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Table of Content

Agriculture on the Road to Industrialisation and Sustainable Economic growth: An Empirical Investigation for Pakistan

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Abstract: The present empirical study investigates the dynamic link between the agricultural and industrial output of Pakistan economy using the Autoregressive Distributed Lag (ARDL) bounds testing approach. Empirical results suggest that agricultural output effect on the industrial output in the long run and short run but the industrial output effect the agricultural output only in the long run. The agricultural output effect on the industrial output more than the industrial output effect on the agricultural output. The error correction terms (ECT) indicates that when shock in industrial output more quickly (61% per year) adjusted agricultural output than the shock in agricultural output and adjustment in the industrial output (13% per year).

Keywords: Agriculture output, Industrial output, ARDL

INTRODUCTION

In developing countries the interaction between agriculture and industry has been extensively explored on the theoretical and empirical grounds. But in the case of Pakistan this issue has not been discussed at length. Lewis model (1954) provides pioneer theoretical literature of interaction between agricultural and industry. Industrial sector engine of growth, growth enhances by employing the surplus labor of agricultural sector in the new industries. Sah and Stiglitz (1984), Rattso (1988) and Taylor (1991) concluded agricultural and industrial sectoral association depends on the macro closure of the model. Nachane *et al* (1989) explicated the different links between the agriculture and industry. Henneberry *et al* (1999) concluded industry tends to benefit more from agricultural growth. Chaudhuri *et al* (2004) found bidirectional causality between the agricultural output and industrial output. Craigwell *et al* (2008) stated industrial output has associated with lower agricultural GDP in the long run but in the short run changes in industrial output promoted agricultural output.

Agricultural and industrial sectors played an important role in the economy of Pakistan. Agricultural sector helps the other sectors of the economy in the growth process and contributes 21.5 percent (2008) to the GDP and employing 42 percent of the labor force. More than two-thirds population lives in the rural areas and their living continues to rotate around agriculture and connected activities. Therefore the development of agriculture will be a major vehicle for alleviating not only rural poverty but also the urban poverty. The importance of agricultural sector in the economy of Pakistan may be defined in five ways. Firstly, the sector provides food to the consumers and fiber to the domestic industry. Secondly, it is a major source of foreign exchange earnings. Thirdly, it provides a market for industrial

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production. Fourthly, an increase in agricultural output can increase government saving by increase in indirect tax collection and lastly, increase in agricultural terms of trade may boost households saving and investment in rural areas.

This sector has strong backward linkages (by buying agricultural inputs including fertilisers, pesticides, farm machinery, etc) and forward linkages (by providing raw materials to food and fiber processing industries in the industrial sector). Industrial sector contributes 25.1% to the GDP and employing 28% labor force of the country. Currently Pakistan's economy is facing four major problems such as, rising inflation, decline in growth, fiscal deficit and widening of trade and current account deficits. In order to overcome these challenges and being an agricultural country, Pakistan's government must work to boost its production of agriculture and industrial sectors. The aim of this research is to model the dynamic relationship between agricultural output and industrial output by using the recent advance Cointegration technique ARDL (Pesaran *et al*, 2001). Rest of paper is organising as follow. Section B presents data and econometric methodology. Section C represents empirical results and final section (D) represents the conclusion and policy recommendation.

Model, Data and Estimation Methods

The present study is composed simple regression model, in order to explain interaction between agricultural and industrial output in Pakistan. The estimation model as follows,

$$Ln(IO) = \xi_0 + \xi_1 Ln(AO) + \psi_t \quad -----(1)$$

Alternative re-writes as,

$$Ln(AO) = \xi_2 + \xi_3 Ln(IO) + \psi_t \quad -----(2)$$

Where, AO and IO are agricultural output and industrial output respectively. The terms ξs represent parameters, ψ is the error terms and Ln, symbols of natural logarithm. The time series data of agricultural output (AO) and industrial output (IO) contain annual observations for the period 1971- 2007. Data of both variables is taken from various issue of Pakistan Economic Survey. Both data series were transformed in natural logarithm form for econometric analysis and both series are used in an index form, based on the 2000=100.

