = fertilizer applied (tonne).This is explicitly expressed as:

Intermediate Phillips-Perron test results for unit root						
Series	***Prob.***		***Bandwidth***		***Obs***	
	Level	**1st Difference**	**Level**	**1st Difference**	**Level**	**1st Difference**
CO2	0.3613	0.0000	2.0	0.0	42	41
FERT	0.1870	0.0000	1.0	7.0	42	41
LNCO2	0.1083	0.0000	2.0	4.0	42	41
LNFERT	0.1156	0.0000	7.0	7.0	42	41
LNMLTA	0.3742	0.0000	3.0	3.0	42	41
LNMLTP	0.9859	0.0054	0.0	0.0	42	41
LNMLTYD	0.0363	0.0000	1.0	4.0	42	41
LNRAIN	0.0001	0.0000	9.0	25.0	42	41
LNSGM	0.1125	0.0000	2.0	0.0	42	41
LNSGMA	0.0279	0.0000	3.0	1.0	42	41
LNSGMP	0.6263	0.0000	3.0	1.0	42	41
LNSGMYD	0.0448	0.0000	3.0	14.0	42	41
LNTEMP	0.9991	0.0000	2.0	3.0	42	41
MLTA	0.3864	0.0000	3.0	3.0	42	41
MLTP	0.1674	0.1032	1.0	4.0	42	41
MLTYD	0.0924	0.0000	2.0	6.0	42	41
RAIN	0.0001	0.0000	11.0	23.0	42	41
SGM	0.1585	0.0000	2.0	0.0	42	41
SGMA	0.0649	0.0000	3.0	3.0	42	41
SGMP	0.9480	0.0000	3.0	13.0	42	41
SGMYD	0.1166	0.0000	5.0	16.0	42	41
TEMP	0.9995	0.0000	2.0	3.0	42	41
YEAR			Dropped from Test			

Source: Computed from CBN Data by Authors, 2015

logy= $\beta_0 + \beta_1 A_{it} + \beta_2 T + \beta_3 P + \beta_4 CO_2 + \beta_5 Fert + e$…….....2

β_0- β_5 = parameters to be estimated; e = stochastic error term.

3. Results and Discussion

Prior to the estimation of the impact of climate variability on grain yield, the variables to be used were subjected to stationarity tests (CO2, FERT, Rain, Temp, Area harvested, yield) Philips-perron (PP) unit root test was used in determining the stationarity of the variables under consideration and the results were presented in Table 1.

Impact of climate variables on grain yield based on estimates from Fully Modified Ordinary Least Squares (FM-OLS)

The FMOLS parameter estimates of the cointegration regression model applied in analyzing the climate variables alongside CO2 emission and fertilizer input application effects on grain yields in sorghum and millet in Nigeria over the period of study are summarized in Table 2. It was indicated from the result that land area expansion (lnarea) exerted a significant effects on the yield of sorghum in the study at a 5% level of significance within the period of study. All other variables, including the climate variables showed no significant effect on the yield of sorghum.

The slope coefficient of -7348.971 sorghum implied that land area expansion by a single percent resulted in yield decrease by 7,348.97 tonnes in the period of study. This could be supporting law of decreasing marginal productivity (Elodie 2011) or also imply that land expansion was probably not accompanied by intensive utilization of inputs such as high yielding seeds, appropriate fertilizer and pesticides which could have boosted the yield of sorghum.

However, in terms of the model's diagnosis, it was found that the model also had residuals which were normally distributed with a Jarque Bera statistic of 5 at p = 0.21 (i.e. p>0.10), thus affirming that the distribution of the residuals of the estimated model was normal. Similarly, the cointegration test using Engle-Granger Tau statistic recorded a value of -5.649808 (p<0.05) implying that we have to reject the null hypothesis which held that "series are not cointegrated" at 5 percent. The series are therefore deemed as cointegrated and could be reliably used for forecasting. The test for model fitness gave an R squared value of 0.58, which implies that 58% of the variations in yield of sorghum were accounted for by variability in the independent variables included in the regression model. The fact that the correlogram of the residuals squared did not show significant values at 5% implies that the threat of serial correlation at the various lags examined in the study was not severe in the model. All these affirmed that the model had desirable properties of OLS.

For millet, the results indicated that climate variable (mean annual temperature), CO2 emissions as well as land area expansion significantly impacted on the yield of the crop 1%,5% and 1% respectively.

From Table 1, the entire test variable for determining impact of climate variability and change on grain yield were not stationary at levels but became stationary in difference on the basis of the Philip Perron probability level. The null hypothesis of non-stationarity was rejected after the first difference.

Their slope coefficients in Table 2 were -10493.78 (p<0.01), 530.58 (p<0.05) and -7348.97 (p<0.01) respectively. These results implies that while temperature increase by one percent resulted in mean annual yield decrease in the study by 10, 493.78 tonnes, curiously increase in CO2 emissions by a

percent resulted in an increase in yield by 530.58 . However, the direction of impact of land area expansion was similar to that of sorghum which indicated a negative impact of land expansion. It was specifically indicated that a unit or percentage increase in land area in the country resulted in a yield decrease by 7,348.97 tonnes within the period of study.

The model fitness test indicated an R^2 of 0.52 which implies that 52 percent of the variation in yield of millet were accounted for by increase or decrease in the independent variables included in the model. This is a fairly good result. From the Jarque-Bera statistic of 3.76 ($p< 0.16$) recorded as well as the squared correlogram at various lags which were not significant at 5 nor 10 percent, implied that the residuals were normally distributed and devoid of serial correlation at various lags. The Engel-Granger Tau statistics of -4.933853 ($p<0.05$) indicated that the series were cointegrated as the null hypothesis of no cointegration was rejected at 5 percent. The low mean VIF recorded too (2.41) means that

Table 2: Results of FMOLS parameter estimates to model the effect of climate variables, CO2emissions and fertilizer input utilization on yields of sorghum and millet in Nigeria (1970-2012)

Dependent variables:		**Sorghum Yield**			**Millet Yield**	
Independent variables	***Coeff.***	***Std. error***	***t-Statistic***	***Coeff.***	***Std. Error***	***t-Statistic***
Lnrain	-754.797 (-0.438)	1725.085	-0.438	1694.356 (0.879)	1927.207	0.879
Lntemp	-10493.780 (-0.948)	11067.670	-0.948	-44258.49 (-3.507)**	12619.08	-3.507***
lnco2	530.578 (0.429)	1235.522	0.429	3405.613 (2.347)*	1450.838	2.347**
Lnfert	-98.075 (-0.171)	574.806	-0.171	-681.471 (-1.000)	681.691	-1.000
Lnarea	-7348.971 (-3.655)**	2010.418	-3.655***	-6780.010 (-3.454)**	1963.066	-3.454***
C	157562.500 (2.438)*	64638.670	2.438**	223704.40 (3.199)**	69933.59	3.199***
@TREND	240.718 (3.400)**	70.790	3.400***	201.006 (3.362)**	59.783	3.362***
R-squared	0.58			0.52		
Adjusted R-squared	0.50			0.44		
Jarque Bera Statistic	5			3.76		
Engle-Granger tau-statistic	-5.649808**			-4.933853		
Mean VIF	3.42265			2.410132		
Remark on Correlogram of Residuals Squared	Significant at 5% only I the first 7 lags but not significant thereafter			Significant at 5% only I the 3 and 4th lags but not significant thereafter		
Mean dependent variable	11023.4			11349.18		

Source: Output of result from E view

Note: "***" = Figures significant at 1% level"**" = figures significant at 5% level "*" = figures significant at 10%

the threat of sever multi collinearity is ruled out in this model. All these confirm that our model is fit and have all desirable econometric properties good enough for forecasting and economic analysis.

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4. Conclusion

The results obtained from the regression analyses on effect of climate variability on yield of grain reveals that temperature, CO2 and area harvested affected the yield of grains under study. It is recommended that land expansion should be accompanied by intensive utilization of inputs such as high yielding seeds, appropriate fertilizer and pesticides which could help to boost the yield of sorghum and millet in the study area. The government has a role to play in this regard by using the Ministries of Agriculture and Natural Resources to source and make the agricultural inputs readily available to farmers at the growing season when they are most needed and at rates that are affordable.

References

Adam, R. M., Fleming, R. A., Chang, C. C., McCarl, B. A. & Rosenzweig, C. (1995). A reassessment of the economic impacts of global climate change on US Agriculture. Climate Research 30: 147-167.

Ahmed, S. A., Diffenbaugh, N. S. and Hertel, T. W. (2009). Climate volatility deepens poverty vulnerability in developing countries. Environmental research letters, 4(3) 8pages.

Apata T. G., Samuel, K. D and Adeola, A. O. (2009).Analysis of climate change perception and adaptation among arable food crop farmers in South Western Nigeria. Contributed paper prepared for presentation at the International Association of Agricultural Economists 2009 Conference, Beijing, China August 16-22, 2009.

Aye, G.C. and Ater, P.I. (2010).Impact of climate change on grain yield and variability in Nigeria.A stochastic

production model approach. *European Scientific Journal* 8(35): 138-151.

Ayinde O. E., Ojehomon, V. E. T., Daramola, F. S. and Falaki, A. A. (2013).Evaluation of the effects of climate change on rice production in Niger State, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 6 : 763-773.

Ayinde, O.E, Muchie, M., and Olatiyi, G.B (2011) Effect of climate change on agricultural Production in Nigeria. A Co integration model approach. *Journal of Human Ecology* 35(3): 189-194.

Badiane, O. and Delgado, C. (1995).A 2020 vision for food, agriculture, and the environment in Sub-Saharan Africa. Food, Agriculture, and the Environment Discussion Paper 4. Washington, DC, International Food Policy Research Institute.

Building Nigeria's Response to Climate Change (BNRCC), (2008). 2008 annual workshop of Nigeria Environmental Study Team (NEST): The recent global and local action on climate change held at Hotel Millennium, Abuja, Nigeria 8-9 Cot, 2008.

Christensen, J. H. and Hewitson, B. (2007). Regional climate projections in climate change 2007. The physical science basis. contribution of working group 1 to the Fourth assessment report of the intergovernmental panel on climate change, 847-940 Cambridge University Press, 2007.

Dinar, A., Hassan R., Kurukulasunya, P., Benhin, J. and Mendelsohn, R. (2006). The policy nexus between agriculture and climate change in Africa. A synthesis of the investigation under the GEF/WB project: Regional climate, water and agriculture: impacts on adaptation of agro-ecological systems in Africa, CEEPA discussion paper No 39. Centre for Environmental Economics and Policy in Africa, University of Pretoria.

Elodie .B (2011) The impact of climate on crop production in sub-saharan Africa. A Ph.D Dissertation submitted to the Department of Economics University of Otago, Dunedin New Zealand.

FAO (2000). The state of food and agriculture: Lessons from the Past 50 years. Rome, Italy, Food and Agricultural Organization of the United Nations.

Fischer, G., Frohberg, K., Parry, M. L. and Rosenzweig, C. (1994). Climate change and world food supply, demand and trade: who benefits, who loses? *Global Environmental Change*, 4, 7-23.

FOS (1989). Federal Office of Statistics, Nigeria.

Hassan, M. R. (2010). Implication of climate change for agricultural sector performance in Africa: policy challenges and research agenda. Centre for Environmental Economics and Policy Analysis in Africa (CEEPA), University of Pretoria

Himanshu, A. A and Leste, C. H, (2007), Electricity Demand for Sri Lanka: A Time Series Analysis, Surrey Energy Economics Discussion paper Series, No.118.

International Food Policy Institute (IFPRI) (2012). West Africa agriculture and climate change. A comprehensive analysis - Nigeria. December 2012.

Integrated Regional Information Networks (IRIN) (2013). Slowing Nigerian grain trade threatens Sahel food security.

Intergovernmental Panel on Climate Change (IPCC) (2007).Climate change 2007 - IPCC Fourth assessment report. Cambridge, UK: Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC) (2013).IPCC 5th Assessment Draft Report.

Kane, S., Reilly, J. and Tobey, J. (1991). Climate change: Economic implications for world agriculture, US Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 647, US Department of Agriculture, Washington, D.C.

Nigerian Environmental Study Team (NEST) (2004). Regional climate modeling and climate scenarios department on support of vulnerability and adaptation studies: outcome of regional climate modeling efforts over Nigerians. NEST, Ibadan, Nigeria.

Philips, P.C.B. and Hansen, E. (1990).Statistical inference in instrumental variables regression with I(1) process, *Review of Economic Studies,* 57(1): 99-12.

Reilly, J. (1994). Crops and climate change. Nature, vol 367: pp118-19.

Rockström, J., Folke, C., Gordon, L., Hatibu, N., Jewitt, G., Penning de Vries, F., Rwehumbiza, F., Sally, H., Savenije, H. and Schulze, R. (2004). A watershed approach to upgrade rainfed agriculture in water scarce regions through water system innovations: An integrated research initiative on water for food and rural livelihoods in balance with ecosystem functions. *Physics and Chemistry of the Earth* 29: 1109-1118.

Rosenzweig, C. and Parry, M. (1994). Potential impacts of climate change on world food supply. Nature 367, 133-138.

Rukhsana, K. and Mohammad, S. (2008), "Remittances and Poverty Nexus: Evidence from Pakistan", Oxford Business & Economics Conference Program

United States Agency for International Development (USAID) (2009).Adapting to coastal climate change: a guidebook for development planners' sustainable coastal ecosystems program, coastal resources centre, University of Rhode Island, USA, 164 pp.

Von Braun, J. (2007). The world food situation: New driving forces and required action. IFPRI Food Policy Report. Washington DC: International Food Policy Research Institute.

World Bank (2009). *World development report,*.World Bank Washington DC.

World Fact Book (2014).

Yusuf, S.A. and Yusuf, W.A. (2007). Determinants of selected agricultural export crops in Nigeria: An ECM approach. Proceedings of African Association of Agricultural Economists held in Ghana, 469 – 472.

Effects of Financial Service Delivery and Trade Openness on Economic Growth in Nigeria (1970-2010): Implications for Nigerian Agricultural Trade Development

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Abstract

The study identified the major long-run determinants of economic growth in Nigeria with emphasis on financial services delivery and trade liberalization. It also discussed the trend of financial services performance, economic growth and trade openness in the economy alongside the policy implications of the findings for agricultural transformation in Nigeria. It relied on time series data spanning over 41 years (1970-2010), obtained from World Bank and Central Bank of Nigeria. Unit root tests were performed after which the bound testing for co-integration (Autoregressive Distributed Lagged [ADRL]) model was used. The results indicated a combination of downward and upward swinging trend of economic growth rate and financial services performance from 2004 to 2010. Agricultural growth, financial service performance and trade openness appeared to be moving in similar directions. The ARDL model estimated had an estimated F-ratio of 25.47, ($p<0.05$ with upper value of 5.966) signifying that there is co-integration among the series. The empirical results of the long-run model obtained by normalizing the explanatory variables on the log of real GDP indicated that financial services delivery (M2) indicated a significant positive relationship with economic growth (real GDP) at $p <0.05$. It was recommended that the Federal Government of Nigeria and its Central Bank should pursue implementation of effective macro-economic policies along with momentous improvements in the structure and functioning systems of governance for stabilising economic growth along financial liberalisation reforms among other recommendations. Need to also use the financial service sector to improve agricultural growth via increased access of farmers to long-term loans was recommended.

1. Introduction

According to Cromer (2012) Nigeria displays the characteristics of a dual economy: one dominant sector (oil) with poor links to the other sectors of the economy, and a typical developing economy heavily relying on agriculture and trade. Trade in Nigeria faces myriads of challenges ranging from lack of consistent policy support to poor infrastructure evidenced by inadequate roads and inefficient, expensive, and congested port facilities.

Private entrepreneurs lack capacity and access to credit, bereft of regulatory frameworks and poor enforcement of existing laws. Despite the Government's economic reform efforts over the last past years, its

capacity to overcome these persistent obstacles to growth has a long way to go (Sanusi, 2010 & Cromer, 2012). Nigeria's trade policy has been adjudged to be at a crucial turning point (Walkenhorst & Cattaneo, 2006).

Nigeria had operated a very restrictive import regime that yielded enormous transfers to domestic producers while encouraging strong anti-export bias. Yet, in its current poverty alleviation strategy, Nigeria subscribed to deeper trade integration as a strategy for fostering economic growth and poverty alleviation. Border tariffs were being reduced, trade regulations were reviewed and ambitious restructuring programmes for customs services and port infrastructure were launched. The reforms envisaged far-reaching changes to trade regimes that promised to create new opportunities through improvement of efficiency of production and consumption, with requirements for adjustment of domestic producers to the new and highly competitive economic environment, the World Bank report added (Walkenhorst & Cattaneo, 2006). It is however unclear in empirical terms how these reforms have contributed to economic growth in the country over time.

The trade reform efforts, which were supported with revenue from increased oil production and high oil prices, contributed significantly to the nation's macroeconomic growth, including reduced inflation and increased GDP growth, which remained steady in 2011 at 7.2 percent (Central Bank of Nigeria, 2011 & Cromer, 2012). While significant, this growth rate was insufficient to raise the majority of Nigerians out of poverty, especially under a high population growth rate of 3 percent, with over half of its citizens living on less than $2 per day. Crude oil exports accounted for 95 percent of the nation's export revenue and 85 percent of government revenue, while agriculture—which employed 70 percent of Nigerians—accounted for only 2.6 percent. Unemployment is also a growing concern, with up to 3 million young people entering the labour market each year.

Even though there were recorded impacts of reforms on growth it was observed that meaningful sustainable growth and development was yet to be achieved, as Nigeria ranked among the poorest countries in the world (Nurudeen and Usman, 2010 and UNDP, 2011). According to UNDP (2011), Nigeria's Human Development Index (HDI) score for 2011 was 0.459—in the low human development category—positioning the country at 156 out of 187 countries and territories. In addition, many Nigerians have continued to wallow in abject poverty, while more than 50 percent live on less than US$2 per day. The Central Bank governor, Sanusi (2010), noted that Nigerian population grew by about 150 per cent between 1963 and 2006, i.e. approximately 3.75 per cent per annum.

The financial service sector is one sector that has the potentials of contributing towards attainment of sustainable growth and development in Nigerian economy. However, it is still unclear how the sector has fared in the face of economic reforms that include trade liberalization to impact on the economic growth of the country. The financial service sector growth can positively affect the growth in the agricultural sector. A sound and efficient financial system is an important factor to stimulate economic growth and development (Udah, 2011). Financial sector assist in mobilizing savings, fostering productive investment and improved risk management. During the first few years of Nigerian economic reforms, Udah indicated from available statistics that the share of the banking system's credit to the private sector improved significantly from 34 percent in the 80s, on the average before the reform, to about 49 percent in the '90s and early part of 2000. However, the larger part of the credit to the private sector was mainly on short term investment. The

depth of the financial sector measured by broad money supply (M2) to GDP ratio (M2/GDP), contrary to expectation, did not improve in the early years of the reform (1990s). It nosedived from 32.6 percent on the average in the '80s to 26 percent in the '90s.

In 2006, the Nigerian financial sector recorded a deepening with an increase in broad money supply (M2) to GDP ratio (M2/GDP) up from 16.4 percent at the end of 2005 to 16.9 percent in 2006. The banking system capacity to finance economic activity was strengthened with a higher rate of credit to the private sector as a ratio of GDP than the preceding year. Credit to the private sector as a ratio of GDP was 23.1 per cent at the end of 2006. In 2008, financial sector further deepened as the ratio of broad money supply (M2) to GDP increased to 37.7 per cent from 21.1 per cent in 2007.

In spite of these various reforms in macroeconomic management with a few exceptions, the country has continued to witness fluctuations in major macroeconomic aggregates, sluggish economic growth and development (Udah, 2011). Against this backdrop, this study was conducted to explore the status of financial service delivery (M2), trade openness, agricultural sector growth and real GDP growth in Nigeria. The study also ascertained the relationship between economic growth and two major hypothesized drivers in this study, M2 (as proxy for financial service delivery) and trade and openness (TOP). Results gave evidence for discussing the implications of the financial service delivery for Nigerian economic transformation with a rider on agricultural transformation drive.

Literature Review

Atif et al (2010) investigated the impact of financial development and trade openness on GDP growth in Pakistan with the aid of annual data covering the period 1980-2009. They used the bound testing approach of co-integration. Their results confirmed the validity of trade led growth and financial led growth hypothesis in Pakistan. Their resulted showed a co-integrated relationship between economic growth, trade openness and financial development in both the short- and long-runs.

Winters (2002) observed that trade liberalization was beneficial because it afforded a country the opportunity to trade in larger markets thereby significantly reducing the risks associated with trading in smaller markets. Winters et al (2004) opined that one of the consequences of international trade was its tendency to expose the participating countries to foreign shocks, but the intensity or otherwise of these shocks depended on the nature of existing institutions, trade policies and the absorptive capacity of the country of the shocks. Dollar and Kraay (2001 and 2002) emphasized the positive effect of trade liberalization on economic growth and poverty reduction. Dollar and Kraay (2001 and 2002) studies supported the view that trade openness positively affected economic growth and development by postulating that foreign trade increased the domestic income of participating countries. This, according to them, is because trade liberalization allowed domestic entrepreneurs to learn new ways of utilizing or producing quality inputs quicker at lower cost, thus increasing total factor productivity and human capital accumulation.

The role of trade in economic growth in Nigeria cannot be fully accounted for without mentioning the link between agricultural growth, trade and economic growth rate. Research has shown that beyond the supply of food and fibre, agriculture has provided important market-mediated linkages by providing labour for an urbanized industrial labour force, widening markets for industrial output and through provision of export earnings to pay for imported capital goods

(Oguchi, 2007 & CBN, 2006). Oguchi (2007) observed that apart from being a major contributor to the GDP in the sixties, the sector facilitated the growth of the Nigerian economy by facilitating poverty alleviation, employment and income generation, as well as a reduction in rural-urban migration.

Adewuyi (2006) used the Data Envelop Analysis to quantify the contribution of factor productivity to real GDP output growth. He found that albeit, total factor productivity rose during the period of Structural Adjustment Programme (SAP), the growth could not be sustained in the post-SAP era. To the best of our knowledge no Nigerian case study had attempted to investigate the dynamic relationship between trade openness, service delivery and economic performance.

Udah (2011) observed that export diversification index, external reserves, government expenditure on economic and social services and financial sector variables were statistically significant factors that influenced economic growth in Nigeria. The observed effect of financial service sector on economic performance conforms with Iwukemjika et al (2009)'s observation. They however noted that much effect came through its credit supply to the private sector of the economy. On an international basis, they added, Nigeria's credit penetration (credit to the private sector/GDP) measured against a natural international peer group and the US, showed that in 2006, Nigeria's credit penetration was 14 percent, confirming that its banking system remains significantly less penetrated than its peers. However, Nigeria's credit penetration improved to 24 percent in 2007 and the reform programme initiated should help to further reduce the deficit to the likes of Brazil and Russia (Iwukemjika et al, (2009).

Theoretical Framework

Adam Smith argued that the existence of idle resources of land and labour leads to the use of excess resources in producing surplus goods for exports and thus venting a surplus productive capacity that would otherwise been unused (Udah, 2011). This implies that trade promotes efficient international allocation of resources. David Ricardo theory of comparative advantage suggests that trade optimizes production through specialization. John Stuart Mill argued that trade liberalization expands domestic market, induces innovations and increase productivity, have educative effect in instilling new ideas and in the transfer of technology, skills and entrepreneurship (Nyong, 2005).

The dualistic-development thesis (as cited in Sanusi, 2010), postulates that the world is made up of dual societies- rich nations and poor nations. Even in developing countries, pockets of wealth abound within broad areas of poverty. This school of thought embraced four key arguments: (i) different sets of conditions of which some are "superior" and others "inferior" can co-exist in a given space; (ii) This coexistence is chronic and not merely transitional; (iii) The degrees of superiority or inferiority do not show any signs of diminishing, but have an inherent tendency to increase; and (iv) the interrelations between the superior and inferior elements are such that the existence of the superior elements does not pull up the inferior ones.

Corden's (1971) supply driven model replaces the demand driven model of Staple growth theory by emphasizing on the growth of factor supplies and productivity. Corden (1971) maintained that nations that engage in international trade are most likely to benefit from trade. He classified these benefits into four, namely, the static gains from trade leading to increase in income, the capital accumulation effects arising from investing the static gains from trade, the substitution effect

resulting from possible fall in relative prices of investment goods.

This study is equally anchored on the modern development theory studies which views the evolution of growth, relative income inequalities and their persistence in unified models. In many of these models, financial market imperfections play a central role, influencing key decisions regarding human and physical capital accumulation as well as occupational choices. For instance, in theories stressing capital accumulation, financial market imperfections determined the extent to which the poor could borrow to invest in schooling or physical capital. In theories stressing entrepreneurship, financial market imperfections determined the extent to which talented but poor individuals could raise external funds to start their projects. Thus, the advancement of financial development, growth, and intergenerational income dynamics are closely intertwined. Finance exert influence on the efficiency of resource allocation throughout the economy as well as on the comparative economic opportunities of individuals from relatively rich or poor households (World Bank, 2007).

This crucial focus on the financial sector in modeling economic relationships has been supported with the historical development of perspectives on the relationship between economic growth and income inequality. It was long held that the early stages of economic development would inevitably be associated with inequality and wealth concentrations. Adducing to the fact the rich people's marginal propensity to save is higher than that of the poor, theoreticians hypothesized that the need to finance large, indivisible investment projects in the process of development meant that rapid growth would need wealth concentration, which would result in a fundamental trade-off between growth and social justice. On a more general note, Kuznets (1955, 1963), as cited in World Bank (2007), held that this trade-off implied that inequality would increase in the early stages of development until the benefits of growth spread throughout the economy.

Theoretical Model: Bound Testing Approach

The use of the bounds technique is based on three validations. First, Pesaran, Shin and Smith (2001) advocated the use of the ARDL model in estimating level relationships because the model suggests that once the order of the ARDL has been indicated, the relationship can be estimated with OLS. Second, the bounds test enables a mixture of I(1) and I(0) variables as regressors, that is, the order of integration of appropriate variables may not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Third, the technique is appropriate for small or finite sample sizes (Pesaran et al., 2001).

Following Pesaran et al. (2001), Atif , Jadoon, Zaman, Ismail and Seemab (2010) assembled the vector autoregression (VAR) of order p, denoted VAR (p), for the following growth function:

$$Z_t = \mu + \sum_{i=1}^{p} \beta_i z_{t-i} + \varepsilon_t \quad \text{.....(1)}$$

where zt is the vector of both xt and yt , where yt is the dependent variable defined as economic growth (GDP), xt is the vector matrix which represents a set of explanatory variables and t is a time or trend variable. According to Pesaran et al (2001), yt must be I(1) variable, but the regressor, xt , can be either I(0) or I(1). The long-run equations are estimated by using the following Equation (2) and by checking the significance of the variables in lag level forms jointly using F-statistic, i.e., Ho is b1 = b2 = 0. If the F-statistic is significant, we may say that there may exist a long-run relationship between the variables.

The ARDL Representation (for the Two-variables Case)

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta y_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta x_{t-i} + \varepsilon_t$$

.....(2)

The number of lagged differences is determined by using AIC or SBC. It can be checked by using the general to specific methodology, i.e., checking the significance levels of all the differenced variables jointly at each lag. For example, if we regress the equation including 4 lags (lagged differences) of each variable and check all the terms of lag 4 jointly using F-statistic, and if it is insignificant, then we have to regress again using 3 lags and continue this process until it shows statistically significant results.

After the final estimation, the joint significance of the lagged variables was checked. In this equation it will be b1 = b2 = 0. If it is significantly different from zero, then it shows that there exists a long-run relationship among the variables. After this step we can move onto the error correction equation.

The critical values tabulated in Table CI (iii) by Pesaran et al. (2001) will be used to evaluate the computed F-statistic following Atif et al (2010). According to these authors, the lower bound critical values assume that the explanatory variables, xt, are integrated of order zero, or I(0), while the upper bound critical values assumed that xt are integrated of order one, or I(1). Hence, if the computed F-statistic is less than the lower bound value, the null hypothesis would not be rejected; we conclude that there is no long-run relationship between food production index and its determinants. Conversely, if the computed F-statistic is greater than the upper bound value, then dependent variable and its determinants share a long-run level relationship. On the other hand, if the computed F-statistic falls between the lower and upper bound values, the results will be deemed as inconclusive.

RESEARCH METHODS

Area of Study: Nigeria is the most populous country in Africa with a population estimated at 162,265,000 by mid-2011, population living below poverty line of $2 per day of 84 percent, Gross National Income per capita of US $2,070 (Population Reference Bureau, 2011). According to CBN (2010) the GDP of Nigeria stood at approximately US$4.9 billion (N775.4 billion) using 1990 basic prices.

Nigerian agricultural products include cocoa, palm oil, , corn, rice, livestock, groundnuts, cotton, yams, cassava, sorghum and millet. Crude oil export remained the major source of revenue. The industry types in the country include textiles, cement, food products, footwear, metal products, lumber, beer, detergents and car assembly (CBN, 2007).

Data Source and Methodological Framework: Secondary data, mainly time series data from Central Bank of Nigeria's (CBN) Annual Report and Statistical Bulletin which contained data from National Population Commission. The researchers purposively selected 1978 to 2010 i.e. a sample of 33 years, for ease of accessing data that will cover all the variables or series within the period in view.

The series were first tested for unit roots at their levels and first differences with the aid of Augmented Dickey Fuller and Philips Perron tests (following Gujarati, 2006 & Greene, 2008). The results are presented in Appendix 1. When it was observed that some of the series were not I(0) but rather became stable at I(1) the researchers applied the bound co-integration testing approach as adopted by Pesaran et al (2001). Standard econometric diagnosis such as Breusch-Godfrey serial correlation LM test, Jacque-Bera normality test and Ramsey RESET specification test were conducted following Studenmund (2001) and Patterson (2000), Gujarati (2006) and Greene (2008).

The use of the bounds technique was based on three major validations. First, Pesaran et al.

(2001) recommended the use of the ARDL model for estimating level relationships because the model held that once the order of the ARDL is recognised, the relationship can be estimated by OLS. Second, the bounds test allows a mixture of I(1) and I(0) variables as regressors, that is, the order of integration of appropriate variables should not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Thirdly, the technique is quite suitable for small or finite sample size.

Moreover, the bounds testing technique employed in this study is robust for small sample study. The bound testing approach is applicable even when the explanatory variables are endogenous (Alam and Quazi, 2003). The ARDL cointegration test, assumed that only one long run relationship exists between the dependent variable and the exogenous variables (Pesaran, et al, 2001, assumption 3). The bound test is basically computed based on an estimated unrestricted error-correction models (UECM) or error correction version of autoregressive distributed lag (ARDL) model, by Ordinary Least Square (OLS) estimator, noted Pesaran et al. (2001). Thus, the bound test developed by Pesaran et al (2001) is basically the Wald test (F-statistic version of the bound testing approaches) for the lagged level variables in the right-hand side of Unrestricted Error Correction Model (UECM). In other words, we test the null hypothesis of non-cointegrating relation (Ho: δ1= δ2= δ3=…= δn=0) against the alternative hypothesis (HA: δ1≠ δ2≠ δ3≠…≠ δn≠0) (a long-run relationship exists). The estimated F-statistic value will then be evaluated using the critical values tabulated in Table CI (iii) of Pesaran et al. (2001). Thus the lower bound critical values assumed that the explanatory variables xt are integrated of order zero, or I(0), while the upper bound critical values assumed that xt are integrated of order one, or I(1). Therefore, if the computed F-statistic is less than the lower bound value, then the null hypothesis is not rejected and we conclude that there is no long-run relationship between GDP growth and its determinants. Conversely, if the computed F-statistic is greater than the upper bound value, then GDP growth and its determinants share a long-run level relationship. On the other hand, if the computed F-statistic lies between the lower and upper bound values, then the results are considered inconclusive. The researcher must therefore conduct a test to ascertain the order of integration before making a conclusive inference in this circumstance.

Following Pesaran et al. (2001), Atif, Jadoon, Zaman, Ismail and Seemab (2010) and Ellahi (2011) we aggregate the vector autoregression (VAR) of order p, denoted VAR (p), for the following function:

$$Z_t = \mu + \sum_{i=1}^{p} \beta_i z_{t-i} + \varepsilon_t \quad \text{.....(3)}$$

where z is the vector of both x and y , where y is the dependent variable defined as real GDP (Realgdp), xt is the vector matrix representing a set of explanatory variables i.e., trade openness (TOP), financial development (M2) and t is a time or trend variable. According to Pesaran et al. (2001), yt must be I(1) variable, but the regressor xt can be either I(0) or I(1). Then a vector error correction model (VECM) was further developed as follows:

$$\Delta z_t = \mu + \alpha t + \lambda z_{t-1} + \sum_{i=1}^{p-i} \gamma_t \Delta y_{t-i} + \sum_{i=1}^{p-1} \gamma_t \Delta x_{t-i} + \varepsilon_t$$

.....(4)

where Δ is the first-difference operator. The long-run multiplier matrix as:

$$\lambda = \begin{bmatrix} \lambda_{YY} \lambda_{YX} \\ \lambda_{XY} \lambda_{XX} \end{bmatrix} \quad \text{.....} \quad (5)$$

The diagonal elements of the matrix are unrestricted, so the selected series can be either I(0) or I(1). If , then Y is I (1). In contrast, if , then Y is I(0).

The vector error correction mechanism (VECM) approaches described above are imperative in the testing of at most one cointegrating vector between dependent

Trade and Openness represented by total trade (Import + Export) as a share of GDP. Financial service delivery or performance is measured by M2 growth rate (M2_Grwt).

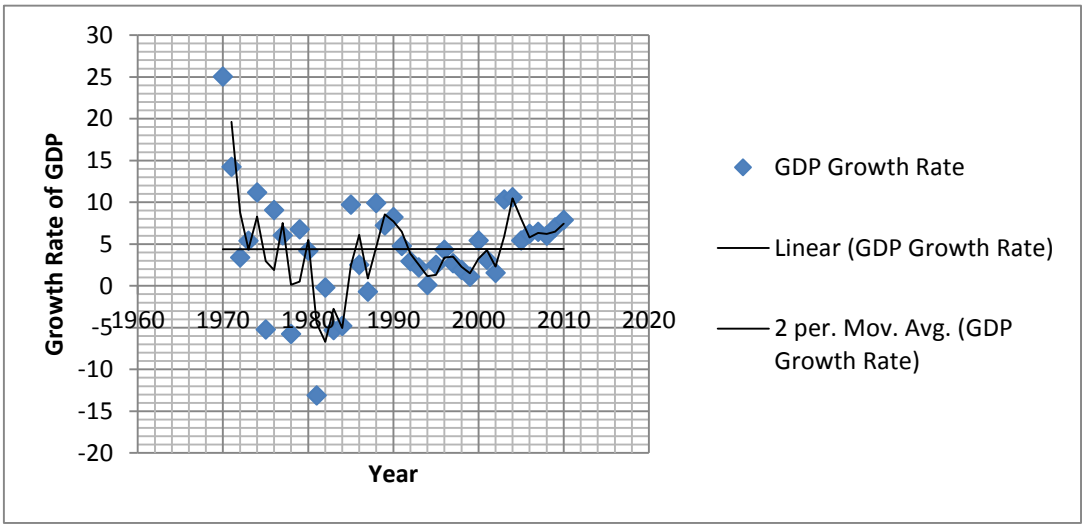

Figure 1. Trend of GDP Growth Rate in Nigeria from 1970-2010 (Source: By authors based on data from Central Bank of Nigeria, 2010)

variable and a set of regressors . To derive the model, the postulations made by Pesaran et al. (2001) in Case III, that is, unrestricted intercepts and no trends was followed.