Table 1: Descriptive Statistic & Correlation Matrix

Descriptive Statistic		
	Ln(AO)	Ln(IO)
Mean	4.21	4.11
Median	4.27	4.20
Maximum	4.76	5.38
Minimum	3.65	3.06
Correlation Matrix		
	Ln(AO)	Ln(IO)
Ln(AO)	1.00	-
Ln(IO)	0.98	1.00

This study uses the Phillips and Perron (1988) unit root test in order to determine the time series properties. Phillips and Perron (PP) test propose an alternative (nonparametric) method of controlling for serial correlation when testing unit root of time series data. The PP method estimates the non-augmented Dickey Fuller equation (3). The test detects the presence of a unit root in a series, say Xt by estimating as

$$\Delta X_t = \alpha + \rho X_{t-1} + \varepsilon_t \quad -----(3)$$

The PP test estimate the modified t-value associated with the estimated coefficient of ρ so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the following statistic

$$\tilde{t}_\rho = t_\rho\left(\frac{\gamma_0}{f_0}\right)^{1/2} - \frac{T(f_0-\gamma_0)(se(\tilde{\rho}))}{2f_0^{1/2}s} \text{-----(4)}$$

Where $\tilde{\rho}$ is the estimate, and t_ρ the t-ratio of ρ, $se(\tilde{\rho})$ is coefficient standard error, and s is the standard error of the test regression. In addition, γ_0 is a consistent estimate of the error variance (in eq.1) which calculated as,

$$\gamma_0 = \frac{(T-k)s^2}{T} \text{-----(5)}$$

Where k is the number of regressors and T tabulated value. The remaining term, f_0, is an estimator of the residual spectrum at frequency zero. The series is stationary if ρ is negative and significant.

ARDL Co-integration

To search for possible long run relationship between the both variables, Ln(AO) and Ln(IO) this empirical work employ the autoregressive distributed lag (ARDL), bound test approach to Cointegration (Pesaran *et al*, 2001). This involves estimating the following unrestricted error correction model (UECM)

$$\Delta Ln(AO)_t = \lambda_0 + \sum_{i=0}^{n}\lambda_i \Delta Ln(AO)_{t-i} + \sum_{i=0}^{n}\lambda_i \Delta Ln(IO)_{t-i} + \alpha_1 Ln(AO)_{t-1} + \alpha_2 Ln(IO)_{t-1} + v_{1t} \text{-----(6)}$$

$$\Delta Ln(IO)_t = \gamma_0 + \sum_{i=0}^{n}\gamma_i \Delta Ln(IO)_{t-i} + \sum_{i=0}^{n}\gamma_i \Delta Ln(AO)_{t-i} + \beta_1 Ln(IO)_{t-1} + \beta_2 Ln(AO)_{t-1} + v_{2t} \text{-----(7)}$$

Where Δ is the first difference operator, Ln AO is the natural logarithm of agricultural output and Ln IO is natural logarithm of industrial output. The F-test is used to determine whether a long run relationship exists between the variables through testing the significance of the lagged levels of the variables. The Pesaran *et al*. approach compute two sets of critical values for a given significance level. One set assumes that all variables are I(0) and the other set assumes they are all I(1). If the computed F-statistic exceeds the upper critical bounds value, then the H_0 (null hypothesis) is rejected. If the F-statistic falls into the bounds, then the test becomes inconclusive. Lastly, if the F-statistic is below the lower critical bounds value, it implies no Cointegration. When long run relationship exists, the F-test indicates variable should be normalised. The null hypothesis of equation (6) is $\langle H_0 = \alpha_1 = \alpha_2 = 0\rangle$. This is denoted as $F_{LnAO}\langle LnAO \mid LnIO\rangle$. In equation (7), the null hypothesis is $\langle H_0 = \beta_1 = \beta_2 = 0\rangle$ this is represented by $F_{LnIO}\langle LnIO \mid LnAO\rangle$.

RESULTS AND DISCUSSIONS

All time series data show some trend. When working with the time series data, the first issue is weather the series are stationary or not. A stochastic process is said to be stationary if its mean and variance are constant over time and the covariance between the two time periods and not the actual time at which the covariance is computed. To test the stationarity of the variables Phillips-Perrons unit root test apply for both variables. The critical absolute value of the test statistics of the PP test is higher than the critical absolute value, the null hypothesis is rejected. It means that there is no unit root in the series and the variables are stationary. Conversely, if the absolute value of the test statistic is less than the absolute value, the null hypothesis is not rejected. The results about the order of integration of the series, given by the Phillips and Perron (PP) unit root test is presented in Table 2.The results indicate that the natural logarithm of Agricultural output and the natural logarithm of Industrial output are not

stationary in their levels. On other hand, after taking first difference of the variables the null hypothesis of no unit root is rejected in both series. So, respectively, leading to conclude that [Ln AO & Ln IO] are integrated of order one. The Cointegration hypothesis between the variables is examined through the Bound test for Cointegration (Table-2).

The bound test results of the existence of long run relationship are presented in Table-2 where eq-6&7 are estimated and then the F-Statistics is computed. Before proceeding to calculating the F-test, an important step is to establish the optimal lag length to be in Co-integration analysis. Using the Schwarz Information Criterion finds that 2 lags are the optimal for this empirical work. The F-Statistic lies above the 10% upper bound when the agricultural output (AO) dependent variable and F-Statistic lies above the 5% upper bound when the industrial output dependent variable [Using the asymptotic critical value bounds computed by Pesaran *et al* (2001)]. Thus the null hypothesis of no long run relationship is rejected in both cases.

Table-2 Unit Root and Bound Test Results

Phillips-Perron unit root test		
Variable	I(0)	I(1)
Ln(AO)	-0.43	-8.10***
Ln(IO)	-1.72	-4.11***
***: indicate the 1% level of significance.		
Bounds Test Result of long run relationship		
Dependent Variable	Computed F-Statistic	
LnAO	3.55*	
LnIO	5.17**	
** 5% level of significance * 10% level of significance		

Table-3 shows the long and short run coefficient when agricultural output dependent variable. In the part (a) the long run results indicate that the industrial output positively impact on the agricultural output in the sample period. An increase in the industrial output by one percent will have a significant long run impact on the agricultural output by 0.52 percent. In the part (b), in the short run the industrial out (at two years lag) negatively affect the agricultural output. The coefficient of error correction terms is statistically significant at 0.00 percent with the expected negative sign. The error correction term represents the speed of adjustment of the change in the agricultural output to its long run equilibrium following a shock in the short run. Moreover the significance of the error correction term confirms the existence of a long run relationship between the regressors and the dependent variable. The error correction term suggests that 61 percent of the adjustment back to long run equilibrium is corrected after one year. The large magnitude of the coefficient of the error correction term suggested that previously shocked, convergence to equilibrium very fast. The diagnostic test also passes the overall validity of the model.

Table-3 Long run & Short run coefficient

(a) Long Run Coefficients using the ARDL Approach ARDL (1,0,2,0,1) selected based on Akaike Information Criterion		
Dependent Variable : Ln(AO)		
Variable	Coefficient	T-Statistics [Inst-values]
Ln(IO)	0.52	13.45[0.00]
Constant	2.17	13.48[0.00]
R-Squared = 0.99	R-Bar-Squared = 0.97	
DW-statistic = 2.08	F-Statistics = 735.36[0.00]	
(b) Error Correction Representation for the Selected ARDL Model ARDL selected based on Akaike Information Criterion		
Dependent Variable : ΔLn(AO)		
ΔLn(IO)	0.33	1.59[0.12]
ΔLn(IO(-1))	-0.27	-1.24[0.22]
ΔLn(IO(-2))	-0.49	-2.44[0.02]
ecmt-1	-0.61	-4.14[0.00]
Constant	1.29	4.20[0.00]
R-Squared = 0.40	R-Bar-Squared = 0.29	