The general co-integration hypothesis function can, therefore, be stated as the following unrestricted error correction model (UECM):

$$\Delta\,(Realgdp)_t = \beta_0 + \beta_1(realgdp)_{t-1} + \beta_2\,(\mathrm{TOP})_{t-1} + \beta_3\,(\mathrm{M2\_Grwt})_{t-1} + \beta_4(\mathrm{elctsgdp})_{t-1} + \beta_5\sum_{i=0}^{q}\Delta\,(realgdp)_{t-1} + \beta_6\sum_{i=o}^{r}\Delta\,(TOP)_{t-1} + \beta_7\sum_{i=0}^{s}\Delta\,(M2\_Grwt)_{t-1} + \beta_8\sum_{i=0}^{t}\Delta\,(elctsgdp)_{t-1} + \varepsilon_t \quad \text{.....(6)}$$

Where Δ is the first-difference operator and ɛt is a white-noise disturbance term. Realgdp = ireal GDP in millions of naira, while TOP =

3. Results and Discussion

Trends of Economic Growth Rates, Trade Openness and Financial Service Delivery in Nigeria (1970 -2010): The graph presented in Figure 1 indicates a fluctuating economic growth rate in Nigerian economy over the period in review. It could be observed that Nigerian economy started declining in 1970 shortly after the civil war that

ravaged her economy. The economy reached an all time low level around 1983 during the civilian regime (Second Republic) headed by Alhaji Shehu Shagari whointroduced some austerity measures as a way of rebounding the economy. The growth period that follows which was upward till 1990 indicated that economic reforms appeared to be yielding some positive results. In 1986 the then military regime

introduced Structural Adjustment programmes (SAP) which was more disposed to liberalization of the economy. It seems the reform programme paid off as the economy bounced back again and maintained upward growth till late 90s when it started falling again. However this trend was short-lived as the growth rate started another gradual upward trend coinciding with economic reform eras in the financial sector and trade in 2000 and above. In mid-2000s the economy nosedived and picked up again around 2007. Since then the growth had been looking upward. It is doubtful however whether this will be sustainable.

A look at figure 2 and figure 3 indicate that financial service sector has been steadily growing in a linear fashion. The financial service sector shares with trade openness (See Figure 3) which was also looking up over the entire period of study on the average. One is not surprised at this development as various governments in Nigerian history introduced several financial and trade reform policies.

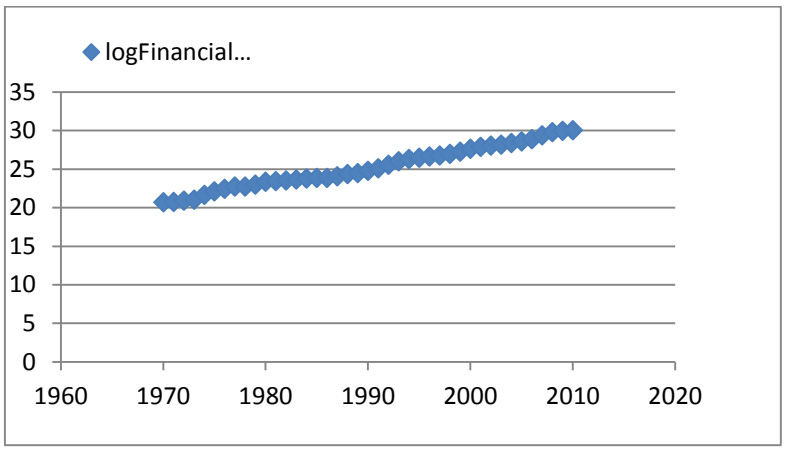

Figure 2. Trend of Financial Service Performance in Nigeria from 1970-2010 (Source: By authors based on data from Central Bank of Nigeria, 2010).

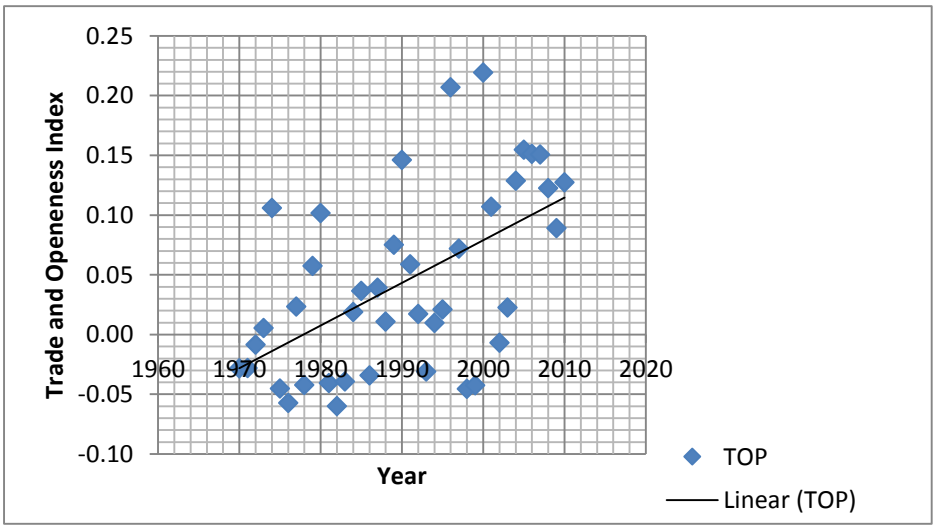

Figure 3. Trend of Financial Service Performance in Nigeria from 1970-2010 (Source: By authors based on data from Central Bank of Nigeria, 2010)

However, agricultural sector of the economy did not appeared to be isolated from the changes in macroeconomy of Nigeria over the period of study. From evidence indicated in Figures 4 and 5 it is clear that agricultural growth rate appears to be moving in the same direction with financial sector growth trends as well as trade openness and real GDp growth rate. This may not ve surprising as agriculture

positively on agricultural growth on the long-run due to its disregard for farmers requesting for long term loans. Agricultural production requires long period of waiting for recoupment of investment thus making it a candidate for long term loans to be able to impact sustainably on farmers' productive drives. Unfortunately it had beenobserved by Udah (2011) that the bulk of the credit to the private

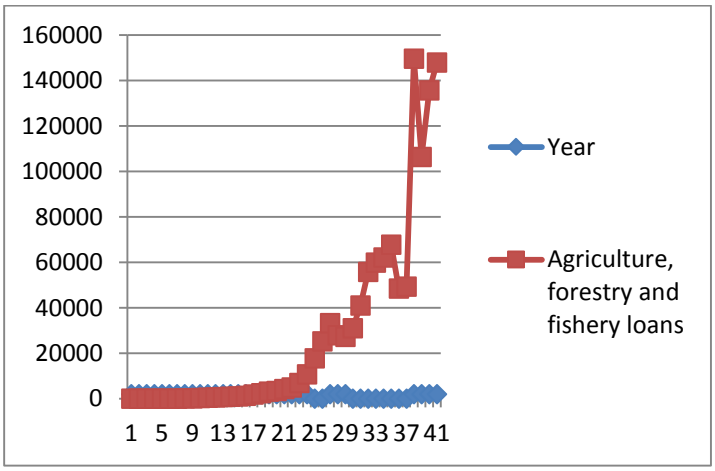

Figure 4. Trend of Loans Advanced to Agriculture, Forestry and Fishery over the period in Review in millions of naira (based on Data from CBN, 2010).

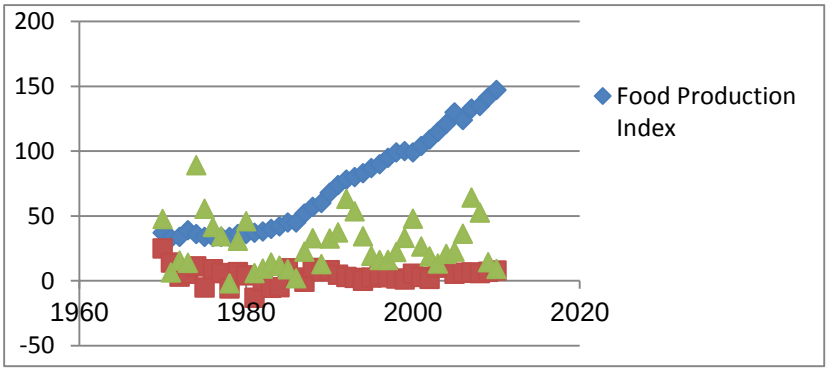

Figure 5: Rate of growth of real GDP compared with growth rates of M2 and food production indexe over the period in review (1970-2010). Source: Computed by authors based on CBN (2011) data.

remains the most important non-oil sector in Nigerian economy. The financial service sector advances loan to the private sector which benefits agriculture thereby stimulating the growth of the agricultural and other sectors of Nigerian economy. It is however feared that the financial service sector may not impact

sector was mainly on short term investment. Udah added that the depth of the financial sector measured by broad money supply (M2)

to GDP ratio (M2/GDP), contrary to expectation, did not improve in the initial years of Nigerian economic reform (1990s). The

similarity in movements of the food production index and those of financial service sector as well as economic growth rate should inform policies aimed at boosting agriculture and food

Table 1. Results of Unit Root Tests using Augmented Dickey Fuller and Philips Perron Tests

VARIABLE OR SERIES	ADF STATISTICS AT LEVELS	ADF 1st DIFFERENCE STATISTICS	PP LEVELS STATISTICS	PP 1st DIFFERENCE STATISTICS	REMARK
Real GDP	1.704(NS)	-5.476 ***	1.949 (NS)	-5.472***	I(1)
M2_Growth	-4.155***	NA	-3.981***	NA	I(0)
TOP	-0.375(NS)	-2.211***	-1.188 (NS)	-4.758***	I(1)

Note: The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null hypothesis is based on MacKinnon (1996) critical values. The lag length are selected based on SIC criteria, this ranges from lag zero to lag two. *, ** and *** indicate the rejection of the null hypothesis of non-stationary at 1%, (t critical = -3.605593), 5% (t critical -= -2.9369) and 10% (-2.607) significant level, respectively.

Table 2: Estimated Model Based on Equation (3)
Dependent Variable: Log (GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Intercept	0.063	0.077	0.823NS	0.416
(REALGDP)-1	-9.42E-07	0.000	-3.976***	0.000
(TOP)-1	0.007	0.021	0.341NS	0.735
(M2_GRWT)-1	0.004	0.002	2.492**	0.018
D(REALGDP)-1	0.000	0.000	11.703***	0.000
D(TOP)-1	-0.021	0.028	-0.761NS	0.452
D(M2_GRWT)-1	0.001	0.001	0.757NS	0.454

R-squared	0.83
Adjusted R-squared	0.80
S.E. of regression	0.63
Akaike info criterion	2.09
Log likelihood	-34.81
F-statistic	27.07***
Prob(F-statistic)	0.000

security. It could seen from Figure 5 that these three variables appear to be moving in the same directions. This is in agreement with World Bank (2007) that finance influences not only the efficiency of resource allocation throughout the economy but also thecomparative economic opportunities ofindividuals from relatively rich or poor households (such as poor rural farm households). However, more quantitative analysis are needed to capture the realeconometric relationships between these macroeconomic variables. This will remain a subject for future research.

Evaluation of the Roles of Trade Liberalization and Financial Service Sector Performance as Drivers of Economic Growth in Nigeria (1970-2010)

Results of Unit Root tests are presented in Table 1. The rsult indicates that the series are mixtures of I(0) and I(1). Since the are mixtures of I(0) and (1) we are justified in using bounds testing approach to cointegration advanced by Pesaran et al (2001).

The estimates of Equation (4) using the ARDL model is reported in Table 2. Using Hendry's general-to-specific method, the goodness of fit of the specification, that is, R-squared and adjusted R-squared, is 0.82 and 0.76 respectively. The implication of these is that the 56 percent variation in food production index was explained by the independent variables in the model.

The robustness of the model has been confirmed by several diagnostic tests such as Breusch- Godfrey serial correlation LM test, Breusch-Pagan-Godfrey test for heteroscedasticity, test for multicollinearity and model stability test using CUSUM test (See the diagram in figure 6). All thetests disclosed that the model has the desirable econometric properties, the model's residuals are serially uncorrelated, homoskedastic, devoid of severe multicollinearity and statistically stable. Therefore, the outcomes reported are serially uncorrelated, stable in series and homoskedastic. Hence, the results reported are valid for reliable interpretation.

Model criteria / Goodness of Fit:

R-square = 0.83; Adjusted R-square = 0.80; Wald F-statistic = 657.058 [0.000]***

Diagnostic Checking:

Results of the model's diagnostic checks are as follow: LM-2 (Breusch-Godfrey Serial Correlation LM Test:) = 1.329 [0.729]; Heteroskedasticity Test: Breusch-Pagan-Godfrey= 1.848 [0.119], Multicollinearity Test: Average uncentred Variance Inflation Factor (VIF) = 4.210 .

In Table 3 the results of the bounds co-integration test demonstrate that the null hypothesis of no co-integration against its alternative is easily rejected at the 1% significance level. The computed F-statistic of 27.07 is greater than the upper critical bound value of 5.06, thus indicating the existence of a steady-state long-run relationship among real GDP, TOP and M2.

The estimated coefficients of the long-run relationship between GDP, TOP and M2 are expected to be significant, that is:

Dlog(realgdp) = -9.42E-07 + 0.0001(TOP) + 0.0002**(M2_growt) ……..(5)

Equation (5) and Table 4 indicate that financial service sector performance had positive impact on economic growth in Nigerian economy. If there is one unit increase in trade liberalisation, economic growth and financial sector service performance increases by 0.0001 percent and 0.0002 percent respectively. This analysis demonstrates that, in the long-run financial led growth hypothesis does hold in Nigeria, as the variable is positive and demonstrated a significant effect on economic growth over the period in review.

The finding is in tandem with those of Udah (2011), Atif et al (2010) andWorld Bank (2007). It is not surprising however that the long run coefficients were very low. These may be as a result of relatively short period of each reform which had always been truncated by instability in government over the years in the country's history. Consequently increases in real GDP as a result of these two variables have not been too strong though that of the financial service sector exhibited a statistically significant relationship.

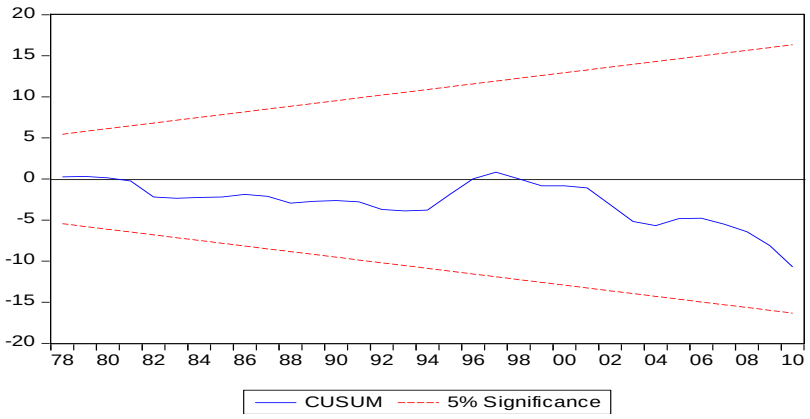

Figure 6: Results of Test for stability of the model. It could be seen that the CUSUM line did not go outside the two extreme critical lines, indicating that the model is statistically stable at 5% level.

Table 3: Bounds Test for Cointegration Analysis

Critical value	Lower Bound Value	Upper Bound Value
1%	3.74	5.06
5%	2.86	4.01
10%	2.45	3.52

Note: *Computed F-statistic: 5.508 (Significant at 0.05 marginal values).Critical Values are cited from Pesaran et al. (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend*.

Table 4: Long-Run Coefficients

Variable	Normalized Coefficients	Remark
(REALGDP)-1	1	Significant at p < 0.01
(TOP)-1	0.0001	Not Significant even at p> 0.10
(M2_GRWT)-1	0.0002	Significant at p < 0.05

5. Conclusion

This study had described the trend and demonstrated the similarities in behaviour of

trade openness, financial sector service delivery and economic growth vis a vis agricultural growth in Nigerian economy over the period in review. It was observed that the three variables were moving in similar manners implying that the policies of trade openness, financial service delivery could impact on economic growth as well as agricultural growth. The implication of these findings is that efforts to alleviate hunger in Nigeria and boost agricultural production (in line with the current government's agricultural transformation agenda) can be meaningful if the financial sector is encouraged to improve its performance in advancing loans to the agricultural sector of Nigeria. There are also signals from the findings that agricultural growth can benefit from trade openness if export and policies are improved to encourage farmers to take advantage of the gains from international trade. The econometric tests conducted on the time series used for this study validated the fitness of the model using various criteria. The model was co-integrated, stable and devoid of serial correlation. The empirical results of the long-run model indicated a significant positive relationship with economic growth (real GDP) at 5 percent level of statistical significance. All these affirm our model as fit for policy making. It is therefore recommended that the Federal Government of Nigeria and its Central Bank should pursue implementation of effective macro-economic policies along with momentous improvements in the structure and functioning systems of governance for stabilising economic growth along financial liberalisation reforms among other recommendations. Need to also use the financial service sector to improve agricultural growth via increased access of farmers to long-term loans is hereby recommended. This is more so when one notes that agriculture is the largest sector of the Nigerian economy with GDP contribution of about 40%. According to FinIntell (2016), the necessary key for successful reform is to turn agriculture into a business that makes money, with a focus on investments as opposed to aid and development. The prospects for the agricultural sector is high, owing to the growing demand for food driven by a large population and growing incomes under a regime of higher prices due to demand in the international market. FinTell further noted that the Federal Government, through the Ministry of Agriculture announced a supportive program towards creating a Nigerian agricultural sector worth $256 billion by 2030.

The pathway to unlocking the growth potential of agriculture in Nigeria is to improve the lot of small scale farmers. By empowering the millions of small holder farmers who have access to millions of hectares, access to appropriate inputs, sufficient financing will be enhanced and that will significantly boost productivity. Following FinTell (2016), we also recommend the Agricultural Franchise Model for Nigeria. Under this model the small holder farmer becomes a franchisee of a larger farm, with access to all the necessary inputs. This model can minimise the risks associated with investing in the sector and thereby stimulates the financial sector (service sector) to invest in the Nigerian Agricultural Sector.

References

Adewuyi, A. O. (2006). Openness total factor productivity growth dynamics: evidence from Nigeria, The Nigerian Journal of Economic and Social Studies, 48:1-30.

Atif, R. M; Jadoon, A; Zaman, K; Ismail, A; & Semab, R. (2010). Trade liberalisation, financial development and economic growth: evidence from Pakistan (1980-2009). Journal of International Academic Research 10: 2.

Central Bank of Nigeria, C. B. N. (2006). Statistical Bulletin, 2005. Abuja : CBN.

Central Bank of Nigeria, C. B. N. (2008). Statistical Bulletin, 2008. Abuja : CBN.

Central Bank of Nigeria, C. B. N. (2011). Statistical Bulletin, 20010. Abuja : CBN.

Corden, W. M. (1971). The effect of trade on the rate of growth, in Trade and balance of payments, Jagdish N. Bhagwati et al (eds) Amsterdam.

Cromer, S. (2012). A closer look at Nigeria: security, governance, and trade. Retrieved on 1/10/2012 from http://www.humanrights.gov/2012/04/03/a-closer-look-at-nigeria-security-governance-and-trade/

Dollar, D. & Kraay, A (2002). Trade, growth and poverty, Journal of Economic Literature, 60: 1865-80.

FinIntell (2016) Sectoral Analysis of Nigeria's Economy. Retrieved on 04/06/2016 from http://www.myfinancialintelligence.com/banking-and-finance/sectoral-analysis-nigeria%E2%80%99s-economy

Food and Agricultural Organization, FAO (2010). Improving infrastructure and trade-related capacities for market access. Comprehensive African Agricultural Development Programme (CAADEP). Retrieved on 21st July, 2011 from http://www.fao.org/docrep/005/y6831e/y6831e00.htm#TopOfPage

Greene, W. H. (2008). Econometric analysis, 5th edition. New Delhi: McGraw Hill.

Gujarati, D. N. (2006). Essentials of econometrics. 3rd Edition. New York: Mc-Graw Hill.

Iwukemjika, E., Odigie, F. I., Duru, C., Idogho, P., Okoh, A., Odusote, L., Adesanya, A. & Salami, A. (2009). Nigeria. Retrieved on 1/10/2012 from http://fic.wharton.upenn.edu/fic/africa/Nigeria%20Final.pdf

Nurudeen, A. & Usman, A. (2010). Government expenditure and economic growth in Nigeria, 1970-2008: A disaggregated analysis. Business and Economics Journal, 4.

Nyong, M. O. (2005), International economics: theory, policy and applications. Wusen Press Limited Calabar-Nigeria.

Oguchi, C. B. (2007). The role of agriculture in economic growth: the Nigerian experience, An M.Sc. project proposal submitted to the Department of Economics, University of Nigeria Nsukka.

Patterson, K. (2000) An Introduction to Applied Econometrics Macmillan:184-5

Pesaran, M.H., Shin, Y. & Smith, R. (2001) Bounds testing approaches to the analysis of level relationships, Journal of Applied Econometrics, 16, 289-326.

Romer, P. M. (1994). The Origins of Endogenous Growth. The Journal of Economic Perspectives 8 (1): 3.

Sanusi, L. S. (2010). Growth prospects for the Nigerian economy. Convocation lecture by Mr Sanusi Lamido Sanusi, Governor of the Central Bank of Nigeria, at the Igbinedion University Eighth Convocation Ceremony, Okada, Edo State, 26 November 2010. BIS Review 166/2010.

Solow, R. M. (1956). A contribution to the theory of economic growth. The Quarterly Journal of Economics, 70 (1): 65-94. Retrieved on 6th June, 2012 from : http://links.jstor.org/sici?sici=0033-5533%28195602%2970%3A1%3C65%3AACTTTO%3E2.0.CO%3B2-M

Studenmund, A.H. (2001). Using econometrics - a practical guide, Addison-Wesley-Longman :193-95.

Udah, E. B. (2011). Openness, resilience and economic performance in Nigeria: An empirical investigation European Journal of Social Sciences 26: (4) 545-560. Available at http://www.europeanjournalofsocialsciences.com

United Nations Development Programme (2011). Human Development Report 2011. Sustainability and Equity: A Better Future for All. Explanatory note on 2011 HDR composite indices, Nigeria. Retrieved on 6th June from hdrstats.undp.org/en/countries/profiles/NGA.html

Walkenhorst, P & Cattaneo, O. (2006). Trade, Diversication and Growth in Nigeria. Munich Personal RePEc Archive (MPRA). Retrieved on 1/10/2012 from http://mpra.ub.uni-muenchen.de/23735/1/MPRA_paper_23735.pdf

Winters, A. L. (2002). Trade Liberalization and Poverty: What are the links?, The World Economy, 25: 1337-1367.

Winters, A. L., McCulloch, N. & Mackay, A. (2004). Trade Liberalization and Poverty: The Evidence so far, Journal of Economic Literature, 42: 72-115.

World Bank (2007). Finance for all? Policies and pitfalls in expanding access. Retrieved on 1/10/2012 from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPRRS/EXTFINFORALL/0,,menuPK:4099731~pagePK:64168092~piPK:64168088~theSitePK:4099598,00.html

The Nexus Between Horticultural Farming, Biotechnology and Food Security in Ghana

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Abstract

Horticultural exports contribute immensely to Ghanaian agriculture and rural development, by generating pro-poor growth and developing non-traditional exports. With appropriate policies and technologies like biotechnology, horticulture increases the incomes of smallholder farmers, enhancing rural development and increasing foreign exchange earnings. However, Ghana's major handicap is her inability to sustain export growth on the open market. Currently, only about 40,000MT out of the 100,000MT of pineapples demanded by markets across Europe from Ghana can be produced. Although conventional plant breeding techniques have made considerable progress in the development of improved varieties, they have not been able to keep pace with the increasing demand for vegetables and fruits in developing countries. There is the need to integrate biotechnology to speed up crop improvement programmes. Biotechnological tools have revolutionized the entire crop improvement programs by providing new strains of plants, supply of planting material, more efficient and selective pesticides and improved fertilizers. This study examined the link and interrelationship between horticultural farming, biotechnology and food security. The impact of biotechnology on the welfare of smallholder farmers was also analyzed. The paper concludes that the role of biotechnology in food security in Ghana cannot be overemphasized but still has a long way to go. Agricultural production and productivity problems in developing countries like Ghana go beyond technological solutions alone; already existing challenges of smallholder farmers should be addressed first.. Biotechnology could however contribute to sustainable development by increasing agricultural productivity using new breeding techniques. It can also increase the revenues in agricultural production.

Key Words: Biotechnology, Food Security, Horticulture and Smallholder Farming

1. Introduction

Insecurity of food is prevalent in most parts of Africa. The chronic food insecurity in SSA is because about 85 % of agricultural production is rain-dependent and according to the World Bank, this accounts for about 35% of Sub-Saharan Africa's GNP, and about 40% of exports and 70% of employment. Also, domestic food production makes up for about 80% of consumption. It is estimated that about 40% of the people in SSA are living below the poverty line (IFAD, 2012). With the introduction of economic reforms notwithstanding, economic development in many SSA countries slow, adversely affecting the wellbeing of the rural poor in particular. Also, natural disasters have worsened this situation. There is the

need to address these issues to ensure poverty reduction, food security, and sustainable development.

Food production is done predominantly in Ghana by smallholder farmers; as many as about 70 per cent of farmers are smallholders (Afari-Sefa, 2008). These farmers are challenged in their way of farming as they are faced with many production constraints. These include limited access to land, labour, high yielding seed varieties, credit, markets, limited access to and adoption of technology among others. These challenges have greatly affected their efficiency, productivity and yields dramatically. In developing countries like Ghana, most farmers own small lands that are only able to or in some cases scarcely feed one household and generate very small income. The issue of low soil fertility and crop losses from pests and droughts has also reduced harvests to very low levels.

As agriculture and food security have become more and more of a priority, it has been observed that more attention has been focused on supporting research and capacity development in this area. There has also been an increase in donor-supported interventions in agricultural development and the improvement of the welfare of smallholder farmers especially. More attention and funds are also being allocated to the improvement of scientific discoveries and innovations to produce quality, high yielding and disease resistant seeds to combat hunger and poverty. This is where biotechnology comes in very handy.When farmers grow more food and earn more income, they are better positioned to feed their households and send their children to school, see to their family's health needs and are also able to invest in their farms. Biotechnology is expected to help them achieve these. The current state of agricultural technology in Ghana is not capable of bracing with the production challenges ahead. Innovative technologies like biotechnology have to be exploited to guarantee sufficient availability of food in the future. Since land and water for agriculture continue to become diminishing resources, it has become necessary to research further into the use of biotechnology to boost agricultural productivity to ensure enough food for all.

Biotechnology is now considered as a potential means to improve food security. These technologies can be used to speed up traditional ways of plant breeding for instance. Biotechnology can be used as a major tool to boost crop yields and reduce production costs for smallholder farmers. Biotechnology can help in researching drought-resistant varieties of crops that will adapt well to the harsh environmental conditions under which they are grown. It can also help solve land issues by maximizing the use of the limited land available to cultivate and get many returns from the land. It is however not clear how biotechnology affects food production in Ghana. A study of this nature is therefore desirable to x-ray the extent of biotechnology adoption with the aid of exploring how food

security in Ghana can be advanced through biotechnology. Hence the need for this study.

Objectives of the Study

The overall objective of the study is to draw the link between horticultural farming in Ghana and biotechnology and how this impacts food security. The specific objectives are to:

(i) review horticultural farming in Ghana

(ii) discuss the perceived risks and benefits of biotechnology adoption

(iii) determine the potential of biotechnology in increasing the productivity of horticultural farming in Ghana.

2. Horticultural Farming in Ghana

There has been an increase in the share of high value products in world agricultural trade especially from developing countries (Maertens & Swinnen, 2006).. However, Africa's exports are still dominated by traditional commodities, and the share of agriculture in Sub-Saharan Africa's (SSA) total exports has decreased in the past few decades (Webber & Labaste, 2010). Only a few SSA countries such as South Africa, Zimbabwe and Kenya have achieved some significant diversification of their exports over the years. Despite those trends, agriculture remains the largest source of export revenue for most SSA countries and the largest income generator for their populations. Production and trade of agricultural commodities continue to play a major economic role in many African countries. About 70% of the population in Sub-Saharan Africa is largely dependent on the production and export of agricultural commodities including horticulture (Gioe, 2006).

Horticulture is the production and marketing of crops (such as fruits and vegetables) that have with a relatively high value per unit or high perishable character, produced under intensive use of labour, land, and other inputs (Afari-Sefa, 2008). They are usually produced with the export market in mind. The growth of horticultural exports plays an important role in agriculture and rural development, in generating pro-poor growth and in developing non-traditional exports. Through the implementation of relevant policies, horticultural production can significantly contribute towards increasing the incomes of farmers especially smallholder farmers, expanding employment opportunities, enhancing rural development and contributing towards foreign exchange earnings (USAID, 2005). Horticultural products may offer substantial prospects for export growth in Sub-Saharan Africa in view of its comparative advantage due to Sub-Saharan Africa's relative proximity to the growing European market (Gioe, 2006). The main competitive advantage of Ghana relative to probably the most important horticultural exporter to Europe; Costa Rica, is her location. Additionally, Ghana's political stability, business environment and travel costs compare favorably with her neighbor, Cote d'Ivoire.

However, low-productivity supply chains may result from the low unit of agricultural production in Sub-Saharan Africa. It may also be that a majority of producers of agricultural products in Africa are smallholders. According to Maertens & Swinnen (2006), in Africa, majority of fruit and vegetable cultivation for both domestic consumption and for export continues to be dominated by small-scale farms. In Ghana, smallholder farmers account for about 70 per cent of horticultural producers (GEPA, 2010). In spite of the successes of many African exporters in selling on new markets, if there are no advancements to their executions of businesses on the export market, many risk being trapped by producing low-skill, low-value products and services. This means they would struggle to obtain a significant value-added share in the world market. The efficient operations of agricultural supply chains are important for the success of the SSA rural poor in terms of their income. Ghana's horticulture has potential. This is evidenced by the fact that many donors have focused on and invested in activities in this agricultural sub-sector. Some of these donors include GIZ, USAID, ACDI/VOCA, among others. The government of Ghana has also shown keen interest in developing the horticultural sector. This, according to GEPA (2010), is because about 15% of the population of Ghana depends on horticultural export-related production and/or marketing for their livelihood. The Ministry of Food and Agriculture has therefore put in place the Horticulture Export Industry Initiative (HEII) to see to the development of horticulture in Ghana. The Ministry of Trade and Industry has also formulated a national export strategy focusing on increasing revenue from non-traditional exports.. In view of this, the Trade Ministry has implemented the Private Sector Development Strategy (PSDS II) that is aimed at developing a thriving sector to improve the wellbeing of Ghanaians. It is hoped that the PSDS II will boost the country's GDP by a minimum of 10% per annum (GEPA, 2010). This notwithstanding, the positioning of Ghanaian products in the European markets is still weak. Even though horticultural exports have grown dramatically over the last ten years, these have yet to fulfill their potential. For instance, currently, only about 40,000 MT out of the 100,000 MT of pineapples demanded by markets across Europe can be produced.

3. Welfare Implications of Horticultural Farming in Ghana

Developing countries have been advised to change the way food is produced and traded. Improvements in horticultural production have been advocated for in the past decades because of its benefits. Horticulture has important welfare implications for rural households. The effects may be in various ways, through product and labour markets, and through direct and indirect mechanisms. The continual growth in horticulture has led to debates among academics, policy-makers and the development partners on horticulture's

overall welfare implications. Some have seen this as an engine for rural income mobility and poverty reduction, while others argue that it exacerbates existing inequalities and fails to create direct gains for the rural poor. In order to understand the overall welfare implications of the growth in modern food supply chains for rural households, it is necessary to take into account and distinguish between several different effects. The growth in horticulture in developing countries can bring about important positive welfare effects for rural development and poverty reduction. These effects can come in various ways through product effects on income and contribute immensely towards welfare and development. This implies a need for supporting the development of horticulture especially smallholder horticultural farmers in poor countries.

4. Biotechnology and Horticultural Farming in Ghana

Agriculture, especially horticultural crop farming has been the mainstay of the rural economy. The sector is however plagued with a myriad of challenges ranging from drought, floods, limited access to labour and capital inputs, low levels of irrigation, prevalence of weeds, pests and diseases, and limited access to credit facilities among others. These problems have placed huge limitations on the scale of farm production and also leads to low crop yields, and low farmer incomes, consequently. Since farmlands are the major natural resources in rural Ghana, households continue to produce in the midst of these devastating conditions over the years that seem to confine them to abject poverty.

The application of biotechnology in other parts of the world seem to provide solution to the bulk of the production bottlenecks associated with horticultural farming in Ghana. Studies over the years show that application of biotechnologies in the field of GMOs for instance has been beneficial to farmers in some developing countries. The first GMOs became commercially available in the mid-1990s; and since then, their relevance to the agricultural production sector has not waned. Consequently, the number of GM crop varieties has increased significantly and the area sown to GM crops has also seen appreciable increases. Adoption across countries has however not been even, with almost the entire expansion taking place in developed countries. Also, in spite of the increasing availability of various varieties of GM products, commercial success has been concentrated on a few varieties or traits.

In those countries where GM crops are applied, principal benefits reported include productivity gains, cheaper and improved food quality, minimized pests and disease infestation, and the ability to save and improve land resources among others. These benefits notwithstanding, the adoption of such technologies appears not widespread among Ghanaian horticultural farmers, especially the rural smallholder farmers. Limitations to the adaptation of these biotechnologies may be due to inability to meet the initial costs of such

technologies, especially by poor rural farm households. There are also debates over the safety and the long term impacts of the adoption of such technologies thereby leaving farmers in a state of dilemma, whether to adopt these technologies or not.

The role of research, and relevant policy tools combined with some financial assistance to farmers willing to adopt these technologies would be useful if the expected gains from the adoption of these technologies are to be realized by farmers in Ghana.

5. Benefits of Biotechnology

The potential socio-economic benefits of the applications of biotechnology abounds in the extant literature. Enhanced food production via insect, disease, insect and weed resistant seeds; nutritional enhancement are strongly proposed as potentials likely to follow the application of biotechnology (Mackey, 2003). Overall, biotechnology is being considered globally as a potential means to improved food security, especially in drought and disease prone regions of developing countries. These technologies are expected to improve traditional ways of plant breeding for instance. Biotechnology can be used as a major tool to boost crop yields and reduce production costs for smallholder farmers. Biotechnology can also help in researching drought-resistant varieties of crops that will adapt well to the harsh environmental conditions. It can also help solve land issues by maximizing the use of the limited land available to cultivate and derive the maximum returns from a given piece of land; thus further inuring to environmental conservation gains. The crucial role of biotechnology in the economic transformation and sustainable development of the developing world has assumed increased significance as a result of a variety of factors involving fast technological advances, increasing commercialization of genetically engineered foods, increasing food insecurity, and increasing food prices.

James (2007) enumerated the following as the most compelling case for biotechnology, especially in the case for genetically engineered (GE) crops in their capability to contribute to: (i) increase in productivity, and thus contributing to global food, feed, fiber and fuel security, with benefits for producers, consumers and society at large; (ii) conserving biodiversity, as a way of saving land (iii) lowering the environmental effects of agriculture and adopting more sustainable agriculture systems; (iv) mitigating climate change and reducing greenhouse gases by using biotech applications (v) increasing stability of productivity and production to lessen suffering during famines due to biotic and abiotic stresses, particularly drought which is the major constraint to increased productivity on the 1.5 billion hectares of arable land in the world; (vi) the improvement of economic, health and social benefits, food, feed and fiber security and the alleviation of abject poverty and malnutrition for the rural population dependent on agriculture in developing countries; (vii) the cost-effective production of

renewable resource-based biofuels, which will reduce dependency on fossil fuels, and, therefore, contribute to a cleaner and safer environment with lower levels of greenhouse gases that will mitigate global warming; and (viii) as a result, provide significant and important multiple and mutual benefits to producers, consumers and global society. James further suggests that the most promising technological option for increasing global food, feed and fiber production is the integration of the best of conventional technology and the best of biotechnology applications in the production process.

6. Risks of Biotechnology

There has been expression of fears and uncertainties about the risks associated with the use of biotechnology in agricultural production. There have been concerns about the adverse effects on the environment and on human health due to the direct manipulation of the genetic makeup of plants for instance. These may be environmental, such as the threat that crops may develop into weeds or transfer genes to other plants thus creating super weeds (John Innes Centre, 1998). It is also possible that pests could in the long-run overcome the resistance presented by GM crops, and hence the variety will only be protected for a short while (Tabashnik et al., 2000). There is another risk dimension similar to those involved in studying the adoption of agro-technologies by farmers in the developing world. Research has shown that are potential socio-economic problems responsible for the differentiation between those who can afford the technology and those who cannot (Morse, 1995). For instance, the adoption of biotechnology in Asia has over the years provided some evidence (Lipton, 1989; Freebairn, 1995).

Further, it is observed that though the applications of biotechnology, especially in the field of GM crops has been widely explored in terms of its contribution to overall global food security, some studies argue that it may not be the optimal option available to developing countries in the long-run. It is has been argued time and again that biodiversity is crucial for sustainable food production, because agricultural diversity can help in reducing the impact of climate change. Food security will therefore depend on agricultural production systems that are resilient, sustainable and which produce benefits that are equitably shared.

Similar to the debate on the socio-economic impacts of GM crops adoption, there have been various schools of thoughts on the potential risks of the cultivation of GM crops for the environment and, in particular, biodiversity. While some judge the environmental risks of GM adoption as severe, others argue that the benefits of GM crops compared to conventional crops prevail and the risks are rather limited. Carpenter (2011) however asserts that GM crops have contributed to increasing agricultural sustainability resulting in yield increase, and the less use of chemicals.

Even beyond the assertion of Carpenter (2011), the precise impact of GM crops on biodiversity continues to remain a risk area that future research is expected to clarify in the long-run.

Studying the long-term effects of GM crops on the environment and health, De Coppi et al (2007) identifies different potential environmental risks of GM adoption from the literature. Although the study points out that it is not yet possible to quantify long-term risks of GM crops adoption as quantitative evidence is lacking, it warns over potential future environmental risks, which are differentiated in four major priorities areas: (i) potential adverse effects due to changes in cultivation and agricultural management of HT crops, mainly by the use of complementary herbicides, (ii) resistance development in pests targeted mainly by Bt crops followed by an even higher use of pesticides, (iii) potential gene flow to wild relatives with consequences for species conservation and biodiversity, (iv) potential impacts on soil and soil organisms with a high degree of uncertainty due to a limited number of studies available.

Further, a recent assessment of the impacts of genetically engineered crops on pesticide use in the U.S. in the last 16 years (Benbrooke, 2012) has shown that the overall pesticide use has increased by an estimated 183 million kg or about 7 per cent since the adoption of GM crops. Benbrooke (2012) further observes that the use of HR crops and the emergence and spread of glyphosate-resistant weeds are some of the endearing reasons for promoting the use of herbicide on land where herbicide-resistant varieties are grown. Herbicide-resistant weeds are forcing farmers to respond by increasing their herbicide application rates, resulting in multiple applications of herbicides, which exerts negative impacts on biodiversity .For Bt crops such as cotton and maize, Benbrooke (2012) shows that the application of insecticides can be significantly reduced, at least in short-terms. However, this advantage potentially poses a threat to growers of genetically modified crops. The use of genetically modified cotton for instance and the associated lower levels of conventional insecticide spraying create a safer environment for other, non-bollworm insects (Wang et al, 2009), which are not targeted by the modified traits. That in turn can lead to yet another compensating increase of pesticide use for combating secondary insect infestations as happened for example in China (Wang et al, 2009).

Additionally, some concerns have also been raised in terms of the gene flow of GM crops to wild relatives. A respective study for the HR transgene concluded that there is no evidence that its presence in wild plants is inherently problematic (Warwick et al. 2008). The study suggests that wild hybrids containing the transgene are expected to be present in large quantities in agricultural areas where herbicides are applied frequently as they can outcompete plants with no resistance against the herbicide. As in many developing countries a frequent use of herbicides is rather

exceptional, it can be tentatively concluded, that gene flow is of rather minor significance in these areas.

These potential risks notwithstanding, it is noteworthy, that the potential danger of living modified organisms (LMOs) on global biodiversity was the greatest concern and underlying mandate for adoption of the Cartagena Protocol on Biosafety under the Convention of Biological Diversity (CBD) in 2000 (Warwick et al, 2008). In order to minimize these potential risks from GM seeds and other organisms, the Protocol requires exporters to seek consent from importing countries before the initial introduction of an LMO into the environment and provides the necessary guidance for risk assessment.

7. Potential of Biotechnology in Increasing Productivity of Horticultural Farming

There is no aspect of plant production that will not undergo profound changes as a result of the application of biotechnology, nonetheless in horticulture. Commercial applications of plant genetic engineering have not yet occurred. Presently, many traditional aspects of biotechnology such as tissue culture have been of major importance, especially in the acceleration of the breeding process for new varieties and in the multiplication of disease-free seed material.

Biotechnology can be used in many ways to achieve higher yields; for example by improving flowering capacity and increasing photosynthesis or the intake of nutritive elements. Breeding of horticultural plant species has been enhanced considerably by in vitro development of improved varieties that tend to be better adapted to particular environments. The application of tissue culture attributed to this in many ways such as: (i) the rapid reproduction and multiplication of cultivars (produced by selective breeding); (ii) the production of healthy cultivars, free of viruses and pathogenic agents; (iii) the rapid adaptation and selection of cultivars that are resistant to specific stress factors (for instance, salinity and acid soils); (iv) the availability of seed material throughout the year (rather than seeds which are subject to the seasonal cycle); (v) the possibilities to produce species that are difficult to reproduce or that reproduce and grow slowly; and (vi) improved possibilities for the storage and transportation of germplasm. The application of tissue culture does not require very expensive equipment, thus technology can be applied easily in developing countries that in turn helps to improve other varieties of horticultural crops.

Biotechnology aids in the reduction of the need for agro-chemicals that small farmers in developing countries often cannot afford. A reduction in the use of agrochemicals implies fewer residues in the final product. Worldwide, nitrogen-fixing bacteria are being used increasingly to inoculate the soil, thus allowing reduced inputs of fertilizer that is expensive and often presents a heavy drain on the scarce foreign exchange resources of developing

countries. Biotechnology helps to identify the strains of bacteria most suitable for specific crops and soils and to multiply them for large-scale use. There are about a hundred fungus species with insecticidal effects known today. Biotechnology can facilitate the mass production of these fungi in a storable form and the use of these products may be less expensive than that of agrochemicals. As living organisms, they will multiply under favorable conditions depending on the intensity of the pests to be controlled. In addition, improved screening techniques at an early stage may reduce the amount of agrochemicals needed to fight specific diseases.

The potential of biotechnology for increasing horticulture productivity is vast indeed. The fact that such a capability exists, however, does not assure that it will be realized. Obstacles frequently stand in the way of the application of new technologies in horticultural farming. Some of these obstacles are: (i) weak linkages between international and national research institutions; (ii) poor communication between national research institutions and farmers; (iii) a lack of support measures (credit schemes, regular provision of improved seeds, demonstration plots and marketing outlets); and (iv) landholding structures which dampen the interest of landlords and tenants in introducing new technologies. Biotechnology has tremendous potential for promoting horticultural farming. However, where the application of this new technology aims to increase productivity in the export sectors, the successes in this area could be at the expense of the market position of others. In such cases, international competition may endanger cooperation between other fields of farming and could impact other technologies that seem necessary for the application of biotechnologies that are specifically suited to their interests.

8. Conclusion

From the arguments made so far, it is evident that the role of biotechnology in food security in Ghana and other developing countries remain one of the greatest developmental concerns over the years. Agricultural production and productivity problems in developing countries like Ghana go beyond technological solutions alone. It could however contribute to sustainable development by increasing agricultural productivity using new breeding techniques. It can also increase the revenues of agricultural production. This notwithstanding, the application of agricultural biotechnology in developing countries is not without debate. Potential challenges are expected to follow the application of such technologies with potential harmful effects especially on smallholder farmers. Irrespective of these potential fears highly publicized by civil society groups and researchers in the developing world, sustainable alternatives to biotechnology applications to not appear handy and their potential abilities compared to those likely to be derived from biotechnology applications do not appear superior.

From a human welfare standpoint, the greatest benefits of plant biotechnology will surely be derived from the adoption of improved crop varieties in the developing countries of the world where billions of people still depend on agriculture for their livelihoods. Finally, the paper generally agrees with Makinde et al (2009) that agricultural biotechnology alone is certainly not a panacea to the multitude of problems that farmers in Africa face; however, it has the potential to make crop breeding and crop management systems more efficient thereby generating improved crop varieties and higher yields.

Based on the conclusions made, some recommendations are suggested. Firstly, for biotechnology to have the desired effect on productivity and thus food security, there is the need to first of all tackle the myriad of challenges faced by smallholder farmers in Ghana. Secondly, it is necessary to build the required capacity to generate plant biotechnologies and then incorporate these into our national crop improvement programs. Thirdly, it will also be important for Ghana to establish the required intellectual property rights and regulatory policies that will assure safety and encourage the private sector to develop and market these new crop varieties. Finally, both public and private sector research institutions in Ghana should be empowered to continue producing and delivering products and research that are targeted towards the needs of poor farmers and consumers.

References

Afari-Sefa, V. (2008). Horticultural exports and livelihood linkages of rural dwellers in southern Ghana: An agricultural household modeling application. *The Journal of Developing Areas*, 44(1), 1-23.

Benbrook, C. M. (2012). Impacts of genetically engineered crops on pesticide use in the US–the first sixteen years. *Environmental Sciences* Europe, 24(24), 2190-4715.

Carpenter, J. E. (2011). Impact of GM Crops on Biodiversity. *GM Crops*, 2(1), 7-23.

De Coppi, P., Bartsch, G. Jr., Siddiqui, M. M. et al (2007). Isolation of amniotic stem cell lines with potential for therapy. Nature Biotechnology: 25(1). 100 – 106.

Freebairn, D. K. 1995. Did the Green Revolution concentrate incomes? A quantitative study of research reports.*World Development* 23 (2), 265-279.

GEPA (2010), Export Performance Report, GEPA Annual Report, Accra.

Gioe, M. (2006). Can horticultural production help African smallholders to escape dependence on export of tropical agricultural commodities? Crossroads ISSN 1825-7208, 6(2), 16-65.

International Fund for Agricultural Development (IFAD) (2012). The future of world food and nutrition security: Investing in smallholder agriculture-an international priority.Available at https://www.ifad.org/en/topic/tags/food_and_nutrition_security/1952762Accessed 11-05-2016.

James, C. (2007). Global Status of Commercialized Biotech/GM Crops, 2007(37). Ithaca Nova Yorque: ISAAA.

John Innes Centre (1998). Biofuture, http//www-biofuture.cbcu.cam.ac.uk/develop.htm

Lipton, M. (1989). New seeds and poor people. London: Unwin Hyman.

Mackey, M. A. (2003). The Developing World Benefits from Plant Biotechnology. Journal of Nutrition Education and Behavior, 35(4), 210-214.

Maertens, M., & Swinnen, J. (2006). Standards as barriers and catalysts for trade and poverty reduction. In IAAE Conference Papers (1-34).

Morse, S. (1995). Biotechnology: A servant of development? In People and Environment, S. Morse and M. *Stocking* (eds.), 131-154. UCL Press: London.

Makinde, D., Mumba, L., & Ambali, A. (2009). Status of Biotechnology in Africa: Challenges and opportunities. *Asian Biotechnology and Development Review*, 11(3), 1-10.

Tabashnik, B. E., Patin, A. L., Dennehy, et al (2000). Frequency of resistance to Bacillusthuringiensisin field populations of pink bollworm.Proceedings ofthe National Academy of Sciences of the United States of America 97 (24), 12980-12984.

USAID (2005). Horticulture market assessment study: A look at the Export Potential. A report for prepared for USAID.

Wang, Z. J., Hai, L., Huang, J. K., et al (2009). Bt cotton in China: Are secondary insect infestations offsetting the benefits in farmer fields?. Agricultural *Sciences in China,* 8(1), 83-90.

Warwick, S. I., Legere, A., Simard, M. J., & James, T. (2008). Do escaped transgenes persist in nature? The case of an herbicide resistance transgene in a weedy Brassica rapa population. Molecular Ecology, 17(5), 1387-1395.

Webber, C. M., & Labaste, P. (2010). *Building competitiveness in Africa's agriculture: Guide to value chain concepts and applications.: Agriculture and Rural Development Series,* The International Bank for Reconstruction and Development/The World Bank.

Analysis of Technical Efficiency and its determinants in Rice Production: Evidence from Abia State, Nigeria

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Abstract

The study was carried out to determine the technical efficiency of rice production in Abia State, Nigeria. It specifically analyzed the socio-economic characteristics of the rice farmers, the level of technical efficiency and inefficiency among rice farmers and identified the constraints of rice production in the study area. Data for the study were obtained from a total of 93 farmers and were analysed using descriptive statistics and stochastic frontier production function model. The results showed majority (65.6%) of the rice farmers were in the age bracket (40 – 60 years), 58.1% of them were women and most of the farmers (48.4%) had farming experience of 11 years and above. A mean technical efficiency of 83% was recorded in the area. The gamma coefficient was (0.81) which implied that 81% of the variation of rice output from the production frontier was accounted by the technical inefficiency of the farmers. The major factors which influenced the farmers' technical efficiency were farm size and labour while gender and occupation exerted a significant effect on their inefficiency level. The major problem faced by the farmers were insufficient fund, pest and diseases, planting materials, high price of inputs, cost of production, access road and processing equipment. Improved production technology, land acquisition policies and mechanized labour was recommended for the government and ministries intervention.

Key Words: Determinants of technical efficiency, rice production, stochastic frontier

1. Introduction

Asian rice (Oryza sativa) or African rice (Oryza glaberrima), a cereal grain, is the most widely consumed staple food globally. Rice is a major staple crop produced in Nigeria and remains a staple food for over half of the world's population. Nigeria is the highest producer of rice in the West African sub-region. The total paddy rice production in Nigeria was estimated at about 4.0 million metric tonnes, representing about 44% of the total production in the West African sub-region (Food and Agricultural Organization, FAO, 2008). However, domestic production had not meet domestic demand thus necessitating the importation of rice. Daramola (2005) held that Nigeria was the highest importer of rice in the sub-region . FAO (2008) estimates indicated that Nigerian rice import increased from 2630 tonnes in 1980 to 1.88 million tons in 2002. The total import stood at 1.9 million tonnes in 2003 (Central

Bank of Nigeria, CBN, 2004). In 2004, Nigerian rice production figure was about 2.96 million tonnes, cultivated on an area of 1,595, 840 hectares. This estimate indicated that rice imports represented more than 25% of agricultural imports and over 40% of domestic consumption (Federal Ministry of Agriculture and Rural Development, FMARD, 2005). From 1999, the value of rice imports rose steadily from $259 million to US $655 million and US $756 million in 2001 and 2002 respectively (CBN, 2006). According to National Bureau of Statistics (NBS, 2012), Nigeria spent ₦56.91 billion in the importation of semi-milled or wholly-milled rice in the fourth quarter of the year 2012. Rice is a good source of protein and a staple food in many parts of the world, but it is not a complete protein, it does not contain all of the essential amino acids in sufficient amounts for good health and should be combined with other sources of protein such as nuts, seeds, beans, fish or meat. It is the predominant dietary energy source for 17 countries in Asia and the pacific, 9 countries in North and South America and 8 countries in Africa. Rice provides 20% of the world's dietary energy supply. It is no longer just a mere meal as in the past but staple of most homes in urban and rural areas (Longtau, 2003). Rice protein contains high lysine and amino acid, it is important in making beer, rice wine and vinegar. However, the domestic production of rice has not met the domestic demand, leading to food shortage problems (Enwerem and Ohajianya, 2013). Rice is an increasingly important crop in Nigeria. It is a staple food for millions of people in West Africa and the fastest growing commodity in Nigeria's food basket (Akande, 2003). Although rice production in Nigeria has boomed over the years, there has been a considerable lag between production and demand level with imports making up the shortfall. The supply-demand gap kept widening due to increasing population growth and shift in consumers preference towards rice (Achike and Okoye, 2004; Ugwuanyi, et al. 2008). The inability of the Nigerian rice sector to meet the domestic demand may be due to the low hectarage under cultivation and inefficiency of the farmers in the use of production resources (Ahmadu and Ehrabor, 2012).

Nigeria has about 4.8 million hectares of potential land area for rice production but only about 36% is under cultivation (Ilevbaoje and Ingawa, 2008; National Food Reserved Agency (NFRA), 2008) with the rice farmers cultivating average farm size of less than 2 hectares (Daramola, 2005). Studies have shown that in Nigeria just as in other developing countries of the world, most resources are not efficiently used in production (Fan, 1999, Okoruwa and Ogundele 2004; Tiamiyi, Akintola and Rahyi, 2008; Akighir and Shabu, 2011).

Observations and studies in recent times have shown that rice production in Abia State is experiencing significant decline due to inadequate planting materials, seasonal fluctuations, inadequate resource input, inadequate information, and inadequate good

road network and pests. Considering the economic value and high demand for rice in the country, therefore it is important to assess the level of efficiency attained by rice farmers in the study area. It is on this background that this study is developed to asses technical efficiency of rice farms in Abia State, Nigeria.

The general objective of this study was to determine the technical efficiency of rice (Oryza sativa) production in Abia State, Nigeria The specific objectives includes to determine the socio-economic characteristics of rice farmers in the study area; determine the technical efficiency and inefficiency levels of rice farmers in the study area and identify the constraints of rice production in the study area.

2. Research Methods

Study Area : The study was conducted in Arochukwu Local Government Area of Abia State, Nigeria. Arochukwu Local Government Area is one of the major local government areas in Abia State that produce rice, it is the third largest city in the state and is in the food belt of Abia State where most of the staple foods are produced. It is located in the south-eastern Nigeria between latitude 5˚23'N and 7˚55'E and longitude 5.383'N and 7.917'E, 141 meters elevation above the sea level and bounded on the East and South by Cross River State, West by Akwa Ibom State and by Ohafia Local Government Area in the North . The town is located on a system of waterways, is transverse by Cross River and its tributaries and has an area of 524sqm. According to the National Population Commission of Nigeria,(NPC, 2006), the Local Government Area has a population of 169,339 persons.

Primary data was collected in 2012 production year and the aim was to generate information that would be useful in the determination of technical efficiency and inefficiency in rice production. Structured questionnaire was used in collecting the information. Questions centered on the socioeconomic variables, such as age, gender, level of education, farm size of farmers were asked and responses recorded. Also information on volume of inputs used by farmers in kg, unit price of inputs and total quantity of output achieved were asked, also questions were asked on challenges of rice production in the area.

Secondary sources of data collection included the use of newspapers, journals, reviewed literature materials, records from co-operatives, previous research projects, internet and other materials which were of importance to the research study were also used.

Sampling Selection Technique

Two stage sampling technique was used to select the sample size. In the first stage, purposive sampling was used to select four (4) communities (Ugbo, Atani, Amukwa and Asaga). The four (4) communities were predominantly involved in the production of rice out of the 19 communities in Arochukwu Local Government area. In the second stage, simple random sampling technique was used to select the respondents. Twenty (25) farmers were selected from each community making a

total number of 100 farmers from the total population 1005 rice farmers in Arochukwu Local Government Area. Only 93 copies of questionnaire were retrieved and the analysis of the data was based on 93 respondents.

Method of Data Analysis (Analytical technique)

Descriptive statistics such as frequency and percentage was used to determine objectives one and three Objective one was the socioeconomic variables of the farmers which include range, means and percentages . Objective two was determined using the stochastic frontier production function model (Frontier 4.1c). The stochastic frontier production function is a modified version of a Cobb-Douglas model. It was used to analyze the technical efficiency and inefficiency of rice production in the study area.

Model Specification

The stochastic frontier model was originally proposed for the analysis of the technical efficiency by Battese and Coelli (1995). The stochastic frontier production function for rice production adopted in this study as specified by the Cobb-Douglas functional form (Seyoum, Battese and Flemming, 1998) is defined by an implicit function, y = f(x) , which is explicitly stated as

$$\log Y = \beta_0 + \beta_1 \log Farmz + \beta_2 \log Pltm + \beta_3 \log Lab + v_i + u_i \quad ..1$$

Where,

Y =output/quantity of rice produced in (kg), Farmz= farm size (ha), Pltm= planting materials (kg) , Lab =labor (mandays);$\beta_{1-}\beta_3$ = slopes of independent variables. βo = intercept; v_i, a random error that is assumed to be normally distributed with zero and constant variance, (σ^2, v_1). technical inefficiency efficiency effects which are independent of V_1 and have half normal distribution with zero mean and constant variance, $\{\sigma^2, v_{1,}\}$, the inefficiency production, Ui was modeled in terms of the factors which are assumed to affect the efficiency of production of the farmers.

These factors are related to the socio-economic variable of the farmers and these variables are assumed to influence technical inefficiency of the framers.

$$U_i = \sigma_0 + \sigma_1 Ag_{li} + \sigma_2 Edu_{2i} + \sigma_2 Holdz_{3i} + \sigma_4 Exp_{4i} + \sigma_5 M_{5i} + \sigma_6 Rvty_{6i} + \sigma_7 G_{7i} \ldots\ldots\ldots 2$$

Ui =Technical inefficiency; Ag= age of farmers (years); Edu =Years spent in Education; Holdz =Household size (count); Exp=Experience of farmers (years); MS=Marital Status (1=single,2=married,3=divorced,4=widowed), Rvty=Rice variety used,G=Gender (0=male,1=female).

The stochastic frontier model assumes an error term with two additives asymmetric components which accounts for pure random factors and a one sided component which captures the effects of inefficiency relative to the stochastic frontier.The empirical model is stated by Equation :

$$Y = f(xi, \beta)e^{Vi-Ui} \ldots 3.$$

Where, Y=is the dependent variable, f=is the functional form, β is the technical coefficient.

The vital parameters estimated in this stochastic function included the sigma squared (δs^2), gamma (γ) and the maximum-likelihood ratio test. The δs^2 indicates the goodness of fit of the model used. The gamma gives the proportion of the deviation of the rice output from the production frontier caused by technical inefficiency. If γ = 0, it means U is absent from the model and hence all deviations from the frontier are attributed to noise. If γ = 1, it means all deviations from the frontier are due to technical inefficiency. The maximum-likelihood ratio test will be used to test for the significant presence of technical inefficiency effects in the farmers' production.

The δs^2 and γ are respectively expressed as:

$\delta s^2 = \delta v^2 + \delta u^2$ ...4

Where

δv^2 = variance of the error term due to noise

δu^2 = variance of the error term resulting from technical inefficiency

$\gamma = \delta u^2 / \delta s^2$ ...5

Where

Y=is the dependent variable; f=is the functional form; β is the technical coefficient.The vital parameters estimated in this stochastic function included the sigma squared (δs^2), gamma (γ) and the maximum-likelihood ratio test. The δs^2 indicates the goodness of fit of the model used. The gamma gives the proportion of the deviation of the rice output from the production frontier caused by technical inefficiency. If γ = 0, it means U is absent from the model and hence all deviations from the frontier are attributed to noise. If γ = 1, it means all deviations from the frontier are due to technical inefficiency. The maximum-likelihood ratio test will be used to test for the significant presence of technical inefficiency effects in the farmers' production.

3. Results and Discussion

The result of the socio-economic characteristics of rice farmers in the study area which includes age, educational level, family size, farming experience (years), farm size (portions) gender and marital status were represented in tables 3 - 5.

The result of the socio-economic characteristics of rice farmers in the study area as shown on Table 1 includes age, educational level, family size, farming experience (years), farm size (portions) gender and marital status of the farmers. The result indicated that majority (65.6%) of the rice farmers were in the age bracket (40 – 60 years). The reason why older people dominating rice farming enterprise would likely due to the number of youths migration from rural to urban areas in search of white collar jobs.

The result further showed that 58.1% of women were involved in rice production in the study area. This is an indication that rice farming in the study area was dominated by the women. This is in agreement with the findings of Rahman et al. (2004) who noted

Table 1 Socioeconomic Attributes of Farmers in the Study

Variable	*Frequency*	*Percentage*
Age in years		
20 – 39	9	9.7
40 – 59	61	65.6
60 and above	23	24.7
Total	**93**	**100**
Gender		
Male	39	41.9
Female	54	58.1
Total	**93**	**100**
Marital Status		
Separated	10	10.8
Single	1	1.1
Married	51	54.8
Widowed	31	33.3
Total	**93**	**100**
Family size in number		
1 – 5	24	25.8
6 – 10	65	69.9
11 and above	4	4.3
Total	**93**	**100**
Educational level (years)		
Non-formal education	25	26.9
Primary education	43	46.2
Secondary education	19	20.4
Tertiary education	6	6.5
Total	**93**	**100**
Farming experience (years)		
1 – 5	13	14
6 – 10	35	37.6
11 and above	45	48.4
Total	**93**	**100**
Farm size (hectare)		
0.1 – 0.9	86	92.4
1.0 – 2.0	6	6.5
2.1 – 3.0	1	1.1
Total	**93**	**100**
Occupation		
Craft work	13	14
Hunting	2	2.2
Civil servant	1	1.1
Trading	77	82.8
Total	**93**	**100**

Source: Field Survey, 2013.

that women were involved in rice production in the study area. This is an indication that rice farming in the study area was dominated by the women. This is in agreement with the findings of Rahman et al. (2004) who noted that women played vital roles in food production, processing and marketing in Nigeria, producing about 60-80% of food in the country. It was also observed that majority of the respondents were married (54.8%). It could be inferred that married households are in better position to supply farm labour (family labour) which would enhance rice farming and reduce labour cost. This is in consonance with the research findings of Horna et al (2005) who observed that most rice farmers were married. Most of the respondents (69.9%) had family sizes within the range of 6-10 persons. This higher number of households recorded could serve as a source of cheap labour in the farm especially when the cost of hired labor is high. The findings of Al-Hassan (2008) whose study on technical efficiency of rice farmers in Northern Ghana found that the main reason for maintaining large household sizes was to ensure adequate supply of family labour for rice production activities and that larger family also enabled household members to earn additional income from non-farm activities.

The result also indicated that the highest level of education attained by most of the respondents in the study area was primary education (46.2%). Education plays an important role in farm decision making, helps the farmers to gain skills, adopt new technologies. With a basic primary education, a farmer is considered to have some level of literacy and numeracy which is important for production and farm business transactions. This is in agreement with the findings of Hyuha, (2006) who stated that educational level of primary was necessary to increase profit efficiency of rice farmers; the research findings of Sharma and Leung, (2000) who observed that educational level of more than 4 years has been reported to improve efficiency of farmers and the findings of Akpokodje, Lancon, and Erensterin (2001) who also observed that majority of rice farmers in Nigeria could read and write.

The result further showed that (48.4%) of the farmers had farming experience of 11 years and above. This indicated that most of the rice farmers had acquired rice farming experiences good enough for increasing the productivity of rice. It is assumed that the longer one stays on a particular job, the better the person becomes in terms of his/ her skills to accomplish a task. This is in accordance with Ellis, (2003) who stated that agriculture is a risky venture, so all agricultural production technique can never be acquired from formal extension education thus making experience play a vital role in improving production.

The largest farm size of the farmers was within the range of 0.1 – 0.9 hectares which is an indication that the farmers were operating in small scale of production. The findings also showed that majority of the farmers were involved in off-farm work of trading (82.8%),

Table 2 Technical efficiency of rice farmers in the study area

Variables	parameters	coefficient	standard-error	t-ratio
Intercept	b_0	5.748	0.658	8.739***
Farm size	b_1	0.506	0.102	4.972***
planting material	b_2	0.127	0.108	1.17
labour	b_3	0.255	0.092	2.782***
Sigma-squared	σ^2	0.174	0.041	4.242***
Gamma	Γ	0.81	0.31	2.613***
Log likelihood function				48.7782
LR of one sided error				17.16
No of observation				93
Mean efficiency				0.8316
RTS $b_1 + b_2 + b_3$				0.89

this could be because of their search for capital so as to increase production. This is in agreement with the findings of Hung-Hao and Fang (2011) who stated that off-farm work provides an opportunity for farm households to stabilize household income and reduce the uncertainty associated with agricultural production.

The result of the socio-economic characteristics of rice farmers in the study area as shown on Table 1 includes age, educational level, family size, farming experience (years), farm size (portions) gender and marital status of the farmers. The result indicated that majority (65.6%) of the rice farmers were in the age bracket (40 – 60 years). The reason why older people dominating rice farming enterprise would likely due to the number of youths migration from rural to urban areas in search of white collar jobs.The result further showed that (48.4%) of the farmers had farming experience of 11 years and above. This indicated that most of the rice farmers had acquired rice farming experiences good enough for increasing the productivity of rice. It is assumed that the longer one stays ona particular job, the better the person becomes in terms of his/ her skills to accomplish a task.

The result on the determinants of technical efficiency of rice farmers in the study area indicated that the area of land cultivated (farm size) and labor used for rice production significantly influenced technical efficiency of rice farmers at 1%. This is in agreement with the findings of Hung-Hao and Fang (2011) who pointed out that farm sizes and the share of the family labor in labor used as a whole have positive effects on efficiency. It was observed that the variable planting material was not significant on the technical efficiency level of rice production in the study area.

The returns to scale (RTS) value of approximately 0.89, obtained from the

summation of the coefficients of the estimated parameters (elasticities) indicated that farms in the study area were in stage II of the production frontier. This implied that an increase in the use of the selected variables would result in less than a proportionate change in the production of rice in the study area.

The result also indicated that the gamma value or variance ratio was estimated at 0.81 or 81% means that about 81% of the discrepancies between observed output and the frontier output were due to technical inefficiency. The gamma ratio indicates ratio of the random error effect to the inefficiency effect. If the gamma value is greater than unity, the random error dominates the technical inefficiency effect (Ui). This statistics gamma, was significant at less than 1 percent alpha level. This justifies the choice of the inefficiency variables selected for this model (the six socio-economic characteristics of the farmers used as inefficiency variables). The highly significant ($p < 0.001$) sigma squared value 0.174 indicated that technical inefficiency exists in rice farms in the study area. The above assertions are buttressed by the high estimates of Log likelihood function and Log likelihood ratio (LR) estimates from this model which gave 48.78 and 17.16 respectively.

The highest range of farms technical efficiency was 0.90-1.00 with a percentage of 38.71 followed by 0.70- 0.80 (27.96%), and the lowest range of technical efficiency was 0.50-0.60 (3.23%). The minimum technical efficiency recorded in the farms was 0.51 (51%) while the maximum estimate recorded was 1 (100%). Mean technical efficiency recorded in the study area was 0.83 (83%). This implies that the average rice farmer in the study area had a technical efficiency of 83%. Put in another way, the average rice farmer in the study was 17% far away from the frontier technical efficiency (100%) given the existing technology in the area. However, the mean technical efficiency recorded was high; therefore in the short run, it is possible to increase rice production in the study area by an average of 17% by adopting the technology used by the best farmer. The study revealed that 90.3% of the farmers experienced insufficient fund as a problem in rice production in the study area. This is an indication that fund is a problem faced by majority of the rice farmers because they depend on their personal savings for the production of rice. This may be due to lack of credit facilities from the banks, government and non-governmental organizations and the high interest rate charge by lending institutions in the study area. It was observed that pest and diseases were militating factors to rice production as majority of the farmers (93.5%) accepted that pest and diseases infestation is a limiting factor in rice production in the study area. The problem of getting good quality planting materials was found to be a problem among rice farmers in the study area. (66.7%) of the farmers agreed that planting material such as rice seedling is a problem militating against rice production Also high price of

inputs was identified as a problem militating against production of rice in the study area.

The farmers also pointed out that inadequate production technology in terms of having access to modern harvesters and threshing equipment was a serious problem in rice production. About (98.9%) farmers agreed that problem of inadequate production technology is a militating factor in rice production. Majority of the farmers (96.8%) agreed that processing equipment was also a rice production challenge. This may be as a result of the long distance between the farm site and the processing centre and the unavailability of processing equipment in the area. 55.9% of the farmers agreed that accessible farm road was a challenge to production of rice in the study area. Most of the farm sites are too far away from the residential area of the farmers. Secondly, there is no (bridge) to link the adjoining road therefore, it is difficult for vehicle to pass through and evacuate farm products.

Conclusively, the farmers were inefficient in the use of a given technology or mix of inputs but can attain optimum efficiency or produce at the frontier line by a 17% increase. Gender and occupation were the determinants of technical inefficiency in production and the use of poor production technology; insufficient funds were among the factors militating against the technical efficiency of rice production in the study area. It is therefore, recommended that production technology such as provision of farm machines like tractors, ploughs, harvesters etc. should be made available to farmers at affordable price increase the efficiency of rice production in the study area.