DW-Statistic = 2.24	F-Statistics = 4.61[0.005]	
(c) Sensitivity Analysis		
Test Statistics	LM Version	F Version
I: Serial Correlation	2.02[.154]	1.71[0.20]
II: Functional Form	2.96[.085]	2.57[0.12]
III :Normality	1.14[.563]	-
IV: Heteroscedasticity	0.003[.954]	0.003[0.95]

I: Lagrange multiplier test of residual serial correlation.
II: Ramsey's RESET test using the square of the fitted values.
III: Based on a test of skewness and kurtosis of residuals.
IV: Based on the regression of squared residuals on squared fitted values.

Table 4 shows the long and short run coefficient when dependent variable industrial output. In the part (a) the long run results indicate that the agricultural output positively impact on the industrial output in the sample period. An increase in the agricultural output by one percent will have a significant long run impact on the industrial output by 1.98 percent. In the part (b) in the short run the agricultural output positively affect the industrial output. The coefficient of error correction terms is statistically significant at 6 percent with the expected negative sign. The error correction terms represents the speed of adjustment of the change in the industrial output to its long run equilibrium following a shock. The error correction terms suggests that 13 percent of the adjustment back to long run equilibrium is corrected after one year. The diagnostic tests also pass the overall validity of the model.

Table-4 Long & short run coefficient.

(a) Long Run Coefficients using the ARDL Approach ARDL (1,0,2,0,1) selected based on Akaike Information Criterion		
Dependent Variable : Ln(IO)		
Variable	Coefficient	T-Statistics [Inst-values]
Ln(AO)	1.98	10.73[0.00]
Constant	-4.21	-5.70[0.00]
R-Squared = 0.99	R-Bar-Squared = 0.97	
DW-statistic = 2.14	F-Statistics = 1919.0[0.00]	
(b) Error Correction Representation for the Selected ARDL Model ARDL selected based on Akaike Information Criterion		
Dependent Variable : ΔLn(IO)		
ΔLn(IO)	0.48	2.98[0.00]
ΔLn(IO(-1))	0.30	1.71[0.09]
ΔLn(AO)	0.26	2.03[0.05]
ecmt-1	0.13	1.90[0.06]
Constant	0.57	2.01[0.05]
R-Squared = 0.36	R-Bar-Squared = 0.28	
DW-Statistic = 2.24	F-Statistics = 4.22[.008]	
(c) Sensitivity Analysis		
Test Statistics	LM Version	F Version
I:Serial Correlation	0.72[0.39]	0.60[0.44]
II:Functional Form	2.19[0.13]	1.92[0.17]
II :Normality	6.87[0.11]	-
IV: Heteroscedasticity	0.73[0.39]	0.70[0.40]

CONCLUSION AND POLICY IMPLICATIONS

The goal of this paper was to model the relationship between the agricultural output and industrial output. ARDL bounds testing approach by Pesaran, *et al* (2001) was employed in order to establish the long run relationship. Empirical evidence indicates the bidirectional relationship between agricultural output and industrial output. The agricultural output affects industrial output in the long run and short run. But industrial output affects the agricultural output in the long run only. The elasticity of industrial output with respect to agricultural output is 1.98 & the elasticity of agricultural output with respect to industrial output is 0.52.The coefficient of adjustment (when agricultural output dependent variable) is 0.61 and

(when industrial output dependent variable) the ECT is 0.13. The ECT shows the speed of adjustment.