References

Achike, A.I., & Okoye, F.U. (2004). Comparative profitability analysis is of selected Rice Enterprises in Anambra State. A Paper presented at the annual national conference of Nigeria Association of Agricultural Economists (NAAE) held at Ahmadu Bello University Zaria, 3rd-5th November.

Ahmadu, J., & Erhabor, P.O.(2012). Determinants of Technical Efficiency of Upland Rice Farmers in Taraba State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment.* 8(3): 78-84

Akande,T. (2003).The rice sector in Nigeria United Nation Crop Project (UNCP) Country Agricultural project on trade liberalization in Agricultural sector and the environment Genera pp.10.

Akighir, D.T., & Shabu. T (2011) Efficiency of Resource Use in Rice Farming Enterprise in Kwande Local government Area of Benue State, Nigeria. *International Journal of Humanities and social Science* 1(3):2.5-220. Available at www.Ijhssnet.com/Journals/march-2011/30.pdf.

Akpokodje, G.; Lancon, F.,& Erensterin, O. (2001) The Nigerian Rice Economy in A Competitive World: Constraints, Opportunities and Strategic Choices. Nigeria's Rice Economy: State of the Art, West Africa Rice Development Association (WARDA), Bouake, cote d' Ivoire. Http://pdf.dec.org/pdf-docs/pnadb851-pdf.

Al-Hassan, S. (2008) Technical efficiency ofRice Farmers in Northern Ghana. African Economic Research Consortium, Research paper 178, Department of Economics and Entrepreneurship Development (DEED), University for

Development Studies (UDS) Tamala, Ghana. ISBN 9966-778-26-8

Central Bank of Nigeria (2004). Annual Report and Statement of Accounts, CBN publication.

Central Bank of Nigeria (CBN), (2006). CBN Statistical Bulletin (2006).

Daramola, B. (2005). Government Policies and Competitiveness of Nigerian Rice Economy. A paper presented at the workshop in Rice policy and Food security in sub-Saharan Africa Organized by WARDA, Cotonou, Republic of Benin, 7th -9thNovember, www.warda.org/workshop.ricepolicy/Biyi/ biyi.D.Nigeria.Paper.pdf.

Ellis. F., (2003). Peasant Economics: Farm Households and Agrarian Development. Second edition. Cambridge University press.

Enwerem, V.A. & Ohajianya, D.O. (2013) Farm Size and Technical Efficiency of Rice Farmers in Imo State, Nigeria. Research article, *Greener Journal of Agricultural Sciences.* 3 (2); 128-136,

Fan,S.(1999) Technological Change, Technical and Allocative Efficiency in Chinese Agriculture: The Case of Rice Production in Jiangsu. Environmental and Production Technology division (EPTD) Discussion paper No.39, International food Policy Research institute (IFPRI).http://www.ifpri.org/sites/default/files/publications/eptdp70. DOI: 10.1002/(SICI)1099-1328(200001)12:1

Federal Ministry of Agriculture and Rural Development (FMARD), (2005).. Ministerial Press Briefing by Minister of Agriculture and Rural Development on the State of Nigerian Agriculture

Food and Agricultural Organization, FAO (2008) Rice information. 12, Food and Agricultural Organization, Rome, Italy. FAO statistics Division-http://beta.irn.org (statistics/images/stories/wrs-novo8-tables. *doi*:10.2903/j.efsa.2009.1351.

Horna, J.D., Smale, M., & Oppen, M. VON, (2005). Farmer's Willingness to pay for Seed-related Information: Rice Varieties in Nigeria and Benin. Washington D.C.: International Food Policy Research Institute (IFPRI), EPT Discussion Paper 142.

Hung-Hao, C., & Fang, I.W.(2011). Off-farm work, Technical Efficiency and Rice Production Risk in Taiwan. *Agricultural Economics*. 42: 269-278

Hyuha, T., (2006) ProfitEfficiency among Rice Farmers in Uganda. Unpublished Ph.D thesis, Makerere University.

Ilevbaoje, I.E., & Ingawa S.A. (2008) Nerica Rice Flourishes in Nigeria: The magic wand of Multinational Nerica Rice Dissemination project. In: Aiyedun, E.A.; P.O. Idisi and J.N. Nmadu (eds), processing of 10th Annual National conference of NAAE held at University of Abuja, Abuja, Nigeria, 7th-10th October, 267-275.

Longtau, S. (2003) Rice Production in Nigeria Literature Review. Multi-agency Partnerships in West African Agriculture. A review and description of rice production systems in Nigeria.98.

National Bureau of Statistics (NBS), (2012)Government of Nigeria spends N88b on rice, sugar import. Available from http://thenationonlineng.net/new/govt-imort/

DOI: 10.5897/JSPPR11.077Accessed on 20 November 2014

National Food Reserved Agency (NFRA) (2008) Report of the 2007 Agricultural Production Survey Federal Ministry of Agriculture and Water Resources, 1-88. Retrieved 31st March 2013.

National Population Commission (NPC), (2006). In Nigeria news (2007) census 2006. Retrieved 22nd March, 2013 from

URL: http://www.nigerianews.com/letters/letters.htm.

Okoruwa,V.O. & Ogundele O.O, (2004) Technical Efficiency Differentials in rice Production Technologies in Nigeria. Available at http://www.csare-ox.ac.Uk/conference/2006-Eo-RPI/papers/case/okoruwa.Pdf.

Onoja, A.O., & Achike, A.I.,(2010) Comparative Analyses of Farm Resource Efficiencies in Rice Production under Small Scale Farmer Managed Irrigation Schemes and Rainfed Systems in Kogi State, Nigeria. *Research Journal of Agricultural and Biological Sciences,* 6(6): 1047-1054.

Rahman, S.A., Gabriel, J. Marcus, N.D. (2004). Gender Differentials in Labour Contribution and Productivity in Farm Production. Empirical Evidence from Kaduna State of Nigeria. Paper presented at the National Conference on Family at Makurdi, Nigeria. 1 March 2004.

Seyoum, E.T., Battese, G.E., & Flemming E.M.(1998) Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia: A study of Farmers within and outside the Sasakawa-Global 2000 project. *Agricultural Economics*. 19; 341-348.

Sharma. K. R & Leung, P.S. (2000). Technical Efficiency of Carp Production in India: A Stochastic Frontier Production Function Analysis. Aquaculture Research. 31; 937- 947

Tiamiyi, S.A.; J.O.Akintola & Rahyi, M.A.Y (2008) Potential for Rainfed Upland Rice Productivity Growth in Guinea Savannah Zone of Nigeria. In Aiyedun, E.A.; P.O. Idisi and J.N. Nmadu (eds), Proceedings of 10th Annual National conference of NAAE held at University of Abuja, Abuja, Nigeria,7th-10th October, 267-275.

Ugwuanyi, C.A., Balogun, O.S., Akinyemi, O.G., Balogun, F.,& Zungum, A. (2008) Cost and Returns of Small- scale Locally Milled Rice Marketing in Uzo-Uwani LGA of Enugu State. In: Aiyedun, E.A; P.O. Idisi and Nmadu (eds) proceedings of 10th Annual Conference of NAAE held at University of Abuja, Abuja, Nigeria, 7th – 10th October, 78 – 85

Barros, C.P., Managi, S., & Matousek, R. (2009). Productivity growth and biased technological change: Credit banks in Japan. *Journal of International Markets, Institutions & Money*. 19, 924-936. Available from*www.managi-lab.com/english00.htm*

Barros, C.P. & Weber, W.L.(2002) Productivity growth and biased technological change in UK airports. Transportation Research Part E 45, 642-653. http://mpra.ub.umi-muechen de/id/eprint/34367

Latruffe, L., Bravo-Ureta, B.E., Moreira, V. H., Desjeux, Y. & Dupraz, P. (2012) Productivity and Subsidies in the European Union: An Analysis for Dairy Farms Using Input Distance Frontiers. Presented at 28. International Association of Agricultural Economists (IAAE) Triennial Conference, Foz de Iguaçu, BRA (2012-08-18 - 2012-08-24). Available from http:// www. prodinra.inra.fr/record/199207

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Table 3 Frequency distribution of technical efficiency estimates of rice

Range of efficiency	*Frequency*	*Percentage*
0.50 – 0.60	3	3.23
0.61– 0.70	18	19.35
0.71 – 0.80	26	27.96
0.81 – 0.90	10	10.75
0.91 – 1.0	36	38.71
Minimumtechnical efficiency	0.51	51
Mean technical efficiency	0.83	83
Maximum technical efficiency	1.00	100
Total	93	100

Source: Field survey, 2013

Table 4 Challenges of rice production in the study area

Variables	Yes	No
Insufficient fund	84(90.3)	9(9.7)
Pest and diseases	87(93.5)	6(6.5)
Planting materials	62(66.7)	31(33.3)
Price of inputs	80(86.0)	13(14.0)
Poor production technology	92(98.9)	1(1.1)
Cost of production	84(90.3)	9(9.7)
Access road	52(55.9)	41(44.1)
Processing equipment	90(96.8)	3(3.2)
Toal Respodents	93	

Source: Field Survey (2013)
Note: Values in parenthesis represent percentages

Effects of Rice Farmers' Socioeconomic Characteristics on Child Labour Usein Imo State, Nigeria

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Abstract

This study investigated the effect of rice farmers' socioeconomic characteristics on child labour use in Imo State of Nigeria. Specifically, the study determined the effect of the socioeconomic factors that affect rice farmers' use of child labour in Imo State. Primary data sources were used. Multi-stage random sampling was employed in choosing the respondents for this study. One local government area (LGA) in each of the three agricultural zones was purposively selected for the study based on suitability for rice production. Communities which are known for rice production were purposively selected from the selected LGAs. The list of rice farmers in each chosen community was obtained from Imo ADP. The list formed the sampling frame from which the respondent rice farmers were selected using random sampling procedure. Thirty rice farmers were selected from each community, making a sample size of 90.Data was analyzed with binary logistic regression technique. The variables namely gender, marital status, farm size, rice farmer's experience and family size were significant at 5% level while age and educational attainment were significant at 1% level. Furthermore, gender, marital status, family size, farm size, educational attainment and rice farm experience were statistically significant variables with negatively effect on the use of child labour. Age though statistically significant, had positive effect on the use of child labour. Efforts aimed at curbing the adverse effects of child labour should to all intents and purposes be fundamentally targeted at the predisposing socioeconomic factors.

Key Words: Rice farmers, labour use, socioeconomic, Imo State

1. Introduction

Rice is a staple food for many people in Imo State, Nigeria. It is the most rapidly growing food source in the state and is of significant importance to food security for a large number of low- income food deficit countries including Nigeria (FAO, 2004). Rice-based production system and the associated post-harvest operations employ many hands in rural areas of West Africa including Imo State. According to Imo ADP (2009), the key problems facing rice production in Nigeria has been identified to consist of lack of competiveness resulting from low and uneconomic productivity, poor access to expensive inputs (especially fertilizer and credit), low capacity to meet quality standard. It should be added that labour is one of the inputs on which lots of money is expended. Labour is an important factor of production. It means the physical and mental effort provided by an individual worker towards production.

In most cultures children help their immediate families through work in manner that is neither hazardous nor exploitative. However, child labour effectively deprives children of their humanity, their childhood, their self-worth, their potential and their general well being. Child labour can equally interfere with the education of the child. This comes about when children are forced to combine their education with hazardously long and tedious work. It may also find expression in children leaving school earlier than is expected; in extreme forms child labour entails children not attending school and are left to cater for themselves (UNDP, 2015). Child labour is an economic activity performed by a person under the age of 18 (Tiaji et. al., 2005). Whether these activities are paid or unpaid, they constitute child labour to the extent that they prevent the child within this age limit from attending to school activities.

According to Sartyarthi (2015) children are preferred by way of child labour because they are the cheapest or even free, if bonded-labour. Sartyarthi (2015) further stated that children are physically and mentally docile; do not form unions; do not go to court and so pose no challenge to the employer. The highest prevalence of child labour is in Sub-Saharan Africa, at one child in five (ILO, 2013). Nigeria is one of the countries that make up Sub-Saharan Africa. Imo ADP (2009) noted that children are involved in labour use in rice production in Imo State and that the contributions of children in rice production in the area include scaring birds, transplanting rice seedling, weeding, providing fire wood for parboiling before milling, applying fertilizer and pesticides. Togunde and Carter (2008) stated that children engage in work in order to contribute financially to the sustenance of their families, and to acquire training needed in future occupations.

According to Ezedinma (2005), there is scarcity of labourers in the rural areas; hence child labour becomes the alternative. Dillon (2009) noted that illiteracy of the parents leads to child labour. Basu and Van (1998) stated that child labour is as a result of poverty and occurs when family or the household income is below subsistence level. There is still gap in understanding the effect of socioeconomic characteristics of rice farmers on the use of child labour in rice production. This study is an attempt to fill that gap in knowledge by investigating the sign and size of the effect of socioeconomic characteristics of the farmers on the use of child labour in their farm operations. The overall objective of the study is to highlight the sign and size of the effect of the socioeconomic characteristics of the rice farmers on the use of child labour in their farm operations. Specifically, the objective is to determine the effect of the socioeconomic factors that affect of the rice farmers' use of child labour. The hypothesis of the study is that rice farmers' socioeconomic characteristics do not significantly affect the use of child labour in rice production. The findings of the study will bring to light the magnitude of the effect of the rice farmers'

socioeconomic characteristics on child labour use in rice production.

Conceptual Framework

According to Imo ADP (2009), in Imo State, children are employed to scare birds from the rice farm mostly with their catapults at the early morning and evening hours. Togunde and Carter (2008), noted that globalization of the economy has led to the desire for cheap labour and profit maximization. However, one major backlash of the global development and spread of industries has been the exploitation of children in terms of low wages and their deplorable working conditions.

According to Ezedinma (2005), there is scarcity of labourers in the rural areas; hence, the child labour becomes the alternative. In Nigeria, child labour is often taken as a means of teaching the children survival skills and as a means of social integration. This is clear when the farmers go to the farm with their children, showing them one skill or the other.

In analyzing the effect of socio-economic characteristics of the respondents in the involvement of children in rice production, this study employs a model that deals with child labour use or not as the dichotomous dependent variable. That is the theoretical basis for the choice of Logit model for the analysis of the main objective. The "Logit" itself from which the technique derives name is the natural logarithm of odds, or the "log odds". The odds indicate the relative probability of interest (Allan, 1986; Eboh, 2009). The relationship of this behavioural dependent variable can be examined with that of the independent variables. Such models cannot be estimated by either multiple regression or the Ordinary Least Square (OLS) techniques which may result in invalid parameter estimates and wrong magnitude of the effects of the independent variables on the dependent variable, the OLS assumptions that the variance of the error terms are constant and not correlated with the level of independent variables are violated.

Nonetheless, four commonly used approaches to estimate such models include: the linear probability Model (LPM), logit model, probit model and the tobit model (Gujarati, 2000). The LPM is not generally recommended because it provides predicted values that may fall outside the 0-1 interval, thus violating the assumptions of the probability. Logit, probit and tobit models give maximum likelihood estimates and overcome most of the short comings of LPM by providing consistent and efficient estimates. The logit model framework is however preferred among the other three model framework because it has been found to be efficient in explaining such dichotomous decision variables (Gujarati, 2000).

Binary Logistic Regression

Binary logistic regression is a form of regression which is used when the dependent variable is dichotomous and independent variables are of any type. They are used to predict a dependent variable on the basis of independent variables, to determine the percentage of variance in the dependent

variable explained by the independent variables, to assess interaction effects and understanding the impact of the covariate variables.

It applies maximum likelihood estimation after transforming the dependent into logit variable (the natural log of odds of the dependent occurring or not). Logistic regression estimates the probability of a certain events, that is, change in the log of odds of the dependent and not changes in the dependent variable itself as the OLS regression does.

The Probability of the event occurring is given by the relationship

Pi = 1/1+e-z---------- (equation 1.1)

Where Pi = the probability of the event occurring which ranges between 0-1

Z = Bo + B1x1 (which ranges -∞ to +∞)

e = the base of the natural logarithm (approx. 2.72).

The probability of the event not occurring is given by the relationship 1 - Pi

odds ratio = $\frac{Pi}{1 - Pi} = \frac{1+ezi}{1+ezi} = ezi$ ----------(equation 1.2)

Note $\frac{Pi}{1 - Pi}$ converts the probability into odds of the event occurring (i.e. the ratio of the event occurring to the probability of event not occurring. Log of odds is therefore given by

$$Li = \frac{Ln(Pi)}{1 - Pi}$$

Li = logistic model, Ln = log, Pi = probability of the event occurring, Bo = constant or intercept, B1X1 = coefficient of the independent variable.

2. Research Methods

*Study Area:*The study was carried out in Imo State, Nigeria. The major economic activity of the people of Imo State is farming. Among the major crops grown in the area are cassava, maize, yam, tree crops, vegetables and rice. The crops are typically grown on small holder plots. Imo State has suitable ecologies for production of different varieties of rice (Imo ADP, 2009). This consists of temporary flooded area and river banks. The shallow swamps have areas such as Imo River Basin at Ihitte Uboma, Nzerem, Umuna (all in Okigwe agricultural zone); Urashi River basin at Oguta and Egbema, Ideato/Arondizuogu flood plains, Otamiri/Nworie/Uramiriukwa flood plains and isolated flood areas.

Sampling technique

Rice farmers in the three agricultural zones in Imo State served as the study population. The three zones are Okigwe, Owerri and Orlu. Multi-stage random sampling was employed in choosing the respondents for this study. Stage 1: One Local Government Area in each of the three agricultural zones was purposively selected for the study based on suitability for rice production. The Local Government Areas were Ihitte Uboma in Okigwe Zone, Ohaji Egbema in Owerri Zone and Ideato North in Orlu Zone. Stage II: Communities which are known for rice production were purposively

selected from the selected LGAs for the Study. Onicha Uboma from Ihitte Uboma LGA, Etekwuru from Ohaji Egbema LGA and Ndiakueme Ikpa-Okorie of Arondizuogu from Ideato North LGA were the selected communities. The list of rice farmers in each chosen community was obtained from Imo ADP. The list formed the sampling frame from which sample of rice farmers was selected using random sampling procedure. Thirty (30) rice farmers were selected from each community, making a sample size of 90. At this stage, three enumerators were recruited, trained and assigned to collect data from the communities selected.

Method of Data Collection

Data for this study was collected using structured questionnaire. The questionnaire was administered to the rice farmers in the area for the collection of relevant data used to achieve the objective of the study.

Method of Data Analysis

The objective was realized with binary logistic regression. The model is

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

$Y = lnY= f(X_1, X_2, X_3, X_4, X_5, X_6, X_7) + e$

$Y =lnY=ln (p/1-p) = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7) + e.$

Where Y = Child Labour use (Dummy variable: child labour use =1; no child labour use =0), P = probability of child labour use, 1-P = probability of no child labour use, X_1= Gender (dummy variable: male=1; female =0), X_2= Age of rice farmer (years), X_3= Marital status (Dummy variable: married =1; single =0), X_4= family size (number of persons), X_5= level of Education attainment (number of years in school), X_6= Rice farmer's experience (years), X_7= Rice farm size (hectare), e = error term.

Table 1: Binary Logit Estimates of the Effect of Rice farmers' Socioeconomic Characteristics on Child Labour Use in Rice Production

Variable	Coefficients (B)	S.B.	Wald	df	Sig.
X_1	-19.759	11363.014	3.842	1	.049*
X_2	0.017	.047	12.765	1	.000 **
X_3	- 0.506	1.369	5.037	1	.023 *
X_4	-0.023	.150	5.029	1	.024 *
X_5	-0.034	.079	8.629	1	.001 **
X_6	-0.068	.049	5.666	1	.022 *
X_7	-0.043	.119	3.893	1	.047 *
Constant	19.115	11399.288	.000	1	.999

**=Significant at 1% level, *= Significant at 5% level.Source: Field Survey, 2010

2. Results and Discussion

Rice Farmers' Socioeconomic Characteristics and Child Labour Usage in Rice Production

The effects of rice farmers' socioeconomic characteristics on child labour use in rice

production in Imo State are discussed in this section.

Table 1 shows the binary logit estimates of the effects of the farmers' socioeconomic characteristics on child labour use in rice production.The estimation of the binary logit model was undertaken to ascertain the effect of rice farmers' socioeconomic characteristics on child labour use. The Omnibus tests of model coefficients and the likelihood ratio statistics as indicated by Chi-Square (X2) statistics are significant (P = 0.049) and (P = 0.000) respectively, suggesting that the model has strong explanatory power. The significance of this likelihood ratio statistic test rejected the null hypothesis of this study which states that, farmers' socioeconomic characteristics do not significantly affect child labour use in rice production. This study accepted the alternate hypothesis that farmers' socioeconomic characteristics do significantly affect child labour use in rice production. The Pseudo R-Sqaure (Nagelkerke) which represents the coefficient of multiple determination has a value of 0.735 (73.5%), implying that the explanatory variables jointly explained 73.5% of the variation in child labour use in rice production (dependent variable). Consequently, the interpretation of the binary logit result indicates that:Gender of the rice farmers(X1) had negative and statistically significant effect (p=0.049) on the likelihood of using child labour in rice production. It means that female rice farmers are more likely to use child labour more than the male rice farmer. This is a pointer to the phenomenon of feminization of poverty in which women bear a disproportionate amount of the burden of poverty linked characteristics. This finding is similar to that of Ikenwilo et.al. (2016). Ikenwilo et.al. (2016) in a study examined the impact that a government-sponsored microcredit project targeting women in rural areas may have on vulnerability and empowerment of the beneficiaries and members of their households. The two major research questions addressed were whether microcredit improves indicators of household vulnerability and women empowerment; and interrogating the extent to which family members of beneficiaries were affected. The findings indicated that the beneficiaries of the microcredit were significantly less vulnerable than non-beneficiaries. This was attributed to significant reductions in both frequency of child labour and food shortage in the household. Employment of cheap children labour in rice farming in Imo State could be on account of limited access to financial services at affordable costs, to such sections of disadvantaged and low income segments of the society as the women.

Furthermore, age of the rice farmer (X2) had a positive and statistically significant (P = 0.000) impact on the probability of using child labour in rice production. It means that the older rice farmers employ child labour more than the younger rice farmers. The likelihood to use child labour increased with increase in age of the rice farmers. This finding is in line with Nwaru, (2004) who stated that the ability to do

manual work decreases with advancing age. Thus with increase in age, the average rice farmer tends to employ more child labour to augment the labour needs in the rice farm.

Additionally, marital status of the rice farmers (X3) had a negative and statistical significant (P = 0.023) influence on the probability of child labour use in rice production. This implies that unmarried rice farmers are more likely to employ more labour (child labour) in rice farm production than the married rice farmers.

Following the information from the study, family size of the rice farmers (X4) had negative and statistically significant (P = 0.24) relationship with the likelihood of child labour use in rice production. This implies that the smaller the family size of rice farmers, the more the likelihood of employment of child labour in rice farms.

Equally from the study, educational attainment of the rice farmers (X5) Educational had negative and statistical significant (P = 0.001) effect on the probability of using child labour in rice production. This finding is in line with Dillion (2009), who noted that parental education has inverse effect on child labour. It should be added that the higher the educational attainment of the rice farmer, the less likely for the rice farmer to employ either own child or someone else's child as a labourer. This implies that rice farmers with higher educational attainment are less likely to employ child labour in their farms on account of the dire consequences as a deprivation for the child. In addition to the awareness that education gives to the rice farmers, education also tends to confer on them the relative ease to be able to successfully utilize external sources of financing from which funds are generated for the hiring of more suitable farm labour.

Findings further indicated that rice farm experience (X6) had negative relationship with child labour use in rice production. Rice farming experience of the farmer significantly (P = 0.022) decreases the probability of child labour use in rice production. This tends to buttress the fact that the more the experience garnered in rice farming the more the realization of the limitations of use of child labour and hence the less the likelihood to employ child labour in farm operations.

Rice Farm size (X7) had a negative and significant effect (P=0.047) on the use of child labour in rice production. This implies that rice farmers with small rice farm size use more child labour in rice production than the farmers whose farm size is large. This tends to show that with the increase in rice farm size, the rice farmer employs mechanization and to that extent is less dependent on the use of child labour.

4. Conclusion

The socioeconomic characteristics of the rice farmers such as gender, marital status, family size, farm size, educational attainment and rice farm experience are statistically significant variables which negatively affect the use of child labour in the study area. Age though statistically significant, had positive effect on the use of child labour. Efforts aimed at

curbing the adverse effects of child labour should to all intents and purposes be fundamentally targeted at the predisposing socioeconomic factors for if we cannot protect our children from child labour in rice farming or any other enterprise, we cannot protect our agricultural enterprise.

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

It is important that rice farmers in general and women rice farmers in particular should have access to formal financial services and products that are designed according to their needs and taking account of their specific situations. Facilitating financial access for rice farmers especially women rice farmers is a critical strategy for enterprise development and economic empowerment. It will expectedly spur human development; reduce the reliance on child labour by rice farmers. Affirmative action programmes in self-employment, entrepreneurial skills development and small and medium enterprise development are strongly recommended because they are significant. It is therefore recommended that financial institutions, including the central bank and commercial banks should develop financial products that address the specific needs of women entrepreneurs including women rice farmers. Enlightenment campaign against child labour by government agencies and NGO's should be carried out in Imo State. This will go a long way in drawing attention to the ills of the use of child labour. Government should ban child labour of any kind. This will compel parents, guardians, and rice farmers to desist from engaging child labour in their activities.

References

Allan, A. B. (1986) Statistical methods for social science. Dellen Publishing Company, San Francisco California.

Basu, K. & Van, P.H. (1998) The Economics of child labour. American Economics Review, 88 (3): 412 – 427.

Dillon, A. (2009) Measuring child labour: Comparisons between hours data and subjective measures. Development Strategy and Governance Division. International Food Policy Research Institute. IFPRI Discussion paper 00879.

Eboh, E.C. (2009) Social and economic research principles and method. African Institute for Applied Economics, Enugu. Pp 174-175.

Ezedinma, C.I. (2000) Farm resource allocation and profitability of arable crop enterprise in the humid forest inland valley ecosystem. A case study of Ozuabam in Southern Nigeria UNISWA Journal of Agriculture. Vol. 9: 48 – 56.

Food and Agricultural Organization (FAO) (2004) Rice Environments. Retrieved July 25, 2016, from www.riceweb.org

Gujarati, D. N. (2000) Basic econometrics. London McGraw Hill International Edition.

Ikenwilo, D., Obembe, O., Akindola, R., Olajide, D., & Ibeji, N. (2016) The Impact of a Rural Microcredit Scheme Targeting Women on Household Vulnerability and Empowerment : Evidence from South West Nigeria. Parnership for Economic Policy Working Paper, Working Paper (January), 26.

Imo ADP (2009) Annual report. Imo State Agricultural Development Programme, Owerri, Nigeria.

International Labour Organization (ILO) (2013) Global estimates and trends of child labour 2000 2012. Geneva. Retrieved July 25, 2016, from www.ilo.org/wcmsp5/References193groups/public/ed_norm/ipec/documents/publication/wcms_221881.pdf.

Nwaru, J.C. (2004) Rural credit markets and resource use in arable crop production in Imo State, Nigeria (Unpublished PhD Thesis). Michael Okpara University of Agriculture, Umudike, Abia State.

Tiaji, S., Hanraha, C. & Cook, N. (2005) Child labour in West African cocoa production: Issues and its policy. Retrieved July 25, 2016, from www.crs.web.org/childlabour.htm

Satyarthi, K. (2015) Working towards the elimination of child labour in Human Development Report 2015 Work for Human Development. UNDP. Washington DC USA . Retrieved July 25, 2016, from http://hdr.undp

Togunde, D. & Carter, A (2008) In their own words: Consequences of child labour in urban Nigeria. Journal of Social Science, 16(2): 173 - 181. Ed Kamla – Raj.

United Nations Development Programme (UNDP) (2015) Human Development Report 2015 Work for Human Development. UNDP. Washington DC USA . Retrieved from http://hdr.undp.org 23rd July, 2016

Assessment of Beneficiaries Satisfaction with FADAMA III/SEEFOR Funded Rural Infrastructures and Productive Assets

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Abstract

The study sought to ascertain productive assets provided by FADAMA III/SEEFOR project to beneficiaries and the proportion of beneficiaries that are satisfied with operation, maintenance and utilization of the productive assets. It also identified the rural infrastructural subprojects provided by FADAMA III/SEEFOR project and the impact of these subprojects on beneficiaries' income. A sample of 170 respondents, comprising of 120 direct project beneficiaries and 50 non beneficiaries were drawn from the five local government areas under study. Data were generated with the use of structured questionnaire and analyzed through the use on descriptive statistics and the Difference in Difference method. Results indicate that 119 respondents representing 70% of the respondents were males while 38.82% were aged between 30 and 39 years; and 84.71% are married. Three enterprises including snailry, pepper and cassava processing enterprises were not satisfied with operation, maintenance and utilization of the productive assets provided to them. Average annual income of beneficiary households before the project implementation in the local government areas was N174,785.00 while that of non beneficiaries was N177,015.00 prior to the establishment of rural infrastructural subprojects. With the implementation of the project, the average income of all type of respondents' enterprises rose to N186,306.17 while that of non participants averaged to N178,662.17 implying an increase in income by 6.59% and 0.09% for participants and non-participants in the project respectively. It is recommended that the project should entrench proper measures towards ensuring that service providers execute projects to specification as this will improve the interest of the project to beneficiaries.

Key Words: SEEFOR, Fadama III, Satisfaction, Beneficiaries, Income

1. Introduction

Nigeria is a country blessed with potentially good land and water resources required for sustainable agricultural development. It is a known fact that many government agricultural intervention development programmes in Nigeria have not had lasting impact on agricultural development and many have not yielded the expected results of sustained increase in food production (Baba and Singh, 1998). Agricultural production methods have remained undeveloped despite many years of efforts on technology generation and transfer in Nigeria. Rural financial supports are scarce and most rural finance policies implemented previously have impaired rather than assisted in improved agricultural production (Simonyan and Omolehin, 2012).

However, in an attempt to alleviate poverty among rural Nigerians and also to increase the incomes and productivity of the rural inhabitants as an approach of meeting up with the millennium development goals (MDGs) of food sufficiency and poverty eradication, the

Federal Government of Nigeria through the pooled World Bank loan came up with Fadama project, to finance the development of fadama lands by introducing small-scale irrigation in states with fadama development potentials (Yunana et al, 2013). This was the first phase of the project which was subsequently followed by the second phased called Fadama II.

The Fadama I and II projects successfully refined approaches for improved utilization of these lands. Fadama II implemented an innovative local development planning (LDP) tool and building on the success of the community-driven development mechanisms initiated in the first Fadama project. Subsequently, following the successes recorded Fadama II project, the World Bank in conjunction with the Federal government introduced the Fadama III project. Fadama III project supported the financing and implementation of five main components designed to transfer financial and technical resources to the beneficiary groups in: (i) institutional and social development; (ii) physical infrastructure for productive use; (iii) transfer and adoption of technology to expand productivity, improve value-added, and conserve land quality; (iv) support extension and applied research; and (v) provide matching grants to access productive assets for income-generation and livelihood improvements

Fadama III project implementation in Delta State was launched on 3rd November 2009 and was implemented in 20 out of 25 local government areas of the State (Delta SFCO, 2011). The project was meant to end by June 2013. The five local government areas that did not benefit from the implementation of the project in the State were Bomadi, Burutu, Warri south, Warri south west and Udu.

Following the effective performance of Fadama III project in rural development strategy among the participating local government areas the State Employment and Expenditure for Result (SEEFOR), which is an establishment of the Federal government and World Bank, adopted Fadama III Project in Delta State to execute her agricultural sector of rural development strategy.

The State Employment and Expenditure for Result (SEEFOR) is being implemented in four States of Nigeria including Bayelsa, Edo, Delta and Rivers. The project which is funded by both World Bank and European Union emphasizes youth employment, good governance, and public sector capacity building as her foundation strategies in achieving the set goals. The project structure has been designed to strengthen the three pillars of Nigeria country partnership strategy anchored on good governance, maintaining non oil growth and human development. This is critically aligned with the Federal Government job creation and infrastructure development.

In line with its mandate, the FADAMA III/SEEFOR funded project in the five local government areas has been implementing rural development activities among which are provision of rural infrastructural subprojects, provision of improved agricultural technology including seeds, fertilizer etc and providing matching grants to access productive assets for income-generation and livelihood improvements.

The project has established a number of rural infrastructure subprojects in the communities and has also provided large quantities of productive assets to different farming enterprise groups benefiting from the project intervention.

Whether the benefiting project participants are satisfied with the operation, use and maintenance of these rural infrastructural subprojects as well as the productive assets provided by the project remains an issue which should be examined as this will ensure

sustainability anticipated benefits after the intervention period. There is also the need to establish if these rural infrastructural subprojects have any impact in beneficiaries' income. Hence, this study which seeks to:

(i) ascertain productive assets provided by FADAMA III/SEEFOR project to beneficiaries

and the proportion of beneficiaries that are satisfied with operation, maintenance and utilization of the productive assets,

(ii) identify the rural infrastructural subprojects provided by SEEFOR/FADAMA III project and the impact of these subprojects on beneficiaries income.

2. Research Methods

Delta state – the project area was created in 1991 and has 25 local government areas. The State is divided into three agricultural zones of Delta north, Delta south and Delta central. This study is located in the coastal areas of the State covering five local government areas that are riverine. The local government areas are Bomadi, Burutu, Udu, Warri South, and Warri South West. The locations of these local government areas are in the south agricultural zone apart from Udu which is in the central zone. The five local government areas have a combined population of about

Study Population and Sampling Techniques

To analyse the beneficiary satisfaction with FADAMA III/SEEFOR funded infrastructure and assets as well as project impact on income, the sampling frame was divided into two strata; (1) Direct project participants, and (2) Non project participants. The stratification is designed to allow for estimation of the direct effects of FADAMA III/SEEFOR projects by comparing project beneficiaries to similar households in similar communities not included in the project.

The LGAs participating in the SEEEFOR funded Fadama III project are Bomadi, Brutu, Udu, Warri south and Warri-south west. These LGAs did not participate in the earlier Fadama III project carried out in the State between 2009 and 2013 (SFCO, 2011). The five LGAs participating in the project were not randomly selected, implying placement bias (NFCO, 2011). Purposive sampling is common with many government-funded programmes in developing countries (Duflo et al, 2006).

All the participating LGAs were included in the study. Three Fadama Community Associations (FCAs) were selected from each of the five LGAs and this gave 15 FCAs. Eight households belonging to different Fadama User Groups (FUGs) were randomly selected from each of the FCAs to give a total of 120 households. Selection of non project participants involved random selection of 10 households from each LGA and this gave a total of 50 households utilized as the control group. In all, 170 households were selected for this study.