With the help of above results the following policy implication can be derived. Normally the general view is, that countries relying on agricultural income cannot maintain over all sustainable economic growth because of cyclical fluctuations in agricultural output. But this empirical work proves that this cyclical fluctuation in agriculture also affects the industrial sector which takes time moving towards equilibrium. So for industrial growth and over all economic growth, there is need of a long term policy for agricultural sector.

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Challenges to Traditional Livelihood Activities of Women in Eastern Obolo, Niger Delta Region, Nigeria

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Abstract: The study assessed the challenges to livelihood activities of women in Eastern Obolo Local Government Area. Two hundred respondents were selected using multi-stage sampling technique and data collected using interview schedule. Descriptive and inferential statistics were used for data analysis. The major livelihood activity of the women was processing of fish/other aquatic products (67.5%). Water pollution and poor storage/processing equipment were the major challenges to livelihood activities. Age ($\chi^2 = 9.397$, $p < 0.05$) and major livelihood activity ($\chi^2 = 5.29$, $p < 0.05$) were significantly related with identified leading challenge to livelihood activities. Water pollution should be controlled and development of non-environmentally dependent livelihood activities encouraged.

Key words: Livelihood activities, Environmental degradation, Fishing, Fish processing, Water pollution

INTRODUCTION

The relationship between environment, agriculture and livelihood in the Niger Delta region deserves a careful consideration, as this nexus represents important variable in the context of survival of the inhabitants of the region. The relative impact on each other, especially impact on livelihood requires effective management in order to sustain the environment. As observed by Farrington *et al* (1999), the environment is a natural asset and livelihood building block and is essential for agricultural production and related activities. Its elements include land, water, air and other free gifts of nature. These are sources of materials and processes required to build up the stock of other capital assets and are therefore tapped by inhabitants of the region for securing livelihood. Land, apart from its requirement for agricultural production is also needed for a variety of other purposes including construction of residential quarters, recreational parks, social amenities and development of forest.

Agriculture, fishing and related activities are important sources of livelihood of majority of inhabitants of the Niger Delta. Moreover, inhabitants of the region do not stick to one particular activity, but combine many activities to make a living. These activities are environmentally and agriculturally oriented and provide employment for a vast majority of the people, as unskilled labourers easily adapt the processes involved.

Livelihood, according to Ellis (1999) is the activities, assets and the access that jointly determine the living gained by the rural households. It is sustainable when it has the capacity to meet the immediate needs of the people while its ability to meet future needs is not

jeopardised (Carney, 1998). However, the ability of livelihoods in the Niger Delta region of Nigeria to meet the needs of the people is seriously threatened. Fishing, agronomic and related activities which are the major livelihood activities of the people in this region are affected, resulting in declining production and productivity.

Though crude oil is the main-stay of the Nigerian economy, many Nigerians still engage in agriculture for their livelihood. However, crude oil exploration, exploitation and increased pressure on the environment for other uses deplete the ability of the environment to support sustainable agriculture and related livelihood activities. Consequently, most livelihood activities, especially of the poor are unable to meet neither the immediate nor future needs. Efforts to meet the immediate needs of the people result in further exploitation of the environment with no regards to its long-term effects. This pressure on the land and other natural resources reduces the sustainability of the environment and agriculture. Women are the most affected, as they constitute the bulk of the marginalised, landless and resource-poor members of the society. They are saddled with the responsibility of contributing to the wellbeing of the household, and in some households, they bear the burden and sole responsibility of providing the households' needs. This could be as a result of death of spouse or migration of males to towns and cities in search of white collar jobs (Yahaya and Olowu, 1998). Reducing the pressure on the environment and challenges to livelihood activities of the people become the bedrock of livelihood, agriculture and environment sustainability. The study was therefore conducted to assess the constraints to livelihood activities of women in Eastern Obolo Local Government Area of Akwa Ibom State with a view to making recommendations to reduce their incidence and impact.

Objective of the study

The general objective of the study was to assess the challenges to livelihood activities of women in Eastern Obolo Local Government Area. The specific objectives were to:

1. examine the personal characteristics of women in Eastern Obolo Local Government Area
2. identify the livelihood activities of women in Easterm Obolo local government area
3. assess the dimensions of challenges to livelihood activities of women in Eastern Obolo Local Government Area

Hypotheses of the study

The following hypotheses were tested:

HO_1: There is no significant relationship between the personal characteristics of women in Eastern Obolo local Government Area and identified leading challenge to their livelihood activities

HO_2: There is no significant relationship between the major livelihood activity of women of Eastern Obolo Local Government Area and identified leading challenge to their livelihood activities

METHODOLOGY

The study was carried out in Eastern Obolo Local Government Area of Akwa Ibom State with headquarters at Okoroete. Eastern Obolo Local Government Area is bounded by Ibeno, Onna, Ikot Abasi and Mkpat Enin Local

Government Areas (Ajana, 1996). It has a population of about 60,543 people (NPC, 2006). Eastern Obolo Local Government Area lies within the tropical rainforest zone and has two major seasons: a rainy season (May to October) and a dry season (November to April). The traditional livelihood activity of the people is fishing, though there is appreciable diversification to other livelihood activities. The Local Government Area has experienced many oil spills within the past few decades.

Women in Eastern Obolo Local Government Area constituted the study population. Three villages; Iko, Okoroete and Elile were selected from the Local Government Area using simple random sampling method. Households were identified and systematic sampling method was used to select two hundred households. From each of the households, a woman was interviewed. Interview schedule was used to collect primary data from the respondents. Frequency count and percentage were used for data analysis while Chi-square was used to test the hypotheses.

RESULTS AND DISCUSSION

The personal characteristics of the respondents as presented in Table 1 shows that 41.0% of the respondents were between 40 – 49 years old. This was followed by 27.0% of the respondents who were between 30-39years of age. Only 0.5% of the respondents were below twenty years of age. This shows that most of the respondents were of age and have actually experienced the challenges to livelihood activities in the area and can easily identify them. Majority of the women (77%) were married, 3% were divorcees and only 7.5% were singles. With this record, there is an expected increase in population in the area with its attendant effects on the already stretched stock of natural resources.

Table 1 also shows that 28.5% of the respondents were heads of their various households and non-household heads accounted for 71.5% of the respondents. Household headship attracts the responsibility of providing the household's needs, a responsibility that is equally saddled by these female heads of the households. In order to provide for the households, livelihood activities are intensified, with a resultant depletion of the environment and asset base of the area. About 49% of the respondents had no formal education, but 34% of the respondents had between 1 and 6 years of formal education while 13.5% of the respondents had between 7 and 12 years of formal education. This implies that, diversification to formal education-oriented activities by women in the area may be limited. A condition which could encourage continued dependence on agriculture and environment-based activities, with more pressure on the land.

Table 1 also shows that the modal household size was 4-6 people (49%), while 12.5% of the respondents had household size of 3 persons and below. Thirty-eight and a half percent (38.5%) of the respondents had household size of seven persons and above. With the moderately large household sizes, there is an expected continued pressure on the stock of natural capital in the region, as the household heads strive to provide for their households. Only 3.0% of the respondents had monthly income above N20, 000.00 while about 39.5% of the women had monthly income of only N5, 000 and below. This suggests that most of the women may be living below poverty line. The

consequence is intensification of environmental exploitation in the course of trying to meet the livelihood needs of members of the household.