Data Collection and Analysis

Data for this study were collected by well trained enumerators through the use of well structured and pre-tested questionnaire. The data generated were analyzed through the use of Descriptive and Inferential statistical tools. The descriptive tools used were mean, percentages, and tables. A four point Likert-type scale was constructed for each of the questionnaire item to elicit the level of satisfaction or otherwise in the operation, maintenance and utilization of productive assets and rural infrastructures executed by the SEEFOR funded Fadama III project in the area. The four-point likert type scale was designed in the form of: Highly satisfied, Satisfied, Not Satisfied and Highly not satisfied. Weights were assigned responses as follows: Highly unsatisfied = 1, Not Satisfied = 2, Satisfied = 3, Highly satisfied = 4. The responses to an item for each variable were multiplied by the weight attached to obtain response scores.

The Inferential statistical tool adopted to ascertain the increase in income of beneficiaries since the subprojects became functional (i.e. impact analysis of the subprojects on participants income) was the difference in difference estimator commonly called the Double Difference method. This was used to determine the changes in income of the project beneficiary households.

Conceptual and Analytical Framework

Difference in Difference Estimator (Double Difference) Method

The cross-sectional comparisons of project beneficiaries' income with that of the non project beneficiaries cannot completely attribute difference in income to programme intervention. As such this study employed a quasi-experimental method known as Difference in Difference Estimator (Double Difference) method to assess the impact of FADAMA III/SEEFOR funded project on income of beneficiary farmers. This quasi-experimental tool is one of the impact assessment methods which involve the selection of respondents that participated in a program (beneficiaries) and the non-participant (non-beneficiaries) from the same location who have similar observable characteristics (Baker, 2000; Chen et al, 2006; Philip et al, 2009).

The double-difference analytical tool is a quantitative method often used to estimate and compare change in outcome pre and post program for participants and non-participants (Chen et al., 2006). In order to use the estimator in question, there must be information on both participants and non-participants and all individuals must be observed both before and after the program (Verner and Verner, 2006).

Table 1: Socio-Economic Characteristics of Palm Oil Processors and Marketers

Variable	Frequency	Percentages (%)
Gender (Years)		
Male	119	70
Female	51	30
Age		
30 – 39	66	38.82
40 – 49	62	36.47
50 – 59	16	9.41
60 – 69	21	12.35
70 and above	5	2.95
Marital status		
Single	7	4.12
Married	144	84.71
Divorced/Separated	2	1.18
Widows	15	8.82
Widowers	2	1.18
Level of Education		
No formal education	18	10.59
Primary education	56	32.94
Secondary education	51	30.00
Tertiary education	45	26.47
Household Size		
1 – 3	29	17.06
4 – 6	77	45.29
7 – 9	29	17.06
10 and above	35	20.59

The advantage of using the double difference method is that it nets out the effects of additive factors that have fixed (time-invariant) impacts on income indicator, or that reflect common trends affecting project participants and non-participants equally such as changes in prices (Ravallion, 2005). A positive and significant income difference value implied project intervention impact on beneficiary otherwise no impact (Verner and Verner, 2006).

Double Difference Estimation model version was adapted as:

$$DD = \left[\frac{1}{p}\sum_{t-1}^{p}\left(Y_{1ia} - Y_{1ib}\right)\right] - \left[\frac{1}{c}\sum_{j=1}^{c}\left(Y_{0ja} - Y_{0jb}\right)\right]$$

Where:

DD = Income difference between the respondents; P = number of participants; C = number of individual control group (non – participants); Y_{1ia} =Income variable of participants after the programme.; Y_{1ib} = Income variable of participants before the programme; Y_{0ja} = Income variable of non participants after the programme. Y_{0jb} = Income variable of non participants before the programme.

The level of significant of the income difference was tested using paired t-test.

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3. Results and Discussion

Socioeconomic Profiles of the Respondents

The gender distribution shows that 119 respondents representing 70% of the respondents are males while 66 respondents representing 38.82% were aged between 30 and 39 years closely followed by respondents who are aged between 40 and 49 years as they formed more than 36% of the project participants in the study area (Table 1).

Majority of the respondents are married (84.71%) indicating that there is support from spouses in carrying out various agricultural activities. Widows constitute the vulnerable group in the project and they formed 8.82% of the project participants. Over 89% of the respondent project participants attained one form of formal education or the other. This will help them to carry out various enterprise activities smoothly.

While 62.35% of the respondents had a moderate family size of between 1 and 6 members more than 37%% of respondents have family members of 7 to 11 and above. The implication of a large household in the field of agriculture can be viewed from two angles. It can provide a cheap source of labour as it can bring about the use of small amount of hired labour while it can as well negatively affect the family if most of the household members are not of productive age and hence cannot contribute to family labour in farming activities. In such a situation there will be high consumption expenditure on food and this is one of the predisposing factors to poverty among rural farming households in Nigeria (Ike and Uzokwe, 2015).

Analysis of Beneficiaries Satisfaction with Productive Assets

The SEEFOR funded Fadama III project in the five local government areas under study has

provided productive assets to different Fadama User Groups (FUGs). The productive assets were

provided based on the enterprises engaged in by the user groups. Among the enterprises engaged in by the beneficiaries are crop, livestock, agro-processing, fisheries, agro-forestry and vulnerable groups. The various enterprise groups and the productive assets provided to them are presented in Table 2.

Table 1: Socio-Economic Characteristics of Palm Oil Processors and Marketers

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7 – 9	29	17.06
10 and above	35	20.59

Table 2: Productive Assets Provided by SEEFOR/Fadama III Project to Beneficiaries on Enterprise Basis

S/N	Category of Enterprise	Productive Assets Provided
1	**Crop Enterprise**	
	(i) Cassava	Rain boots, Rain coats or Coverall, Cutlasses, Wheel barrows, Boats or wooden canoe, Files, Life jackets, Hoes, Knapsack sprayers, Head pan, Hand gloves, Nose masks, Axe, Sign board, Spade, Shovel, Fertilizer, Agro chemicals, cassava stick bundles
	(ii) Plantain	Life jackets, Sprayers, Cutlasses, Shovels, Wheel barrows, Nose masks, Hoes, Rain boots, Sacks, Axe, Sign post, Wooden canoe, Out board engine, Tricycle, Files, Diggers
2	**Livestock Enterprise**	
	(i) Poultry	Poultry pen, Safety boot, Hand gloves, Wheel barrow, Coverall, Feeders, Drinkers, Nose masks, Shovel, Lamp, Stove, Buckets, yards of Tarpaulin, Borehole with tanks and Tank stands, Generators, De-beaking machine, tricycle
	(ii) Piggery	Safety boots, cutlasses, Hand gloves, Wheel barrow, Iron bucket, Nose mask, Shovel, Head pan, Rake, Generator
3	**Fisheries**	
	(i) Aquaculture	Weighing scale, Plastic basins, Wire gauze, Cutlasses, Wheel barrow, Sucking hose, Sign post, Spades, Iron bucket, ph meter, Coverall, Rain boot, Hand gloves, Pumping machine, Earthen ponds, Tarpaulin ponds, Borehole
	(ii) Artisanal fishing	Drag net, Fishing trap, basket, Raincoat, Fishing spear, Fishing hook, Boat, Engine, Wooden canoe, Paddle, Life jackets
4	**Agro-forestry**	
	(i) Snailry	Wheel barrows, Shovel, Cutlasses, Water engine, Hand gloves, Nose mask, Drinkers, Signboard, Coverall, Head pan, Rain boot,
5	**Agro-processing**	
	(i) Palm oil processing	Processing mill shade, Diesel engine (fly horse power), Drums, Spade, Wheel barrow, Presser
	(ii) Pepper processing	Grinding machines, Hand gloves, Nose masks,
	(iii) Cassava processing	Frying pans, Big plastic basins,

Table 3: Level of Satisfaction with Operation, maintenance and Utilization of Productive Assets

S/N	Category of Enterprise	Mean value of level of satisfaction	Remark
1	**Crop Enterprise**		
	(i) Cassava	2.86	Satisfied
	(ii) Plantain	2.75	Satisfied
2	**Livestock Enterprise**		
	(i) Poultry	2.72	Satisfied
	(ii) Piggery	2.81	Satisfied
3	**Fisheries**		
	(i) Aquaculture	2.67	Satisfied
	(ii) Artisanal fishing	2.83	Satisfied
4	**Agro-forestry**		
	(i) Snailry	1.96	Not Satisfied
5	**Agro-processing**		
	(i) Palm oil processing	2.65	Satisfied
	(ii) Pepper processing	2.01	Not Satisfied
	(iii) Cassava processing	2.15	Not Satisfied

Table 4: Rural Infrastructure Subprojects established

S/N	Rural Infrastructure Subprojects	Community Located	LGA
1	Mini water scheme (Borehole) Generator and Water Reticulation	Okolor Inland	Udu
2	Open market stalls, Toilet, Waste disposal facilities and Generator	Oghior	Udu
3	Market stalls with borehole and toilet	Okpaka	Udu
4	Acquisition of Cargo boat	Deghelle	Warri south west

by SEEFOOR/Fadama III Project in the Study Area

The major reason adduced by respondents engaged in snail rearing for their unsatisfactory observation is that they have not received proper training on management process for snail production. Pepper and cassava processing enterprises are operated by widows. The pepper grinding FUG complained that they are yet to take off many months after the commencement of the project hence their unsatisfactory remarks.

Rural Infrastructural Subprojects established by FADAMA III/SEEFOR Projectral Infrastructural subprojects were established in some of the benefiting communities. These projects were Community Driven Development (CDD) projects in the sense that the communities chose them and participated in their construction. Among the functional subprojects established are Market stalls, Mini water schemes, Toilets and acquisition of cargo boat. The various subprojects as well as the communities and local government areas where they are located are presented in Table 4.

Findings reveal that there has been a significant increase in the number of residents who have accessed the services of projects supported by FADAMA III/SEEFOR in targeted communities. Specifically in Okolor Inland more than 85 households throng the water borehole on daily basis to access clean water for use at homes. In the same vein, residents of Oghior and Okpaka communities all in Udu local government area enjoy the benefits of water schemes and modern small markets constructed in the area. The presence of market-related infrastructure (especially rural access roads) not only reduced delivery costs but also made it easy for traders to reach farmers in rural areas. This invariably will enhance farmers' bargaining power. For example, the non-participants benefit from access roads and markets, water schemes and toilets constructed by the project. Such other rural infrastructures as the acquisition of cargo boat is one infrastructure that is expected to have wider spillover benefits on even non-participating riverine communities.

Rehabilitated rural roads exert positive impact on the waiting time for vehicles, waiting time for tricycles and motorcycles, access to farm land, easy transportation of goods, easy access to market, easy access to community, reduced spoilage of farm produce, reduction in transportation cost, access to social amenities, increase sales and increased patronage.

Impact of SEEFOR/FADAMA III Funded Rural Infrastructure Project on Income

(a) Income Level of Beneficiary and Non Beneficiary Households before the

Establishment of SEEFOR/Fadama III Rural Infrastructure Project

Findings show that over 33% beneficiaries and 30% of non beneficiaries had an income range of between N101,000.00 to N200,000.00 prior to project intervention. The range of income of different beneficiary and non-beneficiary households prior to FADAMA III/SEEFOR project is as shown in Table 5.

Analysis of the data generated indicate that the average per capita income of the sampled FADAMA III/SEEFOR beneficiary households before the project implementation in the local government areas was N174,785.00. Similarly, the non beneficiary sample had an average per capita income of N177,015.00 prior to the establishment of rural infrastructural subprojects in the LGAs.

The findings indicate that over 40% of the sampled households participating in FADAMA III/SEEFOR project have an average income of not more than N50,000.00, while only six respondent households (5.00%) have income level of between N201,000.00 to N300, 000.00. Comparatively, 48 % of the sampled non beneficiaries are within the income range of N50,000.00 while the highest income was between N151,000.00 and N200,000.00..

(b) Income Level of Beneficiary and Non Beneficiary Households after the Establishment of SEEFOR/Fadama III Rural Infrastructure Project

Findings reveal that the average annual income of project participants since the implementation of FADAMA III/SEEFOR project in the five local government areas for all type of respondents enterprises ranged from N141,850.00 to N192,000.00 with an average of N186,306.17 while that of non participants ranged from N131,560.00 to N196,100.00 with an average of N178,662.17 (Table 6). From the foregoing it implies that the average income of project participants have increased from N174,785.00 to N186,306.17 (N11,521.17 or 6.59%) while that of non-participants increased from N177,015.00 to N178,662.17 (N1,647.17 or 0.09%).

Based on the result of the Double- Difference

Table 5: Income Level of Respondent Households before FADAMA III/SEEFOR **Subproject**

	Beneficiaries		Non-Beneficiaries	
Level of Income (N)	**Frequency**	**%**	**Frequency**	**%**
Less than N50,000	49	40.83	24	48.00
N51,000 – N100,000	31	25.83	11	22.00
N101,000 – N150,000	22	18.33	7	14.00
N151,000 – N200,000	16	13.33	8	16.00
N201,000 – N250,000	6	5.00	-	-
N251,000 – N300,000	2	1.67		
Total	**120**	**100.00**	**50**	**100**

Estimation, the increase in income of beneficiaries is attributed to their participation in the FADAMA III/SEEFOR project.

Considering the income of beneficiaries before and after the project (without controlling for other reasons for income to change), more than 30 percent of the beneficiaries increased their incomes by at least 19.05

percent in the first year of SEEFOR/Fadama III operation in the five local government areas. This finding is in tandem with that of Yunana et al (2013) which established that Fadama III project had a positive impact on income and wealth of participants in Federal Capital Territory of Nigeria and also Iwala 2014 who found a positive economic impact of Fadama III small scale community owned infrastructure on beneficiaries in Ondo State.

4. Conclusion

The relevant productive assets provided by FADAMA III/SEEFOR project in the study area has been properly identified and documented. The proportion of project beneficiaries that are satisfied with the operation, maintenance and utilization of productive assets has also been determined. It is established that FADAMA III/SEEFOR project has impacted positively on the income of project participants. Based on the findings the study recommends that the project should entrench proper measures towards ensuring that service providers execute projects to specification as this will improve the interest of the project to beneficiaries.

Table 6: Distribution of Beneficiary Enterprise Groups and Non Beneficiary Groups according to Current Income Level

	SEEFOR/Fadama III Beneficiaries		SEEFOR/ Fadama III non-Beneficiaries	
Enterprise Category (FUG)	**Income Level (₦)**	**Av. Income Level (₦)**	**Income Level (₦)**	**Avg. Income Level (₦)**
Crop Farmers:				
Cassava farmers	157,182.00		154,625.00	
Plantain farmers	148,800.00		144,187.00	
		152,991.00		**149,406.00**
Livestock Farmers:				
Pig farmers	168,960.00		150,564.00	
Poultry farmers	177,663.00		170,050.00	
		173,311.50		**160,307.00**
Agro-forestry:				
Snail farming	141,850.00		131,560.00	
		141,850.00		**131,560.00**
Vulnerable Groups:				
Pepper processing	141,260.00		132,860.00	
Cassava processing	147,109.00		140,100.00	
		144,184.50		**136,480.00**
Agro processing:				
Palm oil processing	168,500.00		150,120.00	
		168,500.00		**150,120.00**
Fisheries: (Artisanal & Aquaculture)	181,000.00	**1 81,000.00**	176,100.00	**176,100.00**
		$\bar{X}$ **=160,306.17**		$\bar{X}$ **=150,662.17**

References

Baker, J. (2000) Evaluating the impact of development projects on poverty: A handbook for practitioners; Directions in Development, World Bank, Washington, D.C

Chen, S; Ren, M; and Martin, R (2006), "Are there lasting impact of aid to poor areas. Evidence from Rural China; Development Research Group, World Bank Policy working paper 4084, December, 12-23.

Delta State Fadama Coordination Office (SFCO) (2011) Brief of Fadama III Implementation in Delta State presented at the State Executive Council Meeting, Oct, 5th

Delta State Fadama III Coordinating Office (2012) Household Income Generation, Progression and Sustainability under Fadama III Implementation in Delta State, Nigeria; Research Report

Duflo, E., R. Glennerster and M. Kremer (2006) Using Randomization in Development Economic Research: A toolkit. Working Paper No. 138. Cambridge, MA: Harvard University, Center for International Development

Ike P. C. and U. N. Uzokwe (2015) Estimation of Poverty among Rural Farming Households in Delta State, Nigeria, Journal of Poverty, Investment and Development; 11: 86 – 93

Iwala, O.S. (2014) Economic Impact, Viability and Sustainability of Fadama III Small-Scale Community-Owned Infrastructure in Ondo State, Nigeria, American Journal of Research Communication, 2 (5): 60 - 70

Oladoja, M.A & Adeokun, O.A (2009) An Appraisal of the National Fadama Development Project (NFDP) in Ogun State, Nigeria, Agricultural Journal, Scientific Research Publishing Company, Volume: 4 (3): 124-129

Phillip, D., E. Nkonya, J. Pender & O.A. Oni (2009) "Constraints to Increasing Agricultural Productivity in Nigeria: A Review" Nigeria Strategy Support Programme (NSSP) Background Paper 6; Washington D.C.: International Food Policy Research Institute

Verner, D. & Verner, M (2006), Economic impacts of professional training in informal sector: The case of the labour force training program in cote d'voire. World Bank Policy Research Working Paper 3668, July :.5-14

Ravallion, M. (2005), Evaluating Anti Poverty Programmes; Policy Research Working Paper No. 3625, Washington D.C. World Bank

Simonyan, J.B & Omolehin, R.A. (2012), Analysis of Impact of Fadama II Project on Beneficiary Farmers Income In Kaduna State: A Double Difference Method Approach, International Journal

of Economics and Management Sciences, 1 (11), : 01-08

Yunana, M. B.; Abubakar, A. S. & Adebayo, F. O. (2014), Analysis of Impact of National Fadama Development Projects on Beneficiaries Income and Wealth in FCT,*Nigeria; Journal of Economics and Sustainable Development*; 4 (17) :11 - 23

Impact Evaluation of Agricultural Infrastructure on Small Holder Farming Production inDelta State, Nigeria

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Abstract

Crop production in Nigeria is dominated by small holder farmers with less than 5 hectares. They make up about 70 percent of the farming population and produce the bulk of the food crops. However, with their immense contributions to the food needs of the country, they are still bedeviled with enormous challenges of inadequate agricultural infrastructures. This study examined the structure of the government agricultural infrastructure and estimated the impact of these infrastructures on the agricultural production of farmers in Delta State. Data were obtained from cross-sectional survey of farmers via the use of a well structured questionnaire. Both descriptive and inferential statistics were used to analyze the data. The analysis of the result on the structure of infrastructure using test of difference in proportion showed agricultural infrastructure has significantly improved the structure of rural social infrastructure. However, they have not improved the structure of agricultural infrastructure in Delta State on the general basis. The infrastructures so far provided have increased lake and pond (aquaculture) fishing, livestock number, improved health, farming techniques, produce evacuation and marketing. The recommendations made include: need to increase in agricultural infrastructural base especially in rural physical and institutional infrastructure, farmers' cooperative groups handling the distribution of agricultural infrastructure, feeder roads supplement with engine boats and articulated agricultural extension programmes. These will be necessary for increased agricultural production and the transformation of rural farmers from socio economic stress..

Key Words: Agriculture, Small Holder Farming, Infrastructure, Transformation, Rural, Poverty, Institutional, Social

1. Introduction

If agriculture, particularly smallholder agriculture is to provide one of the principal routes out of poverty for the next generation of rural men and women, and create the sectoral growth that provides non-farm opportunities for others, it must be productive, profitable and sustainable. There should also be an efficient market system that offers opportunities in terms of demand of products with optimum standards. In addition, it needs to help reduce the vulnerabilities of poor rural people to risks and shocks. Finally, it needs to be able to support the livelihoods of future generations, one that does not deplete, but rather helps to

protect or restore, the natural resource base(International Fund for Agricultural Development, 2011). The agrarian sector has a strong rural base, hence concern for agriculture and rural development become synonymous, with a common root.

The concept of agricultural development is defined as the agrarian, cultural and institutional transformation of the rural areas leading to the acquisition of the capacity and capability, and the willingness to use these, to supply the goods and services needed by the entire population in increasing numbers and diversity occurring in such an area (Oyaide, 1996). Different experts of agricultural development bothered about rural or agrian transformation have offered various definitions on its stimulants (agricultural infrastructures). Two categories of agricultural infrastructure were identified by Ibana(1995); Capital Extension Infrastructures (CEI) and Capital Intensive Infrastructure (CII). Some of the former includes agricultural research, health facilities, educational services, soil conservation, agricultural extension, credit institutions, crops and animal protection and the latter includes such items as; electricity, water development facilities, transport services in the form of roads, railways, bridges, jetties, machine and equipment for processing and storage. Idachaba et al., (1980) classified capital intensive infrastructures into three: Rural Social Infrastructures (RST) like health facilities, education facilities, rural utilities such as water and electricity supply, Rural Physical Infrastructures; (RPI) like transportation, storage processing, soil conservation and irrigation systems and Rural Institutional Infrastructure (RII) which are institutions established to give support to the agricultural sectors such as research, credit, marketing and cooperative institutions. The relevance of these infrastructures to agricultural production cannot be over emphasized.

According to Parson (1966), agricultural development, is a transformation process which involves structural changes of an economy from a small holder base to one that is industrial-urban oriented. While Dittoh and Adegeye (1985) defined agricultural development as the provision of more and better food, improvement in infrastructures such as good feeder roads for the evacuation of farm produce, clean water supply, electricity, provision of schools within easy reach of the rural dwellers which translates to higher standard of living. This is a systematic and conscious approach to utilise the agricultural resources of a nation for the benefit of all citizenry. The relationship between agricultural infrastructures and production is so high and almost complimentary that Eboh (2013) defined agricultural development as an integrated approach to food production with the provision of physical, social and institutional infrastructures which results in improvement in the standard of living of the rural dwellers.

The small holder farmer does not keep markets in mind when planning production. Individual farmer is an island in the agricultural

inputs and outputs markets or exchange system. The opposite of subsistence farming is commercial farming (Alimi, 2012). According to Idode (1999), some of the factors that affected development of small holder farming in Delta State included rural labour shortage, poor prices for famers produce and transportation challenges.

The Delta State government has undertaken various infrastructures in the agricultural sector like motorable roads, education, health care delivery, provision of pipe-borne water, rural electrification, processing and storage facilities credit, input subsidies, extension, capacity building and agribusiness (Delta State Government, 2014). However, the level of rural infrastructure provided and the extent to which these have helped or improved the agricultural production and thus rural emancipation of farmers in Delta State are questions of great concern. It is clear from the above that much works still needs to be done on the structure of the infrastructure in the agricultural sector of the state and the impact of the infrastructure on the agricultural production in Delta State. However, the level of infrastructures provided to any particular community and the degree to which these facilities have positively affected agricultural production thereby reducing the excruciating food crisis in Delta state is worthy of concern. It is on the light of this and recognizing the fact that existing works are inconclusive that this study therefore, sought to answer two questions. Firstly, how are the structures of agricultural infrastructure in Delta State? Secondly, what impact have the agricultural infrastructure made on transforming small holder farmers in the study area?

The objectives of the study were thus to determine the structure of the infrastructure in the agricultural sector of the state among the respondents. Secondly, to estimate the impact of the agricultural infrastructure on the agricultural production in the study area. Based on the objectives, the null hypothesis (H0) that was tested was: Agricultural infrastructure has brought no significant impact on the agricultural production in Delta State.

Literature Review

Agricultural transformation is a process based on significant long-term productivity increase leading to increase in people employed in agriculture and releasing labour to be transformed to other sectors of economy (Timmer, 2009). Transformation looks for an approach that is characterized by greater partnership between federal, state and local government, economic entities, private industry and other community groups. The process of agricultural transformation involves diversification in the agricultural sector to meet changing domestic and trade demands (Eboh, 2013).Transformation of the Nigerian agricultural sector is therefore a necessary instrument if the country is going to achieve increase in domestic agricultural productivity. Agricultural transformation is not only about food but also about the economy. The process of agricultural transformation involves a greater reliance on input and output delivery systems

and increase in integration of agriculture with other sectors of the domestic and international economies (Obayelu and Obayelu, 2012). Agricultural transformation is characterized as a process of sustainable modernizing agriculture and such a process is often measured by significant improvement in land and labour productivity, greater market-orientation and production diversification, as well as increased domestic and international competiveness (Diao, 2010)

Against the difficulty in finding any African country truly meeting up with most of these definitions as agricultural transformed country, Ikpi (1993) in his own opinion looked at agricultural transformation as involving, acceptance and increase use of improved technology, increase in farm sizes, investments in agricultural production and processing (whether it is consumption-oriented, or commercial-oriented) and response to prices that leads to desirable technical change. The process involves a greater reliance on input and output delivery systems and increase in integration of agriculture with other sectors of the domestic and international economics. The onset of the transformation process however does not necessarily require extensive institutional reforms; rather institutional reform should be seen as an endogenous part of the transformation process (Rodrik, 2003).

The vision in the Nigerian Agricultural Transformation Agenda (ATA) and its strategies were to achieve a hunger-free Nigeria through an agricultural sector that drove income growth, accelerated achievement of food and nutritional security, generated employment and transformed Nigeria into a leading global food player. In order to achieve this vision, most agricultural inputs frameworks were reformed for a more efficient service delivery. For example, the fertilizer strategy stimulated a thriving private sector fertilizer industry sequel to inefficiency in the government distribution system and wastage of resources. The small holder farmers also moved from their high poverty level through market oriented/market surplus facilitated by Nigerian Incentive-based Risk Sharing for Agricultural Lending (NIRSAL) into a commercialized system that would facilitated trade and competitiveness. This was achieved through the Growth Enhancement Support (GES) investment that targeted at 20 million farmers (Federal Ministry of Agriculture and Rural Development, 2011).

2. Research methods

The study was conducted in Delta State, Nigeria. It lies within the geographical co-ordinates of 05.00N and 06.50 N (Latitude) and 05.00 E and 06.70E (Longitude). The State is characterized by a tropical climate that ranges from humid to sub-humid at different times of the year, two distinct seasons-rainy: 266.5cm (Coastal areas) and 190.5cm (Northern part) and dry seasons and the average temperature is 300c (1800F). The three distinct vegetations identified in the State are Fresh Swamp along the coast, Mangrove Forest in the middle and Savannah

Vegetations in the North. The major occupations of Delta people outside widespread employment in the civil service are farming, fishing lumbering, hunting and trading. This is informed by the rich soil, fish and forest resources in the areas (DTSG, 2014).

The simple random sampling method was used to select a total number of 150 famers from 10 communities each from : Ughelli North, Ughelli South, Ethiope East, Ethiope West, Sapele, Okpe, Isoko North, Isoko South, Warri North, Warri South, Ndokwa East, Ndokwa West, Ika South, Ika North –East, Aniocha North, Aniocha South, Oshimili, Bomadi and Burutu LGAs of Delta States.

The primary data used in this study were obtained from a cross-sectional survey of farmers in the State via the use of a well structured questionnaire. Data were collected on agricultural infrastructures embarked upon by the government and the general feelings about the infrastructures provided. Educated farmers completed the questionnaires themselves while the illiterate farmers were personally interviewed. For the older and illiterate respondents, the help of local language translators were sought and used. However, in the use of interpreters, the study recognized the possibility of misrepresentation which might tend to vitiate the desired response.

Data collected were analyzed using descriptive statistics such as percentages, frequency counts, Z-test and the t-test. The Z-test (Z) and the t-test (t) are given as:

Z-test to determine the structure of infrastructure provided by the government

$Z = (x-np)/\sqrt{(np(1-p))}$

X = No. of "Yes" count

x1= No. of "No" count

N = Total sample size

n = Sample size

p= Proportion of infrastructure provided

$$Z = \frac{x-np}{\sqrt{np(1-p)}}$$

X = No. of "Yes" count

X^1= No. of "No" count

N = Total sample size

n = Sample size

p= Proportion of infrastructure provided

t-test to determine the impact of agricultural infrastructure provided by the government on agricultural production

$$\mathbf{t} = \overline{x} - u.\,[S\overline{x}.\,\bar{(n)}^{-\frac{1}{2}}]^{-1}$$

$$U = \sum_{i-1}^{n} x\ \bar{x}.(n)^{-1}$$

$$s\overline{x} = [n\sum \overline{x}^2 - (\sum \overline{x})^2.n(n-1)^{-1}]^{\frac{1}{2}}$$

Where

t = Calculated 't' value

$\overline{x}$ = Mean value

$s\overline{x}$ = Sample mean standard deviation

U = Population mean

$[S\overline{x}.\bar{(n)}^{-\frac{1}{2}}$ = Mean standard error

Structure of Infrastructure provided by the Government

The result of the test as presented in Table I showed the structure of infrastructure provided by the Government in Warri South, Ndokwa West, Okpe, Isoko South, Ughelli North, Ughelli South and Ethiope East Local Government Areas. They were rural physical infrastructure(feeder roads, processing equipment and planting materials), rural institutional infrastructure (cooperative group formation, demonstration farms fertilizer centres) and rural social infrastructure(portable water, electricity, clinic, school facilities and markets).

Impact of Infrastructure provided by the Government on Agricultural Production Farm Size

Table 2a showed the result of the test of the impact of infrastructures so far provided by the government on farm size. There was significant change from 0-3 hectares to between 4 and 6 hectares in Warri South and Ughelli South, from 4-6 hectares to between 7 and 11 hectares in Ndokwa West. There was however no change in farm size in Okpe, Isoko West, Ughelli North and Ethiope East Local Government Areas. Analysis of the data on reason for the increase (change) on farm size revealed that the desire to increase farm income accounted for 67 percent improvement on health (16 percent), provision of improved planting materials and breeding stock by the government (26 percent), membership of cooperative society (58 percent) and access road for easy evacuation of produce (80 percent). The decrease on farm size was informed by the scarcity as a result of increasing population and high cost of inputs. They accounted for 42 percent and 51 percent respectively. The result of this analysis showed that infrastructural provision had positive effect on farm size and vice versa.

The test on Table 2b showed a marked change in pond fishing in Okpe, Ndokwa West, Isoko South, and Ethiope East while Warri South, Ughelli North and Ughelli South showed no significant impact on either pond or lake fishing. Analysis of the data revealed that pollution of inland water (99 percent) and high cost of input (51 percent) accounted for the reduction in river fishing and shift to lake and pond fishing. Access roads (80 percent), ready market (39 percent), desires to increase farm income (67percent) led to the improvement in lake and pond (aquaculture) fishing was the reasons for the increase (change). Result of the analysis showed that despite the high cost of inputs and pollution of inland water, provision of fish production stimulants (infrastructures such as road, market desire to increase farm income etc had positively (increased) changed the fishing activity (lake and pond) of fish farmers in the study area.

The test as shown in Table 2c revealed a significant impact of infrastructure on the number of poultry birds managed in the study area. There was no impact on the number of goats, pigs, sheep, rabbits and snails due to local regulations. The analysis of the data showed the reason for the change as the provision of road accounted for 80 percent, while ready market which as a result of the market provision and increase in number of buyers accounted for 39 percent. The major factor was the desire to increase farm income for 67 percent. The major obstacle to improvement noticed was high cost of inputs which accounted for 51 percent. Data analysis indicated that the provision of ready market, processing and storages facilities and access for roads for easy evacuation of produce opened the areas to commerce thereby leading to improvement in livestock production (goats, sheep, poultry, etc). There was every indication that with all the basic inputs (rural physical infrastructures) provided, rural farmers production can be transformed, diversification of enterprise like fishing, livestock and farm size have been enhanced in Delta State by the provision of road, market, storage and processing facilities, etc.

The null hypothesis is accepted that the agricultural infrastructure has not brought any significant impact on the agricultural production in Delta State, However, great efforts have made in the provision of rural social infrastructure by the governmentagricultural infrastructures. They have significantly provided RSI (clinic, electricity, portable water supply, markets and school facilities) in Delta State.

Analysis of the data showed (Table 3) that the infrastructure provided by the government has had great impact and support of farmers' production activity. There was 66.7 percent improvement in produce evacuation, 26.7 percent improvement in health and 20 percent and 13 percent increment in the farm and agricultural production levels respectively in Warri South local Government Area. In Ndokwa West, it has led to improvement in produce evacuation (80 percent), produce marketing (46.7 percent), processing of farm produce (40 percent), while 26.7 percent improvement in procurement of planting materials. 40 percent improvement in health and 33.3 percent each for farm and agricultural production level respectively.Others included Okpe which had 73.3 percent improvement in produce evacuation, 53.3 percent improvement in produce marketing, 13.3 percent improvement in procurement of planting materials, 26.7 percent increment in fertilizer usage, 33.3 percent improvement in health, 60 percent and 53.3 percent increment in any farm and agricultural production levels respectively. While in Isoko South, it had an improvement in produce evacuation (53.3 percent), planting materials procurement (20 percent), fertilizer usage (6.7 percent) and 46.7 percent each for farm and agricultural production levels

Table 1 Structure of Agricultural Infrastructure Provided by the Government

Class of Infrastructure	Warri South	Ndokwa West	Okpe	Isoko South	Ughelli North	Ughelli South	Ethiope East
Rural Physical infrastructure (RPI)		Feeder road, processing equipment, planting materials.	Feeder road	Feeder road	Feeder roads processing equipment	Planting materials	Feeder roads
Rural Institutional Infrastructure (R.I.I)	Cooperative group formation	Cooperative group formation	Cooperative group formation demonstration farm	Cooperative group formation	Demonstration farm, fertilizer centre	Cooperative group formation	
Rural Social infrastructure (R.S.I)	Potable water, electricity, clinic, school facilities.	Potable water, electricity, clinic, school, facilities market.	Potable water, electricity, clinic, school facilities	Potable water, electricity, clinic, school facilities	Potable water, electricity, clinic, school facilities, market	Potable water, electricity, clinic, school facilities, market	Potable water, electricity, clinic, school facilities

Table 2a Impact of Infrastructure on farm size

Farm size (ha)	BEFORE				NOW			
	Number	t_{cal}	t_{tab}	Conclusion	Number	t_{cal}	t_{tab}	Conclusion
WARRI SOUTH								
0-3	3	3.77	2.132	good	1	0.00	2.132	X
4-6	1	0.34	”	X	3	3.65	”	Good
7-10	0	1.37	”	X	1	0.00	”	X
11-14	0	1.37	”	X	0	-1.825	”	X
Over	0	1.37	”	X	0	-1.825	”	X
NDOKWA WEST								
0-3	0	-1.14	2.132	X	0	-1.32	2.132	X
4-6	9	3.98	”	good	1	-0.66	”	X
7-10	1	-0.57	”	X	8	-3.95	”	Good
11-14	0	-1.14	”	X	1	-0.66	”	X
Over14	0	-1.14	”	X	0	-1.32	”	X
OKPE								
0-3	3	0.00	2.132	X	2	-0.93	2.132	X
4-6	6	2.24	”	good	3	-0.27	”	X
7-10	6	2.24	”	good	9	3.73	”	Good
11-14	0	-2.24	”	X	3	-0.27	”	X
Over 14	0	-2.24	”	X	0	-0.27	”	X

Table 2b. Impact on Fishing Site

Farm site/ place		BEFORE				NOW		
LGA	Number	t_{cal}	t_{tab}	Conclusion	Number	t_{cal}	t_{tab}	Conclusion
WARRI SOUTH								
River	10	3.00	2.353	Good	11	2.96	2.353	good
Stream	0	-1.00	’’	X	0	-1.38	’’	X
Lake	0	-1.00	’’	X	2	-0.59	’’	X
Pond	0	-1.00	’’	X	1	-0.99	’’	X
NDOKWA WEST								
River	9	2.93	2.353	Good	2	-0.31	2.353	X
Stream	2	-0.35	’’	X	0	-1.73	’’	X
Lake	0	-1.29	’’	X	3	-0.35	’’	X
Pond	0	-1.29	’’	X	10	2.88	’’	Good
OKPE								
River	9	2.85	2.353	Good	2	-1.11	2.353	X
Stream	3	-0.12	’’	X	0	-2.10	’’	X
Lake	1	-1.11	’’	X	6	0.87	’’	X
Pond	0	-1.61	’’	X	9	2.36	’’	X
ISOKO SOUTH								
River	10	2.99	2.353	Good	0	-2.11	2.353	X
Stream	1	-0.85	’’	X	3	-0.30	’’	X
Lake	0	-1.28	’’	X	3	-0.30	’’	X
Pond	1	-0.85	’’	X	8	2.71	’’	good
UGHELLI NORTH								
River	8	1.73	2.353	X	0	-2.47	2.353	X
Stream	8	1,73	’’	X	8	0.69	’’	X
Lake	1	-1.50	’’	X	5	-0.49	’’	X
Pond	0	-1.96	’’	X	12	2.27	’’	X
UGHELLI SOUTH								
River	9	2.72	2.353	Good	1	-2.64	2.353	X
Stream	4	0.25	’’	X	10	0.88	’’	X

Table 2c: Impact of infrastructure on livestock number

Livestock	BEFORE				NOW			
	Number	t_{cal}	t_{tab}	Conclusion	Number	t_{cal}	t_{tab}	Conclusion
WARRI SOUTH								
Goat	11	0.10	2.353	X	27	0.31	2.353	X
Sheep	9	-1,25	’’	X	0	-0.94	’’	X
Pig	0	-1.25	’’	X	0	-0.94	’’	X
Poultry	50	4.90	’’	Good	95	3.48	’’	good
Rabbit	0	-1.25	’’	X	0	-0.94	’’	X
Snail	0	-1.25	“	X	0	-0.94	“	X
NDOKWA WEST								
Goat	3	-0.74	2.353	X	8	-1.00	2.353	X
Sheep	5	-0.40	’’	X	34	-0.40	’’	X
Pig	0	01.26	’’	X	0	-1.19	’’	X
Poultry	36	4.96	’’	Good	267	4.97	’’	good
Rabbit	0	-1.26	’’	X	0	-1.19	’’	X
Snail	0	-1.26	“	X	0	-1.19	“	X
OKPE								
Goat	8	-0.43	2.353	X	20	-1.19	2.353	X
Sheep	3	-0.97	’’	X	8	-1.19	’’	X
Pig	0	-1.29	’’	X	0	-1.45	’’	X
Poultry	58	4.96	’’	Good	196	4.76	’’	Good
Rabbit	3	-0.97	’’	X	18	-0.88	’’	X
Snail	0	-1.29	“	X	32	-0.43	“	X
ISOKO SOUTH								
Goat	14	0.21	2.353	X	23	-0.75	2.353	X
Sheep	0	-1.27	’’	X	0	-1.06	’’	X
Pig	0	-1.27	’’	X	0	-1.06	’’	X
Poultry	58	4.85	’’	Good	441	4.99	’’	Good
Rabbit	0	-1.27	’’	X	0	-1.06	’’	X
Snail	0	-1.27	“	X	0	-1.06	“	X
UGHELLI NORTH								
Goat	14	2.74	2.353	Good	23	-1.46	2.353	X
Sheep	15	3.11	’’	Good	400	0.78	’’	X
Pig	6	-0.25	’’	X	139	-0.77	’’	X
Poultry	5	-0.62	’’	X	1051	4.64	’’	Good

Table 3. Specific infrastructural impact provided by the government on farm production

Infrastructural Impact	Warri South		Ndokwa West		Okpe		Isoko South		Ughelli North		Ughelli South		Ethiope East	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Easy evacuation of farm production	10	66.7	12	80	11	73.3	8	53.3	18	60	19	63.3	15	50
Ready disposal of produce	✓		7	46.7	8	53.3	✓		10	33.3	18	60	12	40
Storage of farm produce	✓		✓		✓		✓		✓		✓		✓	
Processing of farm produce	✓		6	40	✓		✓		11	36.7	10	33.3	2	6.7
Planting materials procurement	✓		4	26.7	2	13.3	3	20	1	3.3	8	26.7	4	13.3
Increased fertilizer usage	✓		✓		4	26.7	1	6.7	6	20	12	40	5	16.7
Improved health	4	26.7	6	40	5	33.3	✓		1	3.3	2	6.7	16	53.3
Increased farm production level	3	20	5	33.3	9	60	7	46.7	13	43.3	14	46.7	10	33.3
Increased agric. Production level	2	13.3	5	33.3	8	53.3	7	46.7	12	40	14	46.7	6	20

Source: Author's Computation(2014).

respectively.In Ughelli North, 60 percent improvement in produce evacuation, 33.3 percent improvement in produce disposal (marketing), 36.7 percent improvement in produce processing, 3.3 percent planting materials procurement and health, while improvement in fertilizer usage, farm and agricultural production levels had 20 percent, 43.3 percent and 40 percent respectively.

Clearly from the table is the fact that farm production infrastructure had more severe impact in Okpe, Ughelli South, Ethiope East than Warri South, Ndokwa West, Isoko South and Ughelli North Local Government areas.Analysis of the result revealed that infrastructures such as roads, clinic, water, markets, demonstration farms and co-operative society have enhanced the bio-socio-economic life of farmers in Delta State. The reliefs given to crop produce in evacuating the farmers' produce from the village to the urban centres accounted for the high effect of roads in the study area. The desires to increase farm income led to increase in farm size and hence increase in fertilizer usage and farm and agricultural production levels in all the study area. The market provided has aided the famers in easy and ready disposal of produce thereby promoting some robust commercial activities in the study area.

4. Conclusion

It can safely be concluded, based on findings from the study that in spite of the provision of rural social infrastructures in Delta State, the impact of the government agricultural infrastructures on agricultural production in some LGAs has not been significant. There should be prompt actions for the provision of agricultural infrastructure to increase the productivity of the farmers and enhanced their improved standard of living. This study therefore recommend an increase in the agricultural infrastructure especially in the areas of rural physical infrastructures(storage equipment, farm machineries, herbicides and pesticides, fry and fingerlings, fishing boats and nets) and rural institutional infrastructure(fertilizer distribution centres, agricultural advisory services, credit centres (financial aids) to enable them increase their production. Also articulated agricultural extension educational programmes should be implemented upon by the government so as to imbibe in the rural farmers new farming techniques practices, attitude, values and skill so as to increase their productivity.

References

Alimi,T.(2012). Small or large scale agriculture for Nigeria: Issues, challenges and prospects. An Inaugural Lecture delivered at Obafemi Awolowo University. Ile-Ife, Nigeria. 3-4.

Diao, X.(2010). Economic importance of agriculture for sustainable development and poverty reduction. Findings from a case study of Ghana. Paper presented at the global forum on agriculture between 29th –30th November, 2010 on Policies for agricultural development, poverty reduction and food security, Paris.

Dittoh,J.S. & Adegeye, A.J.(1985). *Essentials of Agricultural Economics*. Impact Publishers. Ibadan. 238.

Delta State Government (2014). Delta State Development Performance: agricultural sector report (1991-2014). A UNDP Assessment Report. 9.

Eboh, E.C.(2013). State of the Nigerian Agricultural Transformation Agenda. Agricultural Policy Research Network Newsletter. 4 (1): 3-4.

Federal Ministry of Agriculture and Rural Development (2011). Implementation strategy on the Agricultural Transformation Agenda, Committee Draft Report, Abuja, Nigeria.

Ibana, S.E. (1995). Impact of oil companies on the agricultural infrastructural development in Eket and Iquo-Ibeno Local Government Areas of Akwa –Ibom State. Unpublished Project Report, University of Benin. 14-16.

Idachaba, F.S., Umubese, A.F. Mabawonku and R.O. Adegboye (1980). Rural infrastructures in Nigeria. Mimegraph. Department of Agricultural Economics, University of Ibadan. 2.

Idode, J.B. (1999). Rural Development and Bureaucracy in Nigeria. Longman Publishers, Lagos. 1.

Ikpi,A.(1993). Agricultural Transformation in Africa. Technical Report No 137 edited by R.H. Goldman and S. Block. Prepared for Agricultural Policy Analysis Project, Phase II (APAP 11).

International Fund For Agricultural Development (IFAD)(2011). Rural Poverty Report: New Realities, New Challenges and New Opportunities For Tomorrow's Generation. FAO: Rome : 223.

Obayelu, A.E.& Obayelu, A.O.(2012). Can Nigeria Agricultural Transformation survive in the presence of unavoidable micro and macro environments? Proceedings of 13th Annual National Conference of Nigeria Association of Agricultural Economists held at the Obafemi Awolowo University, Ile- Ife, Nigeria. 25th -27th September, 2012.

Oyaide, W.J.(1996). Indicators of agricultural development. Unpublished Lecture Notes

in AEE 513 (Problems of Agricultural Development).

Parson,K.H.(1966). Institutional aspects of agricultural development policy: *Journal of Farm Economics*. 48(5):1185-1194.

Rodrik, D.(2003). In search of prosperity: Analytical narratives on economic growth. Princeton, N.J., USA. Princeton University Press.

Timmer, C.P.(2009). A World Without Agriculture. The Structural Transformation in historical perspective. Washington D.C. The American Enterprise Institute for Public Policy Research.

Analysis of Fadama III Project's Impact on Productivity of Watermelon Production in Misau Local Government Area, Bauchi State, Nigeria

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Abstract

The study compared the productivity of watermelon production for Fadama III Project support among beneficiaries and non-Beneficiaries in Misau Local Government Area, Bauchi State, Nigeria. A total of 140 watermelon farmers were randomly selected from the study area, consisting of 70 Fadama III project beneficiaries and 70 non-beneficiaries, respectively. Primary data were collected using questionnaires. The data were analyzed using descriptive statistics, farm budgeting and regression analysis. The result reveals that the net farm income earned by beneficiaries (₦79, 972.80/ha) was higher than those of the non-beneficiaries (₦43, 163.96). The returns on naira invested were equally higher for beneficiaries than non-beneficiaries'. Seed input was a significant fertilizer, labour, farm size, agro-chemicals and fuel significantly determined the output of watermelon in the farms. The efficiency ratio for seeds, agro-chemicals, fuel and farm size were utilized below economic optimum level, while labor, fertilizer were used above economic optimum by both beneficiaries and non-beneficiaries, respectively. The main constraints of watermelon production in both farms included pest and disease infestation, inadequate fertilizer, high costs of seeds. inadequate extension services and lack of credit facilities. The study therefore, recommended the provision of more extension agents, provision of fuel at affordable price, provision of credit facilities by the banks at reasonable interest rates, provision of farm inputs at lower prices and provision of permanent fencing materials to restricts domestic animals on free range from encroaching watermelon farms toward facilitating effective watermelon production.

Key Words: Watermelon, Production, Misau, Nigeria

1. Introduction

Nigerian agriculture is a source of livelihood and food security to its teeming population of over 170 million. There are two types of melon that are of economic importance in Nigeria, Watermelon and Egusi watermelon, also called “wildwatermelon,”. Both are grown throughoutNigeria and the Congo for its seeds,which are high in protein

andcarbohydrates. In Nigeria, it oftengrows wild, but it is also farmed as anincreasingly important cash crop. Thewhite, bitter flesh of the egusi is notedible, but the seeds are a staple of localdiet. Egusi is easy to grow in Nigeria'swarm, arid climate (Walleany, 2016). According to Ajewole (2016), watermelon is a warm season crop that is cultivated worldwide because of its numerous nutritional benefits. Itthrives very well in most well drained soils whether clayey or sandy but preferably sandy loams. Although Chinais reported to be the current world largest producer of the commodity (Huh et al., 2008 as cited in Ajewole, 2015)), watermelons aregenerally believed to have originated from Africa.

In Nigeria, as well as other parts of the world, watermelon is highly relished as a fresh fruit owing to its thirst-quenching attribute in addition to many other identified nutritional values and advantages. It is therefore not surprising that the consumption of the commodity in the recent times has witnessed remarkable development as it cuts across allsocio economic classes. Presently, the largest production of the crop in Nigeria still comes from the northern part.

It has however been established that a good crop could also be achieved in other parts of the country.it is surprising that melon production has not been given much regards in research and agricultural policies of Nigeria. Agriculture being the mainstay of the economy of Bauchi state in general and Misau Local Government in particular. With a vast *Fadama*land, no wonder it is among the states/Local Government Areas that benefited from the World Bank Fadama III assisted watermelon production subproject. Despite its uniqueness in irrigation for watermelon production, no or little work has been done on its economics on the beneficiaries and non beneficiaries in the study area. This study therefore, is intended to provide answers to the following research questions :- 1.) Is there any difference between the beneficiaries of Fadama III project and non-beneficiaries on Watermelon production based on the influence of socio-economic characteristics on production in the study area? 2.) Is the resource use efficiency of beneficiaries of Fadama III project better than that of non-beneficiaries on watermelon production in the study area? 3) Is the returns of beneficiaries of Fadama III project better than that of non-beneficiaries on watermelon production in the study area?

Research Objectives

The broad objective of this study therefore, is to compare the productivities of watermelon production, among beneficiaries and non-beneficiaries of Fadama III project.

2. Research Methods

The study area is situated between Latitude 11^{o} 9" N and Longitude 10^{o} 32" E of Greenwich meridian. It has an average altitude of 600m above sea level and temperature is generally high most of the year, ranging

between 27^0C and 33^0C except during the cold and dry months of November to January. The hottest months in the area are April to June. It has Lake Maladumba and various Fadama (flood plain) areas in the LGA that provides suitable land for Fadama (irrigation) production (Abdullahi and Ibrahim, 2008).

The population for the study was watermelon farmers in Misau Local Government Area. Data were collected with the aid of a structured questionnaire that was administered to the farmers. Double stage sampling technique was adopted. First stage involved the random selection of seven villages from each of the two districts of the Local Government (Hardawa and Chiroma Districts). Thus, fourteen (14) villages were selected for the study. The second stage involved the purposive selection of 10 watermelon farmers from each of the selected villages comprising 5 fadama III project beneficiaries and 5 non-beneficiaries to give a total of one hundred and forty (140) farmers.

Relevant primary data were used for the study, collected from the watermelon farmers of Fadama III project beneficiaries and non beneficiaries through questionnaires administration. In Chiroma district, Kukadi, Gundari, Zindi, Ajili, Dutsi, Gainan Fulani and Gainan Hausa were the villages interviewed, while in Hardawa district area, Gwaram, Jarkasa, Sarma, Akuyam, Dabigi, Rigar Makera and Farin Ruwa villages were also interviewed respectively. Information was collected on the socio- economic characteristics of the farmers such as age, education, marital status etc. Also, information was collected on resource use and productivity of watermelon production. Information was also sought on farm size, labor source, capital, crop yield and returns among others.

Descriptive statistics, farm budgeting, cost and returns estimations and production function analysis were adopted for analyzing the data.

Farm budget analysis was adopted to estimate the production cost, revenue and net farm income accruable to the farmers (Adeoye et. al, 2011). The total revenue (TR) is a function of total physical output and price per total unit of product. The total cost (TC) is made up of total fixed cost (TFC) and total variable cost (TVC), that is

$$TC = TFC + TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$NP = TR - TC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, TC = Total Cost, TFC = Total Fixed Cost, TVC = Total Variable Cost; TR = Total Revenue and NP = Net Profit (All values are in Naira) .

Production Function Analysis

The data for this study were analyzed using multiple regression analysis. Three functional forms were estimated which included: linear, semi-log and double-log (Cobb- Douglas). The linear production function (LPF) assumes a linear relationship between input and output as well as constant marginal productivities of resources used.

The LPF is specified as:

$Y = b_o + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + \mu$.....(6)

Semi-log function,

$Y = bo + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + \mu$ ....(7)

Cobb- Douglas function

$\log Y = bo + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + \mu$...(8)

Where , Y =Total output (Kg/Hectare) ; X_1 = Seed (grammes); X_2 = Fertilizer (Kilograms); X_3 = Agro-chemicals (litres); X_4 =Fuel (litres); X_5 =Labour (Mandays); X_6=Farm size (Hectares); $b_1 - b_6$ = Regression coefficient; b = Constant; and μ = stochastic error term.

Efficiency of resource use

Efficiency of the resources used was assessed based on the ratios of the marginal value product (MVP) to the marginal factor cost (MFC).

$$MVP = \frac{\Delta TVP}{\Delta X_1} = MPP.\ P_Y \text{.....(9)}$$

$$MFC = \frac{\Delta TC}{\Delta X_1} = P_{X1} \text{..... ..(10)}$$

$r = MVP/MFC = 1$.....(11)

Where; r = Efficiency of resource use; MVP = Marginal Value Product of the Resource Input; MFC = Marginal Factor Cost of the Resource Input ; MPP = Marginal physical product of the resources; ΔTVP = Change in total value product; ΔTC = Change in total factor cost; ΔX_1 = Unit change in the variable input quantity; PX_1 = Input price per unit; PY = Output price per unit (Okon, 2005).

3. Results and Discussions

Analysis of Production Costs and Returns for Watermelon Production

Table 1 shows production costs and returns of watermelon in the study area. The table depicted that N108, 511.50 and N85, 246. 30 representing 80.98% and 83.24% of the total cost(s) for beneficiaries and non beneficiaries of fadama III project support was spent on variable cost items/ha and the remaining N25, 493.20 and N17, 163.20 representing 19.02% and 16.76% of the total cost(s) for both groups was spent on fixed cost items/ha. This implies that variable cost was the most important cost items in watermelon production in the study area compares to the fixed cost items. Among, the variable cost items, N37, 011.70 and N33, 190.30 representing 27.62% and 32.41% of the total cost(s) for both categories of farmers was spent on labour/ha. This means that labour was the most important variable cost item in watermelon production. Maikasuwa *et a,l* (2009) obtained up to 63.28% and 72.27% of the total cost spent on labour/ha in pepper production by the Fadama participating and non-participating households, respectively. Similarly, Abubakar *et al,* (2009) realized that

72% of the total cost of onion production was spent on labour. The table revealed further that an average of N79, 972.80/ha and N43, 163.96/ha representing 59.68% and 42.15% of the total cost(s) incurred in the production of watermelon was realized as net profit/ha by the beneficiaries and non-beneficiaries of Fadama III project support, respectively.

Further analysis on the return on investment showed that watermelon has a profitability index of 0.60 and 0.42 indicating that the beneficiaries and non-beneficiaries earns 0.60 and 0.43 respectively, on every naira invested into production. This is in line with the findings of David *et al,* (2009) on a study of Fadama food crop farmers in Bauchi state revealed a return on naira invested of 3.14 naira. This means that watermelon production in the study area was profitable.

The coefficient of multiple determinations (R^2) is 0.64 for fadama III project beneficiaries and 0.60 for non – beneficiaries which implies that 64% and 60% of the variation in the output of watermelon for beneficiaries and non – beneficiaries, respectively was accounted for by the variable inputs in the model. This indicates that an increase in each of the variables considered will result to an increase in the output of watermelon for the two categories' of the farmers. This shows how positive and high degree of association between the independent and dependent (output) variable. The remaining proportion (36 % and 40%) may be due to variation in the production techniques and other factors not included in the models (error or random disturbances). This was further confirmed by joint explanatory power of the input by the F-ratio results of the groups respectively (Table 2).

The positive coefficient for beneficiaries and non-beneficiaries indicated that an increase in one percent of those variables solely or in combination will lead to increase in the output by the corresponding percentage holding other variables constant. The negative coefficient implies that a decrease in any of the variables holding others constant will lead to decrease in yield of watermelon. The result of the regression analysis of linear revealed that seeds, fertilizer, labour, agro-chemicals and farm size were significant resources for beneficiaries and seeds, fertilizer, labour, fuel and farm size are the resources significant for non-beneficiaries in watermelon production respectively.

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Table 1: Costs and Returns for Beneficiaries and Non – Beneficiaries of Fadama III support on Watermelon Production (N/ha)

Cost of Items (Input)	*Beneficiaries*		*Non- Beneficiaries*		*Total (All Farmers)*	
A. *Revenue*	Amount ₦/ha	%	Amount ₦/ha	%	Amount ₦/ha	%
Value of watermelon (Total Revenue)	213,977.50	100	145,572.46	100	359,549.96	100
B. *Variable cost*						
Seed	8,099.30	7.46	6,502.20	7.63	14,601.50	7.5
Fertilizer	27,980.40	25.79	23,480.70	27.54	51,461.10	26.6
Agro-chemicals	9,710.90	8.95	6,969.10	8.18	16,680.00	8.6
Implements and Equips hired	7,306.30	6.73	1,741.40	2.04	9,047.70	4.7
Fuel	18,402.90	16.96	13,362.60	15.68	31,765.50	16.4
Labour cost	37,011.70	34.11	33,190.30	38.93	70,202.00	36.2
Total variable cost	108,511.50	100	85,246.30	100	193,757.80	100
C*. Fixed cost*						
Rent on land	10,000.00	39.23	7,000.00	40.78	17,000.00	39.9
Depreciation of implements and equip.	15,493.20	60.77	10,163.20	59.22	25,656.40	60.1
Total fixed cost	25,493.20	100	17,163.20	100	42,656.40	100
Total cost (TC)	134,004.20		102,408.50		236,412.70	
D. *Indicators of financial success*						
Net farm income/ha	79,972.80		43,163.96		123,136.76	
Return per Naira invested	0.60		0.42		1.02	
Operating Ratio (OR)	0.51		0.59		1.1	
Fixed Ratio (FR)	0.12		0.12		0.24	
Gross Ratio (GR)	0.63		0.70		1.33	

***Source**: Field survey data 2012/2013* *N= Nigerian Naira ($1=N165)*

Production Function Estimates of Watermelon Production

The coefficient of multiple determinations (R2) is 0.64 for fadama III project beneficiaries and 0.60 for non – beneficiaries which implies that 64% and 60% of the variation in the output of watermelon for beneficiaries and non – beneficiaries, respectively was accounted for by the variable inputs in the model. This indicates that an increase in each of the variables considered will result to an increase in the output of watermelon for the two categories' of the farmers. This shows how positive and high degree of association between the independent and dependent (output) variable. The remaining proportion (36 % and 40%) may be due to variation in the production techniques and other factors not included in the models (error or random disturbances). This was further confirmed by joint explanatory power of the input by the F-ratio results of the groups respectively (Table 2).

The positive coefficient for beneficiaries and non-beneficiaries indicated that an increase in one percent of those variables solely or in combination will lead to increase in the output by the corresponding percentage holding other variables constant. The negative coefficient implies that a decrease in any of the variables holding others constant will lead to decrease in yield of watermelon farmers. The result of the regression analysis of linear revealed that seeds, fertilizer, labour, agro-chemicals and farm size are significant resources for beneficiaries and seeds, fertilizer, labour, fuel and farm size are the resources significant for non-beneficiaries in watermelon production respectively.

Results indicated that for seeds inputs the estimated slope coefficient was 7.916 ($p<0.001$) implying that for every unit increase in seed applied, holding other inputs constant output of watermelon increased by 7.916 units, and for agro-chemicals whose coefficient was 5.336 ($p<0.05$) every unit increase in agro-chemicals input use, holding other inputs constant, increased watermelon yield by 5.336 units. For fertilizer the estimated coefficient of 3.527 ($p<0.01$) implied that, for every unit increase in fertilizer input, holding other inputs constant, an increase in watermelon output was recorded by 3.527 percent. For the non-beneficiaries, the slope coefficient of seeds and fuel were 5.189 and of 4.387 ($p<0.05$) implying that, a unit increase in seed and fuel holding other inputs constant increased watermelon yield by 5.189 and of 4.387 percentages respectively. The above result is in line with a study carried out by David et.al. (2009) which revealed that labour, and farm size had significant positive effects on National Fadama development projects' beneficiaries and non – beneficiaries outputs.

Table 2: Relationship between Output of watermelon and production inputs for the Farmers

Variables	***Beneficiaries***		***Non-Beneficiaries***	
	Coefficient	*t– Value*	*Coefficient*	*t – Value*
Constant	10531.20	0.043	40897.17	1.728
Seeds X_1	7.916	3.034***	5.189	2.156*^
Fertilizer X_2	3.527	4.237***	3.534	3.938***
Agro-chemicals X_3	5.336	2.412**	4.809	1.664
Fuel X_4	1.497	1.030 4.387	2.440**	
Labour X_5	2.103	3.438***	3.623	5.499***
Farm size X_6	68541.00	3.974***	80538	4.442***
R^2	64%		60%	
F – Value	112.274***		4.550***	

Source: - Field Survey Data, 2012/2013

* = Significant at 5% % level of probability . ** = Significant at 10% level of probability

*** = Significant at 1% level of probability

Resource Use Efficiency of Beneficiaries and Non-Beneficiaries

Table 3 shows the estimated resources use efficiency in watermelon production for beneficiaries and non-beneficiaries farmers. For the beneficiaries the MVP of seeds was N26.42, agro-chemicals has N22.03, fuel has N11.63 and farm size had N87.30. These were higher than MFC of seeds of N21.74, agro-chemicals had N15.94, fuel had N7.50 and farm size had N77.92. respectively. The non-beneficiaries farmer's MVP of seeds (N22.39), agro-chemicals (N20.89), fuel (N10.89) and farm size (N150.87) were also higher than MFC of seeds(N21.74), agro-chemicals (N16.18), fuel (N7.50) and farm size (N50.40) respectively. Thus, the variable inputs were being used below economic optimum level. Hence farmers should increase their profit by increasing the use of their variable inputs. Fertilizer and labour having the MVP of N6.20 and N4.39 which were less than the MFC of N86.97 and N12.70 implying that there was over utilization of these variable inputs. For farmers to make more profit there is the need to decrease the quantity of these inputs in their production.

It woud be seen from Table 3 that there was under utilization of seeds, agro-chemicals, fuel and farm size by beneficiaries and non - beneficiaries, while fertilizer and labour were utilized above economic optimum level by the beneficiaries and non-beneficiaries respectively. Similar cases of under-utilization of seeds and agro- chemicals and over-utilization of labour was reported by Nwakpu (2008) and Iheke et al (2008). The results further agreed with the findings of Eze et al (2010) which indicated that arable crop farmers over-utilized the resources of labour

Table 3: Resource use efficiency of production inputs for watermelon

Inputs	Beneficiaries			Non-Beneficiaries		
	Marginal Value Product (N)	Marginal Factor Cost (N)	MVP/ MFC	Marginal Value Product (N)	Marginal Factor Cost (N)	MVP/ MFC
Seeds X_1 (gm.)	26.42	21.74	1.21	22.39	21.74	1.03
Fertilizer X_2 (Kg.)	7.65	88.24	0.09	6.20	86.97	0.07
Agro-chemicals X_3 (lit)	22.03	15.94	1.38	20.89	16.18	1.29
Fuel X_4 (Lit)	11.63	7.50	1.5	10.89	7.5	1.45
Labour X_5 (Man days)	5.78	11.59	0.5	4.39	12.70	0.35
Farm size X_6 (Ha)	87.30	77.92	1.12	150.87	50.40	2.99

Source: - Field Survey Data, 2012/2013

and fertilizer in Imo state, Nigeria.This result suggests that there exists the possibility of increasing output under the existing level of operation through the use of lower levels of labour and fertilizer. It is revealing from the table that some resources were considered under - utilized by the watermelon farmers. The resource under -utilization established may not be unconnected with poor capital base of farmers in Nigeria. In order to increase the level of resource use by the watermelon farmers, however, there is the need not only to extend farm credit and subsidize the cost of farm inputs such as seeds, chemical and fuel to the farmers, but they should also be allowed to have increased access to farm land to enable them expand the scope of their farm sizes. Doing this would allow watermelon output to be increased in the area and the country in general, at the same time, enhancing the income generating capacity of the watermelon farmers. This shall go a long way to bringing about increase in the standard of living of both beneficiaries and non - beneficiaries engaged in watermelon production, hence improve their economic and health status.

Conclusion

The study observed that most of the watermelon farmers who benefitted from Faama III project in the state realized more profit than non-beneficiaries by about 50%. The research revealed that seeds, agro-chemicals and fuel inputs were utilized by both group below economic optimum level thus increasing seeds, chemical and fuel would leads to an increase in profit of *Fadama* III project beneficiaries and non beneficiaries, respectively. While labour, fertilizer and cost of hiring implements were used by both categories of farmers above economic optimum, hence decreasing the use of these inputs will improve the profit of the Fadama III project beneficiaries and non beneficiaries, respectively. Similarly, all the resources used in watermelon production by both fadama III project beneficiaries and non beneficiaries, have positive marginal value product (MVP)

however, they were inefficiently utilized. Based on the foregoing findings from the research, the study recommends the provision of more extension agents to educate famers effectively on modern production techniques, pest and disease control measures and proper farm records keeping; provision of credit facilities at reduced interest rate to enable farmers secure loan easily to augment their capital; making available inputs like seeds, agro-chemicals and fertilizer at affordable prices for the farmers and finally, the farmers should provide permanent farm fencing materials to reduce the menace of domestic animals that graze freely at watermelon production sites.

References

Abdullahi, M.B. and Ibrahim, D.B. (2008). Local People knowledge and Attitudes Towards Maladumba Lake and Forest Reserve, Misau, Bauchi State, Nigeria. *International Journal of Environmental Science*42: 36 – 44

Abubakar, I. R., U. B. Kyiogwom and M. A. Maikasuwa (2009).Impact Assessment of Small-Scale Irrigation Scheme on Resource Productivity in Onion Production: A case study of National Fadama Development Programme in Zamfara State, Nigeria. In: I. Mohammed, U. B. Kyiogwom, W.A. Hassan, A.L. Ala, A. Singh and S. D. Dogondaji (eds).Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigerian Held at Usman Danfodiyo University Sokoto, Sokoto State, Nigeria, on 14th – 17th Dec.2009. P.348

Adeoye, I. B., Olajide-Taiwo, F. B, Adebisi-Adelani, O., Usman, J. M.and Badmus, M. A. (2011). Economic Analysis of Watermelon based Production system in Oyo State, Nigeria, *ARPN Journal of Agricultural and Biological Science;* **6** (7): 53 - 59

Ajewole, O. C. (2015) Income and Factor Analysis of Watermelon Production in Ekiti State, Nigeria. Journal of Economics and Sustainable Development. 6(2). 67-72

David, H.D., S. Abdurrahman, R.M Sani, S. Kushwaha, and M. Nasiru. (2009). "Resource Use Efficiency in Irrigated Crop Production by Fadama Users In Bauchi State, Nigeria: Implication For Food Security And Poverty Alleviation." In *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, FAMAN.

Eze, C.C, Amanze, B., Nwanko, O. (2010).Resource Use Efficiency in Arable Crop Production among Smallholder Farmers in Owerri Agricultural Zone of Imo State,Nigeria.http://www.sciencepub.net/researcher; 2(5):14-20

Iheke, O.R, Obasi, O.I. and Nwankwo, J.C. (2008): Socio-economic Determinants and Allocative Efficiency of Arable Crop Farmers in Ikwuano Local Government Area of Abia State, Nigeria. Proceedings of the 42nd Annual Conference of the Agricultural Society of Nigeria (ASN), (eds) 809 812.

Maikasuwa, M. A., Abubakar, I. R., and Kyiogwom, U. B. (2009). An Assessment of the Effect of the National Fadama Development Programme on Resource-use in Pepper production in Zamfara State, Nigeria. *Journal of Agriculture and Environment.* 5(1&2): 17-25

Nwakpu, C.C. (2008). Factor productivity and resource-use efficiency of some recommended rice technology in Ebonyi State Nigeria. Proceedings of the 42nd Annual Conference of the

Agricultural Society of Nigeria (ASN), (eds) 798 - 803.

Okon, E. T. (2005). Comparative Analysis of Large and Small Scale Farmers Resource Use Efficiency in Food Crop Production in Akwa-Ibom State, Nigeria. *Journal of Agriculture andFood Science.* ; 3 (1): 75-84.

Olayemi, J. K. *Elements of Applied Econometrics*. (1998); Elshaddai Globalventures Ltd, Ibadan, Nigeria

Walleany (2016) Growing melon vegetable crop (egusi) in Ngeria. Accessed on 2/08/2016 from https://waleanny.wordpress.com/growing-melon-vegetable-crop-egusi-in-nigeria/

Climate Change and Agricultural Production in Nigeria: A Review of Status, Causes and Consequences

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Abstract

The paper reviewed the causes, consequences and impacts of climate change in the Nigerian agricultural sector. The paper found out that, notwithstanding the existence of modern agricultural technologies, climate change which occurs with different weather varieties hamper productivity levels of both crops and animals in recent time in the country. Although there are information about the negative impacts of climate change in the country, much of these information are not on the doorsteps of the rural agricultural producers due to minimal existence of adequate trained change agents. As Nigeria is currently experiencing increasing incidence of disease, declining agricultural productivity, increasing number of heat waves, unreliable weather patterns, declining rainfall in already desert-prone areas, these gave ways to paradigm shift in the agricultural sector especially in the rural communities. Due to these increases there is decline in production of agricultural produce/products which is consequence of climate change. This paper recommends among other things that there is need for a systematic collaborative approach involving all the stakeholders - science experts and researchers, governments at all levels, policy makers, farmers associations, youths and women groups, private sectors: non-governmental and civil society organizations to work together in turning the critical challenges posed by climate change into opportunity/opportunities.

Keywords: Climate change, agricultural production, causes, adaptation

1. Introduction

In spite of technological approaches and development such as use of inorganic fertilizers, modern land preparation and planting of early season crops, mechanization in farming, agrochemicals, improved seed varieties, expansion of irrigation systems, genetically modified organism, among others, weather is still a key factor in carrying out agricultural productions.

Weather is the short term state of the atmosphere at a specific time and place in terms of precipitation, temperature, wind, humidity, etc. The long term manifestation of weather and other atmospheric conditions in a

given area is called climate, and it is the main focus as it has to do with long term evidence or signs.

Climate is the general weather conditions in an area over a long period. Ngigi (2009) defined climate change as a change in climate that is attributable directly or indirectly to human activities, that alters the atmospheric composition of the earth which leads to global warming. Intergovernmental Panel on Climate Change (IPCC) in (2007) said climate change is a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period typically decades longer.

Climate change can be said to be changes in the earth's climate especially those produced by global warming. Climate change is considered as the most pressing environmental problem facing the globe today, affecting patterns of life and general living conditions.

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods (that may range from decides to millions of years). It is usually caused by factors such as: biotic processes (such as humans, animals, etc), variations in solar radiations received by earth, volcanic eruptions etc. Climate change has repercussions such as upsetting seasonal cycles, harming ecosystems and water supply, affecting agricultural farming systems and food production, causing sea-levels to rise etc.

The survival of agriculture is dependent on climate, and the two are inter-related because they both take place globally as recorded by Adejuwon, (2006). Nigeria is experiencing adverse climate conditions with negative impacts on the welfare of millions of people. Climate fluctuation is putting Nigeria's agricultural system under serious threat and stress, and Nigeria's agriculture is mostly rain-fed, therefore changes in climate affects productivity. In Nigeria, varieties of food crops are produced and are all dependent on rainfall, so that where rainfall is abundant, rain-fed crops are planted and in drier parts of the country, crops that do not require much rainfall are planted.

Flooding, droughts, erosion, off season rains, etc have sent growing season out of the way of a country that is dependent on rain fed agriculture. Climate change has resulted to lakes drying up and reduction in river flow in some regions, resulting in fewer water supplies for use in agricultural production (Ozor, 2009). The agricultural sector contributes some percentage in the Nigerian gross domestic product (GDP). Climate change effects on agricultural production thereby reduce the percentage of agriculture in the GDP of Nigeria. The threat of climate change on agricultural production affects every area of the agricultural sector. The sector has a great effect on Nigeria's economy as reported by

Odekunle, (2014). Given the impacts of climate change in agriculture, its study is important, because the livelihood patterns of millions of people is dependent on agriculture and it is on record that agriculture is the mainstay of the Nigerian economy.

Objectives of the Research

The broad objective of this research is to examine the effect of climate change on agricultural production in Nigeria.

The specific objectives include to;

i. identify the causes and effects of climate change on agriculturists in Nigeria,
ii. examine effects of climate change on agriculture especially on crop production,
iii. examine impacts of climate change on animals; and finally, identify climate change adaptation problems in the country.

2. Research Methods

The study focused on Nigerian agricultural productivity in the context of the effect of climate change on agricultural production as a whole. This is because of the size and population of Nigeria as well as her position as the largest and most populous country in Africa. Added to these is because agriculture is the mainstay of the national economy. The study relies heavily on published and unpublished information from various sources especially that concerning agricultural sector and climate change causes and consequences. Other sources of information about different predicaments of climate change effects were also explored. These include internet sources, grey literature and published opinions of experts. Meanwhile, other key documents consulted included materials produced, case studies, recent research reports including annexes and internal learning documents from development partners including the Intergovernmental Panel on Climate Change(IPCC). African Technology Policy Studies Network (ATPS), The MDG Centre for East and Southern Africa as well as universities where relevant information about the subject matter can be found among other agencies that are involve in climate change activities.

3. Results and Discussion

Causes of Climate Change

According to Botkin and Keller (2010), the phenomenon of climate change is linked to both natural and human causes' i.e. natural events and human activities are believed to contribute to the increasing climate change. Primarily, climate change is caused by increase in green house gases and even changes in ocean currents among others. Due to nature of science, not every single detail is ever totally certain and not all questions are yet to be answered. Below, are some of the causes of climate change and they include:-

i. Changes in the earth's orbit: Changes in the shape of the earth's orbit (or eccentricity) as well as the earth's tilt

and precession affects the amount of sunlight received on the earth's surface.

ii. Changes in the sun's intensity: changes occurring within or inside the sun can affect the intensity of sunlight that reaches the earth's surface. The intensity of the sunlight can cause either warming (for stronger solar intensity) or cooling (for weaker solar intensity).

iii. Volcanic eruption: Volcanoes can affect the climate because they can emit aerosols and carbon dioxide into the atmosphere.

- Aerosol emissions: volcanic aerosols tend to block sunlight and contribute to short term cooling. They do not produce long term changes because they leave the atmosphere not long after they are emitted.
- Carbon oxide emission: Volcanoes also emit carbon dioxide (CO_2), a green house gas which has a warming effect. The level of carbon dioxide (CO_2) has risen since the last past millions of years.

The human factors that emit large amounts of green house gases includes: industrialization, burning of fossil fuel, gas flaring, urbanization, changes in global patterns of land use and agriculture. Furthermore, human activities that reduce the amount of carbon sinks as reported by (IPCC, 2007, and Nzeh, 2008) are deforestation, alterations in land use, water pollution and agricultural practices. These human activities have been proven to contribute to the ongoing climate change in Nigeria.

Effects of Climate Change on Population of Agriculturists

Majority of the rural population in Nigeria survive through the production of agricultural products. Drying up of lakes, streams etc affect fishing. Also crops that are dependent on rainfall are affected. The dominant role of climate change is so obvious that even minor climate deteriorations causes or leads to devastating consequences especially in developing country like Nigeria. Climate change is a big threat to Nigerian food security, affecting both subsistence and commercial farming. Climate change causes an increase of diseases and pests, thereby declining agricultural production. Declining rainfall in northern areas of Nigeria is causing increasing desertification. The former food basket of the nation is now empty and people in the coastal areas who used to depend on fishing have their livelihoods destroyed by the climatic changes. As reported by Ikpi (2010), the increasing effects of climate change in agricultural production have led to the migration of people from rural areas to urban areas. This is so because, people who used to depend on agricultural production have been disappointed and so they have to look for better jobs or means to survive.

According to Nzeh and Eboh (2011); Aphunu and Nwabeze, (2012), in 1999 and 2000, more than 200,000 people were displaced by floods in Niger Delta. Meanwhile, in different parts of the country so many people have been killed by floods in several states especially in the Northern Nigeria where unusually heavy rains have swollen rivers and streams across the region. Agriculture remains the main source of livelihood for most rural dwellers in Nigeria.

Effects of Climate Change on Agriculture

In the recent time, literature stated that there are so many implications of climate change on agriculture. Climate change increases the frequency and severity of floods and droughts. It causes drastic changes in rainfall patterns with rising temperatures which introduces unfavourable growing conditions; it modifies growing seasons which could subsequently reduce productivity. Climate is the primary determinant of agricultural productivity. As reported by Ikeme (2009), Nigeria is currently experiencing increasing incidence of disease, declining agricultural productivity, increasing number of heat waves, unreliable weather patterns, declining rainfall in already desert-prone areas, in the north causing increasing desertification decreasing food production in central regions and destruction of livelihoods by rising water in coastal areas where people depend on fishing and farming.

Climate change may change the types, frequencies and intensities of various crops and livestock pests, also the availability and timing of irrigation water supplies and the severity of soil erosion, Challinor and Wheeler (2008). Livestock's are also affected by climate change. They can be affected in two ways: the quality and amount of forage from grasslands. The qualities of grasses are affected by higher temperatures, which may lead to drying up of grasses, thereby reducing the nutritional values of livestock feeds.

Climate Change and Its Effects on Crop Production

There are different approaches for studying the implications of climate changes on agriculture; one of them is the crop yield analysis. Crop yield analysis estimates the effects of altered environments on crop productivity levels. Parry (2007) argues that the effects of carbon dioxide (CO_2) enrichment, without associated changes in climate would probably be beneficial to agriculture. High temperatures increase the rate of microbial decomposition of organic matter, thereby affecting adversely soil fertility in the long run. Increase in temperature also has effects on pests and diseases, increasing their chances of survival, thereby affecting crops which in turn affect productions.

An analysis of the biophysical impact of climate changes associated with global warming shows that higher temperatures generally hastens plant maturity in annual species, thus shortening growth stages of crop plants. It has also been reported by IPCC Intergovernmental Panel on Climate Change

(2007) that increase in uv-B radiation reduces yield in certain agricultural crops.

Climate change affects planting and harvesting periods. Due to this, there are occasional shifting seasonal rainfall patterns and severe precipitation events and flooding, delay planting and harvesting of plants. Climate change has effects on soil water balance which leads to changes of soil evaporation and plant transpiration; consequently the crop growth period may shorten in the future, causing crops yields to decrease. Climate change also decreases the crop rotation period, so farmers' needs to consider crop varieties sowing dates, fertilization levels when planting crops. Food quality is affected because of the increasing temperatures and decreasing crop growth periods. Changes in temperatures and precipitation patterns may lead to change in the length of growing seasons or the rates of photosynthesis by plants (Rosenzweig and Hillel, 1995), such changes could lead to decrease in crop yield. Increase in rainfall in some parts can lead to higher rates of soil erosion, leaching of agricultural chemicals.

Climate Change Impacts on Animals

There have been some notable and significant impacts of climate changes on livestock production. There are two types of effects which are; Direct and Indirect effect.

1. Direct effect is the constant exposure of animals to high temperatures, which causes reduction in growth and productivity, decline in feed intake, weight loss, etc. For instance, when cattle are under heat stress, they are subjected to the following conditions:
   - Reduced grazing time (because animals may be seeking shade).
   - Reduced feed intake

   In dairy cows, heat stress reduces the amount of milk produced, reduces milk fat and protein content and decreases reproduction rate.

   For chicken and pigs they are susceptible to heat stress in so many area such as:-
   - Reduced feed intake
   - Reduced laying performance in chicken
   - Decreased fertility and activity level
   - Increased mortality

   The effect of high humidity on animals depends on air temperature, area of evaporating surface, available water in the body and air movement. In Nigeria, animals with black skin are affected by solar radiation causing sun burn and skin cancer. Animals with white and glossy skins are less affected by solar radiation than those with dark coarse hair coat or skin.
2. Indirect effects:The quantity and quality of forage available to the animals is determined by climate. In high rainfall areas, plants grow faster. In arid regions or areas, lack of rainfall limits plant growth. High temperature and humidity provides a favorable breeding environment for external and internal parasites, fungi and bacteria.

3. Rising ocean temperatures and ocean acidification as a result of climate change in the country are radically altering aquatic ecosystems as reported by Nzeh and Eboh, (2011). There has been modification in fish distribution and the productivity of marine and freshwater species as affected by climate change. The rising ocean acidity makes it more difficult for marine organisms such as shrimps, oysters etc to form their Shells (a process known as calcification). As a result of this, the distribution productivity and species composition of global fish production is changing, making livelihood difficult for communities that depend on fisheries. The effect of sea level rise means that coastal fishing communities are in the front line of climate change, while changing rainfall patterns and water use impact on inland (freshwater) fisheries and aquaculture, Hale and Keller, (2008).

Climate Change Adaptation Problems

Numerous and various conditions will dictate the extent of adaptation. Climate change adaptation aims at mitigating and developing appropriate coping measures to address the negative impacts of climate change on agriculture. An important limitation to the effective adoption of climate change information in Nigeria's agricultural sector is the lack of a comprehensive baseline. Given the different interests, risk and resources faced by various stakeholders in agriculture, there is likely to be an extensive typology of adaptive responses that may be appropriate for different agricultural zones. The different types of farming systems, tenure system, access to financial resources, level of skills, extent of support (i.e. from extension agents) etc also can affect adaptations to climate change.

Climate change adaptation is increasing on the agenda of researchers, policy makers and program developers who are aware that climate change is real and threatens to undermine social and ecological sustainability.

4. Conclusion

It has been shown by most farmers (mostly in the urban areas) that their awareness on weather patterns are changing as manifested in increasing flooding and changes in rainfall patterns. Others are on increase in temperature, high incidence of pests, diseases and weeds and even decrease in crop yields among other incidence. Meanwhile, their understanding of the concept of global climate change with regard to green house emissions, ozone layer depletion etc is still limited. It is therefore necessary that they have full knowledge of what climate change really is as it is perhaps the most serious threat to the fight against hunger, malnutrition, diseases and poverty in especially in Nigeria where its negative effects on agricultural production lead to more increase in the poverty level of the farmers at both urban and rural areas. It is therefore necessary for us to understand the knowledge of climate change and the best way

to adapt to climate change depending on agricultural zones.This review found out that the major challenges of Nigerian farmers include lack of climate change information and extension services, poor infrastructural development, lack/high cost of factors of production and even capital. It is therefore necessary that there should be an increase in the awareness level of farmers and general public in all these critical farming predicaments especially on climate change issues by the extension agents and different research institutions. There is also need for a systematic collaborative approach involving all the stakeholders such as science experts and researchers, governments at all levels, policy makers, farmers associations, youths and women groups, private sectors: non-governmental and civil society organizations to work together in turning the critical challenges posed by climate change into opportunities. This will assist the nation to generate more revenue at local and international markets from the agricultural sector as there is global crisis in the crude oil market.

References

Adejuwon J.O. (2006). Food Crop Production in Nigeria. II: Potential Effects of Climate Change *Climate Research Journal*, 32:229-245.

Aphunu, A., & Nwabeze, G.O. (2012). Fish farmers perception of climate change impacts on fish production in Delta State, Nigeria. *Journal of Agricultural Extension.* 16: 10-12

Brander Keith, C. (2010). Impacts of climate change on fisheries.. *Journal of Marine Systems* 79:389-402.

Challinor, A. J. & Wheeler T.R. (2008). Crop yield reduction in the tropics under climate change": Processes and uncertainties *Journal of agricultural forest meteorology.* 148: 343-356.

Hale N. & Keller, A. A, (2008). Effective efficiency as a tool for sustainable water resources management. *Journal of Marine Systems*. 23: 76-78.

Ikeme, J. (2009). Assessing the future of Nigeria's economy: Ignored threats from the global climate change debacle". *African Economic Analysis Journal* 1(2).

Ikpi, A, (2010). The Nigerian economy and climate change. National Assembly capacity building workshop on climate change.

Intergovernmental Panel on Climate Change(IPCC), (2007). Summary for Policy Makers. In climate change (2007): Impacts, Adaptation and Vulnerability. Contribution of working Group 11 to the fourth assessment report of the Intergovernmental panel on climate change.

Ngigi, S.N. (2009). *Climate change adaptation strategies: water resources management options for smallholder farming systems in Sub-Saharan Africa*. The MDG Centre for East and Southern Africa of the Earth Institute at Columbia University, New York with financial support from the Rockefeller Foundation.

Nzeh, C.E & Eboh, R.O. (2011). Study of technological and farming systems adaptation to climate change in farming communities of Enugu State, Nigeria. African Technology Policy Studies Network (ATPS) Research Paper Series, No. 5, African Technology Policy Studies Network (ATPS), Nairobi, Kenya. 1-64, , Available at http://www.atpsnet.org

Nzeh, C.E.P. (2008). Economic Valuation of Deforestation in Enugu State, Nigeria. An unpublished Ph.D research proposal presented to Department of Agricultural Economics, University of Nigeria, Nsukka.

Odekunle, T.O. (2014). Rainfall and the length of the Growing Season in Nigeria. International Journal of Climatology. 3: 467-479.

Ozor, H. (2009). Understanding Climate Change. Implications for Nigerian Agriculture, Policy and Extension. Unpublished paper presented at the national conference on climate change and the Nigeria environment.

Parry, M.L. (2007). Technical Summary. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L.Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 23-78.

Rosenzweig, C., & Parry, M.L., (1994). Potential impacts of climate change on World Food Supply.133-138.

The Role of Cooperatives in Financing Food Crop Production in Nigeria: Evidence from Rice Farms in Ideato-North LGA, Imo State

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Abstract

The study assessed the role of cooperatives in financing rice production in Arondizogu, Ideato-North Local Government Area, Imo State, Nigeria. Informal or semi-formal financial institutions such as cooperative societies have become major players in financial services provision. However, the informal providers often have weak institutional and managerial capacity and offer only a narrow range of financial services, often without regulation. Moreover, operating in isolation from the financial system has let some of these providers charge steep and sometimes even usurious interest rates. This study is conceived against this backdrop to provide information n the financing activities of the cooperatives and thereby inform and influence relevant policies. Purposive random sampling technique was used in selection of three communities namely; Ndi-Onuwaoha, Ndi-Njoku, Akame-Ikpa-Okoli in Arondizogu, because they are the prominent rice producing communities in the area. The sample size comprised sixty farmers. The main tool for data collection was the validated structured questionnaire. Data collected were analyzed using descriptive statistical tools. The findings indicated that majority of the farmers (89.99%) applied to their cooperatives for loan amount that ranged N41,000-N100,000 but obtained amount less than that applied to the range of N31,000-N70,000. Result also showed that majority of cooperative societies (81.67%) charged double digit interest rates. The highest number of the respondents represented by 96.67% identified insufficient loan amount as one of the problems encountered by the rice farmers in obtaining loans from the various cooperative societies. Recommendations were made based on the findings..

Keywords: Agricultural finance, rice farming, agricultural production, cooperatives

1. Introduction

Cooperatives are autonomous associations of people united voluntarily to meet their common economic, social and cultural needs and desires through jointly-owned and democratically-controlled enterprises (International Co-operative Alliance, 1995; International Labour Organization, 2002). A cooperative is not a charity organization but rather a distinct form of business organization that provides services or products to its members. As a business venture, cooperatives are anchored on the values of self-help, self-responsibility, democracy, equality, equity and solidarity. The members of these associations believe in the ethical ideals of honesty,

openness, social responsibility and caring for others.

According to Wanyama (2014) it is generally accepted that cooperatives can be distinguished or classified in two ways: either by their ownership structure or by function of the goods and services they provide. On the basis of the ownership structure, cooperatives have been classified into two basic types: worker-owned and client-owned cooperatives (Schwettmann, 2012). In worker-owned cooperative, members own the business, work in it, govern it and manage it. Client-owned cooperatives are formed and owned by individuals or groups that seek goods and services from the business that they have established. Members of client-owned cooperatives seek specific goods and services. The nature of the goods and services has led to the classification of two basic types of client-owned cooperatives namely those oriented towards consumption and those oriented towards production. As a result, client-owned cooperatives are made up of consumer and producer cooperatives. Consumer cooperatives refer to those owned and governed by individuals who seek to purchase goods and services from the cooperative that may not be available from other businesses or are offered by other businesses at higher prices.

Producer cooperatives are owned and organized by people who are engaged in the production of goods and services in different enterprises as a means of supporting their productivity. According to Wanyama (2014) the cooperative members are independent producers; they own a business that may for instance buy and sell farm inputs; advertise and market produce; or operate storage, transport and processing facilities for their produce. This form of cooperative abound in agriculture, where farmers often must band together to succeed in the markets.

Cooperatives provide jobs and livelihoods for millions of people around the world, and, together with small and medium-sized enterprises, are the most significant source of new employment (ILC, 2007). Furthermore, cooperatives contribute to food security by supporting members to diversify the production and marketing of food (Sizya, 2001; Wanyama, Develtere, and Pollet, 2008; Khurana, 2010; IFAD, 2012). Cooperatives contribute to food security by helping small farmers, to solve numerous challenges, including financing, that confront them in their activities to produce food.

Cooperatives are useful in increasing access to credit in rural areas for small and medium scale enterprises they therefore provide the needed opportunity for rural dwellers to participate in financial services. Rice farmers need access to financial services for a range of productive and productive purposes. Examples of productive purposes include purchase of agricultural inputs, maintenance of infrastructure, etc. Examples of protective purposes include managing peak season incomes to cover expenses in the low season,

investment in education/shelter/health dealing with emergencies. The rice farmers in Arondizuogu, Imo State, Nigeria, belong to some cooperative societies.

This paper investigates the financing function of the cooperatives in the rice production enterprise.

The nexus between a sound financial system, economic growth and development has been researched for a long time and numerous theoretical and empirical studies show a positive relationship (Levine, Loayza, & Beck, 2000; Beck, 2011). This is no different for rice production enterprise in a crude oil dominated economy such as Nigeria's. However, rural communities in which most agricultural activities including rice production take place are highly underserved by financial services.

Financing rural farmers has been negatively impacted by the financial sector reforms. Banking services are focused on the high valued end of the market in urban centers due financial profitability and viability considerations. Traditionally, formal financial institutions (e.g. commercial banks, agricultural development banks) have been less than satisfactory to offer sustainable services in ruralareas. Thus, informal or semi-formal financial institutions such as cooperative societies have become major players in financial intermediation.

However, these informal providers often have weak institutional and managerial capacity and offer only a restricted range of financial services, often without regulation. Moreover, operating in isolation from the financial system has let some of these service providers charge high and sometimes even usurious interest rates.

It is against this background that this study is conceived to investigate the role of cooperative societies in financing rice enterprise production in Arondizuogu, Imo State, Nigeria. The study will not only inform and influence policy on the role of cooperatives in rice production, it will also update literature on the agricultural activity.

Objectives of the Study

The broad objective of the study is to assess the role of cooperatives in financing rice production in Arondizuogu in Ideato-North LGA, Imo State, Nigeria.

The specific objectives are to;

i. ascertain the amount of loan applied for and the amounts obtained by farmers from the cooperatives rice;

ii. determine the interest rate charged by cooperatives in giving out loan to rice the farmers in the study area; and

iii. identify the problems rice farmers encounter in the obtaining loan from the cooperatives.

2. Research Methods

This study was carried out in Arondizogu, Ideato-North Local Government Area, Imo State, Nigeria. The study area is located between Latitude 4°45´ and 7°25´ north of the equator and Longitude 6°5´ and 7°25´ east of the Greenwich Meridian and with a population of about 158, 406 (National Population Commission, 2006; National Bureau of Statistics, 2007).

There are two main seasons in the zone –dry and rainy seasons. The annual rainfall range is between 1900mm and 2200mm while the mean annual temperature is between 200C with a relative humidity of about 75% annually. The area is richly endowed with fertile land suitable for the rearing of livestock like sheep, pig, goat, poultry, fish, etc and land suitable for growth of arable crops (Imo-ADP, 2004). The farmers in the zone are mainly smallholder farmers.

Sampling Technique

Purposive sampling technique was used in the selection of the respondent for the study. Three villages namely; Ndi-Onuwaoha, Ndi-Njoku, and Akame-Ikpa-Okoli in Arondizogu were chosen because they are the major rice producing communities in the area. Twenty rice farmers were randomly chosen from each of the three selected communities giving a total sample size of sixty rice farmers for the study.

Data Collection and Analysis

Primary data was collected from the cooperative member rice farmers through the use of validated structured questionnaire. Descriptive statistics were used to realize the specific objectives.

3. Results and Discussion

Amount of Loan Applied for and Eventually Obtained by Rice Farmers from the Cooperatives. The amounts of loan applied for and that eventually received by the rice farmers from the cooperatives are presented inTable1.

Table1 shows that majority of the farmers represented by 89.99% applied to their cooperatives for loan amount that ranged N41,000-N100,000 but obtained amount less than that applied to the range of N31,000-N70,000. Table 1 also shows that the least number of respondents represented by 10.1% received loan amount equal to that applied for which ranged from N1,000-N40,000. The findings tend to show that the cooperatives do not adequately meet the financing needs of the majority of the rice farmers. The findings also tends to show that the less the loan amount applied by the farmer from the cooperative societies, the more the chances of the loan applicant receiving an amount equal to that applied for and vice versa. The cooperative societies could be viewed as lacking in cooperative venture and/or initiative to respond to members' needs. This view is consistent with that of ILO (2014a) which stated that majority cooperatives experienced poor performance due to lack of vision, resources, leadership and unsuccessful business plans.

Table 1: Frequency Distribution of Cooperative Rice Farmers According to their Amount of Credit Applied for and Obtained in the Current Farming Season

Amount Applied (₦)	Amount Obtained	Frequency	%
1,000-20,000	1,000-20,000	2	3.33
21,000-40,000	21,000-40,000	4	6.67
41,000-60,000	31,000-40,000	8	13.33
61,000-80,000	61,000-70,000	11	18.33
81,000-100,000	51,000-70,000	35	58.33
Total		60	100.0

Source: Field Survey Data, 2015

Table 2: Frequency Distribution of Interest Rate Charged by Cooperative Group/Society to Rice Farmers for Obtaining Loan

Interest Rate (%)	Frequency	Percentage (%)
Less than 5	11	18.33
6-10	43	71.67
11 and above	6	10.0
Total	**60**	**100.0**

Source: Field Survey Data, 2015

The range of interest rate charged by cooperative societies to rice farmers for obtaining loan is presented in Table 2.

Table 2 reveals that majority of cooperative societies in the study area represented by 81.67% charged double digit interest rates. The least represented by 18.33% charged single digit interest rates. Overall, the lowest interest rate charged was 3% while the highest was 14%. The interest rates charged by majority of the cooperatives are in the double digit range and to that extent somewhat high. This finding is a pointer to the fact that some cooperative societies like commercial banks charge high interest rates. This view is consistent with that expressed by Rosenberg, Gaul, Ford and Tomilova (2013) who stated that poor

Table3: Frequency distribution of respondents according to problems encountered by the rice farmers in obtaining loans from the various cooperative societies

Constraints	*Frequency**	*Percentage (%) **
Insufficient loan amount	58	96.67
High interest rate	55	91.67
Inadequate information	50	83.33
Problem of loan default	41	68.33

Source: Field Survey Data, 2013*Multiple Responses Obtained

borrowers are exploited by excessive interest rates, given that those borrowers have little or no bargaining power, and that a larger proportion of microcredit is moving into for-profit organizations where higher interest rates could mean higher returns for the shareholders. This trend is worrisome. In the views of Smith (2014) the measure of the success of the cooperative is not the profit which it achieves but the greater prosperity or benefits for its members. It should also be stated that in a shareholder owned business, the more shares one owns, the more votes one has in the running of the business. On the other hand, in a cooperative, members normally have a vote each, a practice known as “one member one vote”. Cooperatives should resist the temptation to be driven by market pressures instead of being driven by the greater prosperity or benefits for its members

Problems Cooperative Rice Farmers Encountered in Obtaining Loan from their various Cooperative Group/Society

The problems encountered by the respondents in obtaining loans from the cooperative societies are presented in Table 3.

Table 3 shows that the highest number of the respondents represented by 96.67% identified insufficient loan amount as one of the problems encountered by the rice farmers in obtaining loans from the various cooperative societies. Loan amount tends to be a function of the amount funds that a cooperative can raise from its members. However, the amount of funds that a cooperative can mobilize is severely limited because of the somewhat modest means of the members.

Table 3 further shows that 91.67% identified high interest rate as one of the problems encountered by the rice farmers in obtaining loans from the various cooperative societies. This finding is consistent with that of ILO (2015) who stated that some informal and semi-formal financial institutions charge steep and sometimes even usurious interest rates. Cooperatives, like all enterprises, need to be competitive in the market. However, they are guided by a set of values other than those associated purely with making a profit. Based on such values as self-help, self-responsibility, democracy, equality, equity and solidarity, cooperatives put people at the core of their business. According to (ILO, 2014b) because cooperatives are owned and democratically controlled by their members, the decisions taken by cooperatives balance the need for profitability with the needs of their members and the wider interests of the community.

Furthermore, Table 3 shows that 83.33% and 68.33 % of the respondents identified inadequate information and loan default respectively as problems encountered by the rice farmers in obtaining loans from the various cooperative societies.

In the views of Wanyama, (2014), poor infrastructure, limited access to services, information, productive assets and markets, have sometimes prevented cooperatives from realizing their potential. Shiferaw (2012) posited that cooperative members around the world continue to face constraints that keep them from reaping the benefits of their labour and contributing to food security not only for themselves but for all through active participation in markets. Inadequate information is information asymmetry by another name.

Information asymmetry comes about when an entity knows more about an economic transaction or asset than the other party does (Wright and Quadrini, 2012). Information asymmetry is related to the issues of adverse selection and moral hazard. Due to adverse selection, the riskiest borrowers who most strongly request loans eventually get the loans by omission or commission. Adverse selection occurs before a transaction takes place. If unmitigated, lenders attract the worst risks on account of information asymmetry. Any post-contractual change in behavior that injures other parties to the contract can be referred to

as moral hazard. Moral hazard occurs after a transaction takes place. If unmitigated, borrowers take advantage of lenders. One of the major functions of the financial system is to manage information asymmetry. Financial systems help to reduce the problems associated with both adverse selection and moral hazard .It never eliminates asymmetry, but usually reduces its influence sufficiently efficiently to let businesses and other borrowers obtain funds to allow them to grow their enterprises. Cooperatives as players in financial intermediation should devise effective and efficient ways of combating information asymmetry.

4. Conclusion

The cooperatives do not adequately meet the financing needs of the majority of the rice farmers. Some of the cooperative societies like commercial banks charge high interest rates. This is a pointer to the fact that some cooperatives tend to be driven by purely profit motives as opposed to the prosperity of the members. Insufficient loan amount, which is one of the major problems encountered by the rice farmers in obtaining loans from the various cooperative societies, mirrors the severely restricted amount of funds the cooperative can raise for lending to members.

The following recommendations were made based on the major findings of the study.

Capacity building programmes should be organized by relevant government agencies for the cooperative societies on the core values of cooperative society especially as they relate to self-help. Such training programmes will enable the cooperative societies constantly keep in focus their core mandates and thereby resist the temptation to be driven by market pressures instead of being driven by the greater prosperity or benefits for its members.

Cooperatives as players in financial intermediation should devise effective and efficient ways of combating information asymmetry without sacrificing such core values as self-help. Group lending approach is recommended. In this approach, borrowers are grouped; and the members of the group guaranteed one another against default.

- Effective agricultural policies and programmes should focus on farmers' access to credit as well as the reduction of the

astronomical interest rate charged by various cooperative groups/societies. This can be achieved through channeling funds to viable cooperative societies for on-lending to farmers who are registered with such cooperatives.

References

Beck, T. (2011) Therole of finance in economic development: Benefits, risks,and politics, Tilburg, Netherlands, *European Banking Centre Discussion Paper* No. 38,

International Co-operative Alliance (ICA) (1995) Statement on the cooperative identity. Report to the 31st ICA Congress, Manchester, in *Review of International Cooperation*, Vol. 88, No. 3.

International Fund for Agricultural Development (2012) Agricultural cooperatives: Paving the way for food security and rural development. Retrieved July 25, 2016, from http://www.ifad.org/english/institutions/yic_flyer.pdf

International Labour Organization (ILO) (2002) Recommendation 193 concerning the promotion of cooperatives. Retrieved July 25, 2016, fromhttp://www.ilo.org/images/empent/static/coop/pdf/english.pdf

International Labour Conference (2007) The promotion of sustainable enterprises. Report VI. International Labour. Retrieved July 25, 2016, from Conference,96thSession,Geneva,.Availableat:http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_ent/documents/publication/wcms_093969.pdf

International Labour Organization (ILO) (2015) Portfolio of policy guidance notes on the promotion of decent work in the rural economy : Decent work in the rural economy policy guidance note / International Labour Office, ACI, Sectoral Policies Department. - Geneva: ILO, Retrieved July 25, 2016, fromhttp://www.ilo.org/wcmsp5/groups/public/ed_emp/emp_policy/documents/publication/wcms_437166.pdf

International Labour Organization (ILO) (2014a) Finding of the assessment of agricultural cooperatives in the West Bank: Challenges and opportunities. International Labour Organization Policy Brief 2014

International Labour Organization (ILO) (2014b) Sustainable enterprise pogramme: The Cooperative way of doing business. Retrieved July 25, 2016, from www.ilo.org/coop

Imo State Agricultural Development Programme (2004) An assessment study of the performance of the national agricultural technology support project in Imo State, Nigeria. Cochita Nig Ltd Owerri.

Levine, R., Loayza N. & Beck T.(2000) Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics* pp. 31-77;

National Bureau of Statistics (2007) Legal notice on publication of the details of the breakdown of the national and state provisional totals, 2006 census. National Bureau of Statistics Official Gazette (FGP 71/52007/2,500(OL24*)*. Retrieved July 25, 2016 www.nigerianstat.gov.ng

National Population Commission (2006) Nigeria federal government initiative of individual head count spread, state by state *MOFINEWS*6(3): 7.

Schwettmann, J. (2012) Cooperatives – A global vision. Paper presented at aSymposium on Perspectives for Cooperatives in Southern Africa. FriedrichEbert Stiftung, Lusaka, Zambia, 20-21 August.

Smith, S. (2014) Promoting cooperatives: An information guide to ILO Recommendation No. 193. International Labour Organization – Geneva

Shiferaw, B. (2012. *Ethiopia*: Agricultural cooperative key for food security*.* Retrieved July 25, 2016 http://allafrica.com/stories/201210190202.html [27 May. 2016].

Sizya, M. J. (2001). The role cooperatives play in poverty reduction in Tanzania*.* Paper Presented at the United Nations International Day for the Eradication of Poverty. October 17.

Wanyama, F.O.(2014). Cooperatives and the sustainable development goals: A contribution to the post-2015 development debate. Geneva: International Labour Organization

Wanyama, F. O., Develtere, P. & Pollet, I. (2008). Encountering the evidence: Cooperatives and poverty reduction in Africa. *Journal of CooperativeStudies*, Vol. 41, No. 3, pp. 16-27.

Wright, R. E. and Quadrini, V. (2012) Finance, banking, and money v. 1.0. Retrieved July 25, 2016 http://2012books.lardbucket.org

Comparative Analysis of Leaf Characteristics of *Irvingia gabonensis* and Irvingia *wombolu*, in Southern Nigeria: Implication for Food Security and Policy in Nigeria

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Abstract

*Irvingia gabonensis*is an indigenous fruit tree species of high economic importance in the forest zone of West and Central Africa . The species was earlier identified to exist in two varietal forms which were *var. gabonensis* and *var. excelsa*, due mainly to the difference in the quality of the respective fruits. These varieties now regarded as *Irvingia gabonensis* and *Irvingia wombolu* respectively show comparative characteristics which need further examination. Investigation of the leaf parameters was carried out to generate further evidence of proper distinction between the two species. The investigation involved the comparison of leaf attributes sourced from three distinct geographical locations in Southern Nigeria. The methodology involved initial investigation of leaves of seedlings in a forest tree nursery in one location, and then mature trees from three locations in Southern Nigeria. Data were generated using parameters of leaf length, leaf width and venation angles, and were analysed using descriptive statistics and tests of significance. The results showed that the length of the seedling leaves of the two species were significantly different, while the width is not at 1% probability level. This difference was observed in the mature leaves as well, at 1% probability level. In addition the venation angles of *I. wombolu* were consistently larger than that of *I. gabonensis,* both at seedling and mature phases thus buttressing the differences in the two species. Based on the findings, it is pertinent to pay attention to vegetative characters while selecting the species partially or wholly for further development towards food security programs.

Keywords: Irvingia species, indigenous economic trees, leaf characters, food security

1. Introduction

Irvingia gabonensis and *Irvingia wombolu* are native species of the West and Central African forest zone. Various studies have shown that the species have great potentials to contribute to national food security programme of Nigeria, if properly harnessed. In addition, the two species are nationally and internationally reputed to be of economic importance. Fruits and nuts are edible for *I. gabonensis*, but the nuts of *I. wombolu* prove superior, and fruits not palatable. Initially the two species constituted one species with two varieties, asearlier reported by Okafor in 1975. Taxonomically *Irvingia* species belongs to the family IRVINGIACEAE of the order Malpighiales. Using the peoples value index, the species were ranked much earlier amongst the first five important indigenous fruit trees in Nigeria. In addition, Akinnifesi, Ajayi, Sileshi, Kadzere & Akinnefesi (2007) reported that in addition to its high financial value, it has high expected rate of adoption by community

farmers and it directly benefitted women. This shows that the issue of equity in the distribution of resources between men and women, as reported by Abugre, Asare & Anaba (2010) is also observed in communal involvement of the cultivation of *Irvingia* species. In addition, is the use of the species in traditional agroforestry systems. For instance, the taproot was found suitable in erosion sites of south eastern Nigeria. Invariably serving as erosion control and windbreaks, such species can conserve soil moisture, increase water filtration, reduce effect of heat, suppress weeds and enhance productivity, (Nwaiwu, 2014). The species also responds well to silvicultural practices, for example pruning (Ujor, 2001). Incidentally the recognition of the potentials of *Irvingia* species in the local economy of West and Central Africa has continued to increase especially now that there is economic recession including the reduced provision of adequate and healthy food crops to cater for the ever increasing population of these regions of Africa. Recently there was a decry about the depletion of Irvingia species in the forests of Bayelsa state in Nigeria (AIT News Correspondent, 2016). It is however known that the population of such indigenous species have been steadily reducing due to modern infrastructure development and deforestation for various reasons, with little or no efforts at regenerating them. The report added that the species were sole sources of livelihoods for some rural households in Bayelsa State. This is because the cotyledons of the fruits, after processing, attract high income (about 20 half cotyledons for N500), (personal market survey in Abuja, June 2016). Earlier, Anegbeh, Tchoundjeu,Anuforum, Ukafor & Usoro (2004) indicated that *I. gabonensis* and *I. wombolu* were part of the indigenous economic trees enthusiastically identified and conserved by community farmers for domestication in order to enhance the availability and yields of the trees' products. But the similarities presented by the two species morphologically, calls for continued and detailed examination of the different vegetative parts of the trees in order to contribute information for improving the development and economic placement of the two species.

Research objective

The objective of this study was to observe and describe some leaf morphological characteristics of seedlings and mature trees of the two species, which were formerly two varieties of one species, and to compare these attributes with a view to ascertaining leaf character differences between the two species which pose respective economic potentials for food security.

2. Research Methods

The study sites selected were Onne, Enugu and Ibadan. Being in different agro-ecological zones, these sites ordinarily show difference in edaphic and climatic characteristics mainly. Onne is a community about 30 km from Port Harcourt in Rivers state. It lies within the

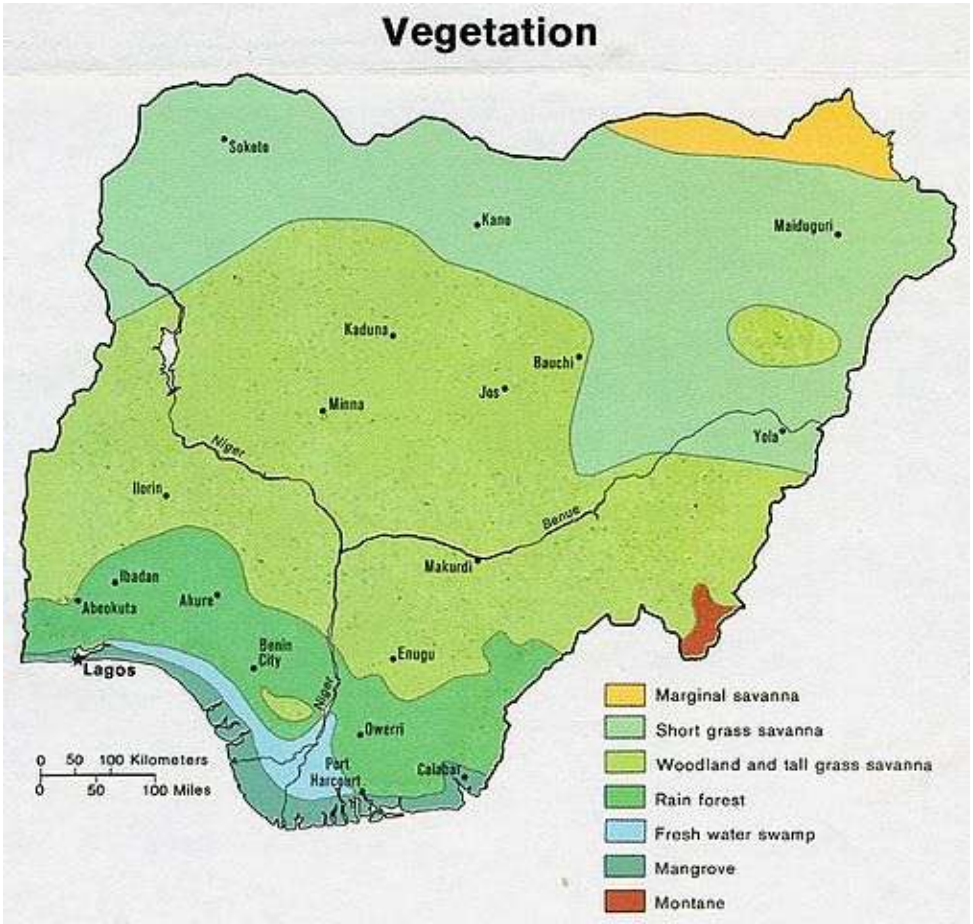

Fig 1. Map of the vegetation zones of Nigeria, showing the Study Sites in the southern part
Source: Google Maps, culled July 2016, en.wikipedia.org.

mangrove/freshwater swamp forest ecosystem in the south-south geopolitical zone of Nigeria. Its geographical coordinates are 6o 51' East and 4o 40' North. The rainfall and temperature average values for Onne are 2311 mm and 26.5o C respectively (NIMET 2014), with hydromorphic soil type. Enugu, Enugu state lies within the derived savanna (southern Guinea savanna) in the south east geopolitical zone of Nigeria. Its geographical coordinates are 7o 30' East and 6o 27' North. The rainfall and temperature average values are 1610 mm and 27o C respectively (NIMET 2014), with ferralitic soil type. Ibadan, Oyo state is on the geographical coordinates of 3o 56' East and 7o 20' North within the south-west geopolitical zone of Nigeria. The ecology is dry forest zone. The rainfall and temperature average values are 1193 mm and 28o C respectively (NIMET 2014), with sandy loam soil type. These three study locations can easily be identified in Figure 1.

The sites were chosen on the basis of easy identification of the trees of I. gabonensis and I. wombolu amongst the population of other tree species in the vicinity. In addition, for comparative analysis, it was deemed important

to choose sites in different ecological zones where the tree species were found.

Tree Selection

From the study sites, three trees of each of the species were randomly selected from the wild in their natural stands per site. Tree selection was based on accessibility to the tree base and the crown. For more comparative analysis, tree seedlings of the two species were also selected from the West African Hardwoods Improvement Project (WAHIP) nursery of the Forestry Research Institute of Nigeria (FRIN), Ibadan. Thus a population of 18 mature trees from the three sites and a further population of 60 tree seedlings were used during the study.

Leaf Parameters Investigation

The investigation which lasted about six months, was carried out in two stages. In stage one, the leaves of two-year old seedlings of the two Irvingia species from the WAHIP nursery were used, while in stage two, leaves of the mature trees in the wild from the three geographical locations were used.

During stage one, a population of 30 leaves per species were observed. To ensure uniformity in the materials collected from the nursery, the leaves were plucked at the 5th nodal position of the terminal shoot counting from the apex. Samples were collected from 30 seedlings per species.

In the three geographical locations, leaf samples of the two species were collected by initially cutting down portions of tertiary branch from each of the selected trees. From each cut branch, leaves attached between the 6th and 3rd nodal positions counting from the tip were plucked and gathered into sacks, one sack per tree. Using the lucky dip method, ten leaves were randomly picked from each sack collection, giving 30 leaves per species per site.

From stages one and two, the length of the leaves along the midrib, without the petiole and the width at the widest margins were measured and recorded. The angles of venation at the tip, middle and base with respect to the midrib were measured and recorded. For clarity, the abaxial side was used for these measurements.

Mean values of the linear and angular measurements of the leaf population samples were calculated. Linear mean measurements were obtained for the length and the width of the leaves respectively. Mean measurements were also obtained for the tip, middle and base angles.

The ratios of the length to the width of the leaves were calculated too. Apart from using mean measurements and values to describe the discrepancies between the two species, analysis of variance was used in all cases to test the significance of observed discrepancies.

3. Results and Discussions

Seedling leaf characteristics

The measurements obtained for the mean length and the mean width of *Irvingia gabonensis* and *Irvingia wombolu* seedlings are presented in Table 1. Also calculated and shown in the table are the standard deviation values and the least significant difference at 1% probability level.

As seen in Table 2 the comparison of the two species using analysis of variance showed that there was significant difference between the two species at 1% level of probability in terms of leaf length. Leaf width was observed not to show any significant difference between the species.

The values for the mean leaf vein angular measurements of seedlings of *Irvingia species* are presented in table 3, in addition to the calculated standard deviation.

Using the analysis of variance, the species respective angular measurements (tip, middle and base), were tested as described in table 4 using the F-ratio.

From the analysis in table 4, significant difference was observed between the middle vein angles of seedling leaves of I. gabonensis and I. wombolu at 5% probability. The I. wombolu seedling leaves invariably have larger mid vein angles than those of I. gabonensis as observed also from the mean values of table 3. No significant difference was

Table 1. Mean values for the linear measurements of seedling leaves of *I. gabonensis* and *I. wombolu*

Parameter	Species	N	Mean	Std. Dev.	LSD(p=0.01)
Length	*gabonensis*	30	13.64	1.32	1.013
	wombolu	30	15.43	1.60	
Width	*gabonensis*	30	5.79	0.74	
	wombolu	30	5.67	0.70	

Source: Author's compilation from Field survey.

Table 2: Analysis of variance for length of seedling leaves of *Irvingia* species.

SV	DF	MS	F-cal	F-tab
Species	1	47.793	21.96*	1%
Error	58	2.177		7.08

NB: '*'= Figure was significant at1% probability level

observed for the tip and the base angles between the species.

Characteristics of Mature tree leaves of I. gabonensis and I. wombolu from three (3) locations in Southern Nigeria .

The values of the mean leaf length measurements of 30 leaves per species per location are shown in table 5.

The least significant difference value of 0.548 at 1% probability indicates leaf length difference between the species in the populations of Enugu and Onne. However I. gabonensis leaves were generally observed to be longer than those of I. wombolu. This difference in the leaf length was tested using the ANOVA in Table 6.

From the analysis of Table 6, there was significant difference in length of the leaves between the two species, and the interaction of the two species and the sources of the leaves. Amongst the sources, difference in the length of leaves observed, was also significant. Below in table 7, the values of the measured mean leaf width are shown.

The analysis presented in Table 8 shows that the leaf width of the Irvingia species studied are significantly different from each other. In addition, the differences observed amongst the locations and the interaction of the species and the location were also significant.

The mean vein angles of the leaf tip, leaf base, and middle of the leaf of both species in the three locations were further examined as shown in Table 9.

From the values of the calculated mean angles in table 9, it is observed that the leaf angles of *I. wombolu* were in most cases larger than those of the *I. gabonensis*. Exception was in the cases of the base angles of Enugu and Onne. This result however synchronised with the earlier presentation in Table 3, where the apex, middle and base angles of *I. wombolu* seedlings were in all cases larger than that of the *I. gabonensis* respectively.

A summary analysis of the leaf vein angles, taking into context the angular position (tip, middle and base) and the source of the leaves were carried out and presented in Table 10.

The analysis in Table 10 further confirmed that the venation angles of I. wombolu is significantly larger than that of I. gabonensis, and the size of the angles on the different positions on the leaf also varied significantly from one another. But there were no significant difference amongst the locations. However the observed occasional difference in size parameters of leaves of the same species amongst locations, as seen sometimes in the linear measurements of length and width, may be as a result of nutrient, soil or other environmental factors in the various sites. The result of this study is supported by Ainge & Brown (2001) report of the existence of the two distinct species. Also Silou et al., (2011) noted the distinct species as sweet I. gabonensis and bitter I. wombolu essentially on morphological and organopleptic criteria. In addition, the

Table 3. Descriptive statistics for leaf vein angles of the seedling leaves of *Irvingia* species

Parameter	Species	N	Mean angle	SD
Tip	gabonensis	30	53.56	4.64
	wombolu	30	54.25	3.96
Middle	gabonensis	30	60.18	3.53
	wombolu	30	62.13	3.37
Base	gabonensis	30	49.3	6.48
	wombolu	30	51.93	4.75

Source: Author's computation from Field survey

Table 4: Analysis of Variance (ANOVA) for tip, middle and base angles of seedling leaves of *Irvingia* species

SV	MS	Error	F-cal	F-tab
Tip	7	18.7	0.38	4
Middle	57	12	4.77*	
Base	103.8	32.3	3.22	

NB: '*'= significant at 5% probability level

Table 5: Mean length of leaves of *I. gabonensis* and *I. wombolu* from 3 locations (cm)

Location	N	I. gabonensis	I. wombolu
Enugu	30	10.52	8.92
Ibadan	30	12.24	11.83
Onne	30	11.24	9.56
Mean	30	11.33	10.1

LSD (p=0.01)=0.548. Source: Author's compilation from the Field

Table 6: Analysis of variance of leaf length of *I.gabonensis* and *I. wombolu* in three locations

SV	Df	MS	f-cal	f-tab
Species	1	68.081	9.808*	0.002
Location	2	84.586	12.186*	0
SpeciesxLocation	2	7.525	1.084*	0.34
Error	174	6.942		

Table 7: Mean width of leaves of *I. gabonensis* and *I. wombolu* in three locations (cm)

Location	N	I.gabonensis	I. wombolu
Enugu	30	4.66	3.47
Ibadan	30	4.87	4.77
Onne	30	4.86	4.37
Mean	30	4.79	4.2

LSD (p=0.05)=0.323. Source: Author's compilation from the Field

Table 8: Analysis of Variance of leaf width of *I.gabonensis* and *I. wombolu* from three sources

SV	Df	MS	f-cal	f-tab
Species	1	15.665	11.369*	0.001
Location	2	9.125	6.623*	0.001
SpeciesxLocation	2	4.556	3.07*	0.039
Error	174	1.378		

Table 9: Mean Angles of Venation of leaves of *Irvingia* species from 3 locations

Location	Species	N	Tip	Middle	Base
Enugu	gabonensis	30	55.95	62	54.47
	wombolu	30	61.25	65.35	52.8
Ibadan	gabonensis	30	55.98	59.67	51.02
	wombolu	30	60.85	67.02	58.63
Onne	gabonensis	30	55	64.68	60.4
	wombolu	30	59.2	66.6	57.73

Source: Author's compilation from Field survey

Table 10. Analysis of Variance of Leaf Venation Angles of *I. gabonensis* and *I. wombolu* Leaves collected from three locations

Source	Sum of square	df	Mean Square	f.Ratio
Block	19.9125	2	9.90625	0.9252
Site	27.75	2	13.875	1.29584
Species	175.859	1	175.859	16.4242*
Position	618.031	2	309.0155	28.8603**
Site x Species	61.4222	2	30.7111	2.86824
Site x Position of leaf	83.3919	4	20.848	1.94708
Species x Position of leaf	41.6725	2	20.83625	1.94599
Site x Species x Position on leaf	49.1234	4	12.28085	1.4696
Error	364.048	34	10.7073	

NB '**'= Figure was significant at 1% probability level

vegetative characters of like tree species were earlier observed to play roles for taxonomic grouping (Berg, 1988, Linder,1989 and Mesfin, 1992), prior to proper valuation of the individual species or their products, sometimes by farmers who seek appropriate technology or skills to propagate and domesticate choice species, (Chah, Ani, Irohibe & Agwu, 2014). It was also reported that biological classification uses taxonomic ranks, from most to least inclusive like domain, kingdom, class, order, family, genus, species, (http://en.wikipedia.org/wiki/biological_classification/taxonomic_description). In the case of I. gabonensis, two forms of one species were classified as two distinct species. And this classification is envisaged to help throw more light on the individual species' contribution towards food security.

4. Conclusion

This study observed variations in the attributes of the leaves of Irvingia gabonensis and Irvingia wombolu, formerly referred to as Irvingia gabonensis var. gabonensis and Irvinga gabonensis var. excelsa respectively.

The consistency of the variation in both the juvenile and mature leaf populations of the tree species, as observed in this study, showed that it is possible to differentiate the two species ex-situ. This is important for the further development of the species by researchers and even farmers who are encouraged to adopt the tree species in their farms for ensuring provision of crop diversification, a needed approach to ensure food security. It is envisaged that the information generated from this study will contribute to further attempts at examining the attributes of these highly priced indigenous fruit tree types in Nigeria with a view to contributing to their further development for food security programs and eventual appropriate food policies that will encompass food crops from the wild. It is further recommended that researchers and relevant government agencies should focus on identifying the various potentials and uses of Irvingia species for food security and biodiversity promotion.

References

Abugre, S., Asare, A.I. & Anaba, J.A. (2010). Gender Equity Under the Modified Taungya System (MTS): A Case of the Bechem Forest District of Ghana. *International Journal of Social Forestry*(IJSF) 3(2);134-150. Retrieved from http://www.scirp.org/Journal/Paper information

Ainge, L. and Brown, N. (2001). *Irvingia gabonensis&Irvingia wombolu*. A State of knowledge Report undertaken for the Central African Regional Program for the Environment. Oxford Forestry Institute. Department of Plant Science, University of Oxford UK. Retrieved from https://www.africanmango234.com/pdf/african ango/irvingiareport

Akinnifesi, F.K., Ajayi, O.C., Sileshi, G., Kadzere, I. & Akinnifesi, A.I. (2007). Domesticating and Commercialising Indigenous Fruit and Nut Tree Crops for Food Security and Income Generation in sub-Saharan Africa. Paper presented at the New Crops International Symposium. Retrieved from http://www.worldagroforestry.org

Anegbeh, P.O., Tchoundjeu, Z., Anuforum, B.C., Ukafor, V. & Usoro,C. (2004). Farmers' participation in Ex-Situ Conservation of Indigenous Fruit Trees in Southern Nigeria. *Agriculture and Social Research* 4 (2); 33-42. Retrieved from http://www.ajol.info/inde

Berg, C.C. (1988). New Taxa and Combination in *Ficus* (MORACEAE) of Africa. *Kew Bulletin* 43 (1); 77-79.

Chah, J.M., Ani, N.A., Irohibe, J.I. & Agwu, A.E. (2014). Exploitation of Bush Mango (Irvingia wombolu and Irvingia gabonensis) Among Rural Households in Enugu State, Nigeria *AgriculturalExtension* 18(2); 44-56. Retrieved from http//en.wikipedia.org

Linder, H.P. (1989). A Review of the Tropical African and Malagasy Restoniaceae. *Kew Bulletin* 4 (1);99-106.

Mesfin, T. (1992). New Combinations and Names in the Genus Vicia Leguminosae: Vicieae) *Kew Bulletin* 47 (1):129-130.

Nwaiwu, J.C. (2014). Soil Conservation Practices Among Arable Crop farmers in Okigwe Agricultural Zone of Imo state Nigeria: Implication for Greener Economy. In: J. Munonye & R.Onyeneke (Eds) *Nigeria and the Green Economy*. Oak Mamre Library, Umuezella-Nsu, Imo state, Nigeria: 157-176.

Nigeria Meteorological Agency – NIMET. (2014). Quarterly Compilation of Agromet Decadals. April – June 2014. Nigeria Meteorological Agency, Abuja (14), June 2014.

Okafor, J.C. (1975). Varietal delimitation in *Irvingia gabonensis* (IRVINGIACEAE). *Bulletin du Jardin Botanique National de Belgique*. 45; 211-221.

Silou, T., Loumouamou, B.W., Nsikabaka, S., Kinkela, T., Nzikou, M., Chalard, P. & Figueredo,

G. (2011). Contribution to the Varietal elimitation of Irvingia gabonensis and Irvingia wombolu ChemicalComposition Variability of Fats Extracted from Kernels. *Food Technology* 9(1); 36-42, doi:10.3923/jftech.2011.36.42

Taxonomy Biology. From Wikipedia, the free encyclopedia – https://en.wikipedia.org/wiki/Biological-ClassificationTaxonomic-description (Retrieved on June 17, 2016).

Ujor, G.C. (2001). Early Graft Compatibility Studies in Seedlings of *Irvingia gabonensis* and*Irvingia wombolu* in Nigeria. *Tropical Forest Resources* 17 (1);148-153.

Cost and Returns Structure in Garri and Fufu Processing in Rivers State, Nigeria

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Abstract
The cost-returns structure of processors was studied based on the agricultural zones. The study dealt with cash (paid) cost and non-cash (estimated) cost items such as family labour, fuel (wood) etc. in Garri and Fufu processing and the returns in monetary terms to the processors. Fufu had the highest margin and returns in terms of product and; the Fresh-Water Salt-Water Transition Zone had the highest profit prospect, highest revenue expectation, and mark-up. In quantitative terms, monetary returns was low because of very low investment and may be inadequate for expansion of the industry. The result presents the picture of subsistence. Family labour and processed cassava tubers were not valued by the processors because the tubers were sourced from their farms, however, the market price was inputted in estimates
.
Key Words Margin, agricultural marketing, Cost and Returns, Profit analysis

1. Introduction

All economic activities consist of transferring resources (Land, labour and various forms of capital) into goods and services which serve the needs and desires of people. These activities cannot be accomplished without some forms of costs. Costs are sacrifices made to achieve an aim or in the course of achieving an aim. Cassava processing, a rural economic activity, all the same, involves some degree of costs. Information on the cost structure of cassava processing in Nigeria is limited. However, the various types of cost factors could be identified. Understanding the true cost of production and processing is essential to pricing and investment.

In cassava processing, input costs are under the control of the processing household and include cash (paid) costs on land, labour, management and capital. Some of these costs are non-cash (estimated) costs such as family labour, fuel (wood) etc. Major cost factors in cassava processing are the cost of purchase of raw cassava tubers, labour hire and fuel (wood) purchases or its estimate (if gathered from the processors farms).

FAO (2006) and IITA (1996) have identified labour as one of the major cost factors among others and have emphasized on its reduction if the traditional processing of foods of cassava origin are to become the basis for commercially viable local industries. FAO (2006) is of the opinion that new improved processing technologies will be required and commercial cassava processors and producers would need to find ways of reducing labour cost.

Though labour supply among these processors is by the households themselves, the opportunity costs have not been adequately represented in the available literatures. This may also vary from state to state and enterprise to enterprise. IITA (1996) has confirmed that it has been established that the post-harvest stage of cassava requires more labour than other staple crops. Bokanga (2004) has revealed that one hectare of cassava containing 10 tonnes of roots (the average root yield in Africa) needs approximately 721 man-hours to harvest and process; of this labour time, 212 man-hours are needed for harvesting, 156 man-hours handling and 353 man-hours for processing.

Another variable cost factor in cassava processing at the rural level is transportation: This is more evident when the farms where the tubers were harvested are far from processing sites or where the markets where they are purchased are also far from the processing site. According to Dada, Siyanbola, Afolabi and Oduola (2007), transportation of fresh tubers from farm to processing site is critical to retain the quality of cassava and cost of transportation is a major component. FAO (2006) also corroborates from their survey that transportation is a major cost component in cassava processing. Tuber grating is another significant processing cost identified by ITTA. Presently, this is done mechanically and the services of machine owners are sought whenever the need arises. This cost however varies with quantity to be processed. IITA, has over the years invested into ways of reducing this very cost in pilot projects. A type of grater designed by IITA has increased output and reduced cost by 20% per unit (IITA, 2007). High energy cost is another cost factor in cassava processing and may be a limitation to the rural dwellers in adopting new post harvest technology. Bokanga (1996) opines that the adoption of cassava post harvest technology especially at the rural and semi-urban settings in Nigeria seems to be hampered by its fuel (energy) consumption. He submitted that most available cassava processing machines are driven by petrol, diesel or electrical energy, and for most rural households, these are scarce and expensive energy sources. The cost of acquiring simple processing machines also is prohibitive for the small farmer and in the more humid cassava producing areas; the use of dryers is critical (FAO, 2006).

There may be evident though unreported fixed costs in the processing of cassava among these rural processors. However, there were scanty documented statistics on this. Income taxes, interests on borrowed capital and

depreciation on processing equipment are costs, which would be incurred whether or not there was production.

The long run success of the cassava processing industry will depend on the profitability of the venture. Over most of the past century, profits from enterprises have been primarily in the hands of those who find ways to reduce costs and expand production fast. A relentless, never-ending search for new sources of profits has been a necessity for survival (Ikerd, 1997). However, recent literature has not captured the extent of profitability of the cassava processing industry in contemporary Rivers State. This may affect pricing and investment decisions.

Garri and *fufu* are widely recognized and utilized throughout the South of Nigeria in our food menu. These cassava derivatives, must however provide an adequate return to cover the processors costs of production and ensure profits. Obtaining higher prices or reducing costs can generate increased profits. Information on cost and returns in cassava processing in Rivers State is presently scanty. Cost and returns relationship must be examined carefully by every producer of any commodity, whether in agriculture, manufacturing or service industries (Hawkes and Libbin, 2013).

The basic building blocks of cost and returns analysis are enterprise budgets; this seem to be absent among the rural folks who process cassava, perhaps, because of ignorance. An enterprise budget includes all costs and returns associated with producing a product Hawkes and Libbin (2013) have stated that enterprise budgets can estimate costs and returns on enterprises. Most enterprise budgets also list physical resources needed for prospective new producers of a commodity. This knowledge may be an urgent ingredient in trying to make the cassava processing industry viable, profitable and competitive.

3. Research Methods

The study area is Rivers State. Rivers State is one of the six states that make up the south geopolitical zone of Nigeria. It is bounded to the north by Imo, Abia and Anambra; to the east by Akwa Ibom State; to the south by the Atlantic Ocean and, to the West by Bayelsa and Delta States. Its capital is Port Harcourt. The state lies at latitude 4o45` and 4.87o north and longitude 6o50` and 6.93o east and covers an area of 10,432.3 sq km with a population of 5,198,716 (census figures) and a population density of 468 people per square kilometer (Inemesit, 2013).

The state has three agricultural zones according to the delineation of RSADP and CPECWC (2002) the delineation was followed for detailed coverage and to capture a good view of cassava processing activities during sampling. The zones are: the Marine Costal Zone; the Fresh-Water, Salt-Water Transition Zone; and Fresh-Water Upland Zone. Five Local Government Areas were randomly selected from each of the zones of the State summing up to 15 Local Government Areas. A community was randomly selected from each

of these Local Government Areas and 10 processors were also randomly selected from each community; bringing the total number of those interviewed and studied to 150.

Relevant arithmetic tools were used to capture the specific objectives of this study. The research objective was investigated using mark-up and gross margins to measure the contribution of each enterprise of Fufu and Garri to the processors profit. Cost items include labour used in processing whether hired or estimate of family or self-provided labour, purchasing cost of raw tubers or estimate of self provided ones and other miscellaneous expenses that were observed in the course of the study. The items on returns were the value of output/kg/N obtained from the sale of Garri and Fufu. The average market price was used to determine the values of outputs and inputs. The gross margin was estimated for each enterprise of Garri and Fufu.

4. Results and Discussion

Cost-Return analysis was carried out based on weekly production activities of the processors. Weekly approach was adopted because processing and sales were done on weekly bases. This approach made simple the process of estimation. Most cassava processing activities targeted market days which were weekly actives. Building on that, an accurate (or nearly so) statistics was obtained. However, there were cases of spurious claims which were discarded for lack of identifiable evidence.The cost-returns structure of Garri processors in the various agricultural zones in Rivers State considered both the cash (paid) cost like hired labour, grating cost and non-cash (estimated) costs such as family labour, fuel (wood) etc in their processing activities. The returns were assessed based on the current monetary value of Garri in the market. The cost-returns structure of Garri producers in the various agricultural zones in Rivers State is presented in Table 1.1.

The Gross margin is seen to be generally low, so also was the mark-up. Margin represents the number of kobo gains there are in each Naira sales and the mark-up a predetermined percentage of cost of production to be added to the selling price. A low margin implies that the given enterprise cannot pay its expenses and retain enough earnings for future expansion. A low Gross margin suggests inefficiency in management. Margin is a metric that can assess a company's overall financial health or position.

Hill (2014) stated that a low Gross margin will result in less money being available to cover the operating costs of a business. The only way to increase an enterprises cash flow and reach target profit is to increase unit sales. The result however suggests a subsistence venture characterized by low investment and low returns.

Table 1.1: Cost – Returns structure of Garri production in the various Agric zones of Rivers State

Zone		**FWUZ**	
Average variable cost/enterprise	**Value**	**Returns per enterprise**	**Values**
Raw tubers	2,978.4	Sales from Garri	7,569.7
Labour	1,800		
Grating	170.7		
Fuel (wood)	496.7		
Total	5,445.8		
Gross Margin: 7,569.7 – 5,445.8 = 2,123.9 Mark-Up 39.0% Source: Field survey, 2012			
Zone		**FWSWTZ**	
Average variable cost/enterprise	**Value**	**Returns per enterprise**	**Values**
Raw tubers	5,326.6	Sales from Garri	13,181.3
Labour	2,768.8		
Grating	395.3		
Fuel (wood)	668.8		
Total	9,159.5		
Gross Margin: 13,181.3 – 9,159.5 = 4,021.8			
Mark-Up 43.9%			
Zone		**MCZ**	
Average variable cost/enterprise	**Value**	**Returns per enterprise**	**Values**
Raw tubers	1,700	Sales from Garri	4,600
Labour	2,250		
Grating	200		
Fuel (wood)	400		
Total	4550		
Gross Margin: 4,600 – 4,550 = 50 Mark-Up 1.11% Source: field survey, 2012			

A low profit margin also suggest the product has a market value close to the cost of production. This may lead to a higher product turnover since the selling price is deemed cheap. However, when an enterprise is generating adequate sales but gross margins are low as observed from field study, it implies that pricing is low with respect to cost of production. Prices may need to be raised further. In order to make a good profit on low margin product, Garri producers may produce and sell large volumes of their product. This will put them in a safe position in the event of a sales decrease.

Cost/Returns Structure Of Fufu Processors In The Various Agricultural Zones In Rivers State

The Cost-Returns structure of Fufu producers in the various agricultural zones of the state also considered both cash (paid) costs and non-cash (estimated) costs. The returns were assessed based on the market value of Fufu at the period of study. The cost-returns in Fufu production is presented in Table 1.2.

The cost and returns structure of Fufu producers in the various agricultural zones in the state is shown in table 1.2. Generally, the

Table 1.2: Cost-Return structure of Fufu Production in the various Agric zones.

Zone		**FWUZ**	
Average variable cost/enterprise	**Value**	**Returns/enterprise**	**Values**
Raw tubers	4,155.6	Sales from fufu	13,611.1
Labour	1,405.6		
Total	5561.2		
Gross Margin: 13,611.1 – 5661.2 = 7,949.9 Mark-Up 143.0%			

Zone		**FWSWTZ**	
Average variable cost/enterprise	**Value**	**Returns/enterprise**	**Values**
Raw tubers	2,944.4	Sales from Fufu	12,244.4
Labour	1,477.8		
Total	4,422.2		
Gross Margin: 12,244.4 – 4,422.2 = 7,822.2 ; Mark-Up 176.9% **Source: Field survey, 2012**			

Zone		**MCZ**	
Average variable cost/enterprise	**Value**	**Returns/enterprise**	**Values**
Raw tubers	3,000	Sales from Fufu	18,000
Labour	2,000		
Total	5,000		18,000
Gross Margin: 18,000 – 5000 = 13,000 Mark-Up 260% **Source: Field survey, 2012**			

gross margin and profit were low. However, the Fufu processing industry was breaking even unlike the Garri processing ones because profit was in all the zones more than the cost of production.

Gross margin impacts both the likelihood of reaching breakeven and the amount of profit that is earned beyond breakeven. In other words, it directly impacts risk and returns. Managing Gross margin helps an enterprise avoid problem with prices that are too low and direct costs that are too high (Ebben, 2004).

With respect to Garri, Fufu has both ahigher profit, Gross margin,and mark-up and a better monetary prospect. Narsey (2013) has stated that items with low turnover rates (field observation shows that Garri had a higher demand rate and turnover) have higher carrying costs and require higher mark – ups for a reasonable profit to be made. Items with higher turnover have lower mark – ups. This may have accounted for the higher mark – up in fufu sales.

A high profit and margin suggest efficiency. However, an enterprise at high profit margin may make fewer sales than one operating at a low profit and margin. Nevertheless, high margin products have higher prices than the costs of production and low sales volume may be sufficient to cover all expenses.

4. Conclusion

The processing of cassava within the study area was largely predicated on demand. The demand for garri and fufu were predominant. The magnitude of processed garri and fufu was very low. This reflected on the profit and revenue levels. The industry exhibits the features of a subsistence venture.

The study shows that profitability is very low and the net effect is a low level of processing income, little savings and consequently, low investment. The processers however may be ignorant of this because the processed raw tubers were sourced from their farms and most labour were supplied by the household. Large scale production may be suggested to earn the benefits of economies of scale.

References

Bokanga, MC (1996). Post-harvest east operation IITA Ibadan. Nigeria. Retrieved 2007 from http://www.cgiarorg/iita.

Bokanga, N & T. Otoo (1991). Cassava based foods how safe are they" in toiwo KA? Utilization of potentials food of cassava in Nigeria, the in Domestic and industrial productions. *Food review International* 22:29-42.

Dada, A.D, W.O. Siyanbola, O.O. Afolabi & I.A Oduola (2007). "Capacity Innovations in Cassava Production, Harvesting and Cassava Processing in Nigeria".

National centre for Technology Management (NACETEM). *Ile-Ife*, Nigeria.

Ekine, S. A. & Osobonye G. T. (1996). Surface Geoelectric Sounding for determination of Aquifer characteristics in parts of bony local government area in Rivers state. *Nigeria Journal of Physics, vol (85).*

Evanhoe, H. (2002) Cassava production and export central working committee" (2002). Rivers State Agricultural Development programme (RISADEP). *Rivers state Ministry of Agriculture.*

Food and Agricultural Organization (FAO) (2006) Post harvest and processing technology Retrieved 2007 from htt://www.fao.org./dowep/009x4007E06 .htm

IITA (2004), Nigeria's cassava industry: statistical handbook. In Dada et al (2007). Capacity innovations in cassava production, harvest and processing in Nigeria. *NACETEM. Nigeria*.

Ikerd, J.E. (1997). Sustain the profitability of agriculture. *University of Missouri*.

Inemesit, F.S. (2013). *Location of Rivers State*. Great Publication. ZODML, Ikoyi, Lagos. Nigeria.

Libbin, J. D. and Hawkes, J.M. (2013). Cost and returns for producing Chile in New Mexico. *New Mexico State university board of Regents*

Libbin, J.D. and Hawkes, J.M. (2013). Cost and returns for producing Lettuce in New Mexico. *New Mexico State University Board of Regents.*