Table 1: Distribution of Respondents According to Personal Characteristics

Variables	Frequency	Percentage
Age		
<20	1	0.5
20 – 29	18	9.0
30 – 39	54	27.0
40 – 49	82	41.0
50 – 59	36	18.0
60 and above	9	4.5
Marital Status		
Single	15	7.5
Married	154	77.0
Divorced	6	3.0
Widowed	25	12.5
Household Headship		
Household head	57	28.5
Non-household head	143	71.5
Years of Formal Education		
>1year	98	49
1 -6 years	68	34
7-12 years	27	13.5
<12 years	7	3.5
Household Size		
1-3	25	12.5
4-6	98	49.0
7-9	68	34.0
10 and above	9	4.5
Estimated Monthly Income		
N5,000 and below	79	39.5
N5,001 – N10,000	88	44.0
N10,001 – N15,000	18	9.0
N15,001 – N20,000	9	4.5
N20,001 and above	6	3.0

Source: Field Survey, 2008

Table 2 provides information on the livelihood activities of women in the study area. It is observed that processing of fish/other aquatic products (67.5%) remains the major livelihood activity of women in the area. Moreover, 9.5% and 8.0% of the respondents engaged in gathering non-fish aquatic products and trading respectively as major sources of livelihood. The women also combined other activities for a living. Apart from the major livelihood activities, 39.0%, 37.5% and 36.0% of the respondents engaged in fishing, crop farming and gathering non-timber forest products respectively as supplementary livelihood activities. The findings support the observation by Olawoye (2002), that the concept of occupation involving one activity by which livelihood needs are met as used in the western world is not relevant to the experience of most rural dwellers in developing countries. These activities are also dependent on the environment, implying continuous pressure on the environment. This could lead to environmental degradation and unsustainable livelihood.

Table 2: Distribution of Respondents According to Involvement in Livelihood Activities

Livelihood Activity	**Major Activity**	**Minor Activity**
	Frequency (%)	**Frequency (%)**
Fishing	8 (4.0)	78 (39.0)
Gathering non-fish aquatic products	19 (9.5)	140 (70.0)
Processing of fish and other aquatic products	135 (67.5)	52 (26.0)
Crop farming	7 (3.5)	75 (37.5)
Livestock rearing	0 (0.0)	39 (19.5)
Trading	16 (8.0)	82 (41.0)
Hired Labouring	2 (1.0)	9 (4.5)
Civil Service/wage employment	4 (2.0)	29 (1.0)
Restaurants operations/food vending	3 (1.5)	1 (0.5)
Hair dressing	1 (0.5)	3 (1.5)
Gathering non-timber forest products	0 (0.0)	165 (82.5)
Others	7 (3.5)	8 (4.0)

Source: Field Survey, 2008

Table 3 presents the challenges to livelihood activities of women in the study area. According to the result, major challenges to livelihood activities of women in the area are water pollution (57.0%) and poor processing/storage equipment (56.5%.) Water is polluted as a result of oil spills and other oil exploration and exploitation activities. The implication is that many aquatic

lives are destroyed in the process, resulting in low fish catch and reduced quantity of fish and other aquatic products available for processing by the women. This suggests reduced income, increased poverty, unsecured livelihood and further pressure on the environment.

Another major challenge to livelihood activities of women in the region is poor and crude storage/processing equipment which leads to inefficiency in the storage/processing of the products. As a result, mangroves are constantly destroyed for firewood that is used in smoking and drying the fishes and other products. This causes deforestation and environmental degradation. About 37% and 36% of the respondents noted that inadequate capital/credit facilities and high cost of processing/storage equipment respectively are major challenges to their livelihood activities in the region. Other major challenges to livelihood activities of women in the area include poor transportation network (21%) and poor marketing structure (26%). Poor transportation network increases the cost of production as the products are transferred to where they are needed. Poor marketing structure encourage sale of the product at the beach or at the farm gate. The challenges reduce the gains derived from the trade. About 13.5% and 4.5% of the respondents indicated high cost of fishing equipment and poor soil structure/fertility respectively as challenges to their livelihood activities.

Table 3 also shows that, though the major livelihood activity of majority of women in the area is processing of fish/other aquatic products, 36% of the respondents indicated water pollution as the leading challenge of all the challenges to livelihood activities of women in the area. This indication can be explained by the fact that fish must first be caught before they are processed, as water pollution reduces the daily fish catch. On the contrary, 32% of the respondents pointed out that poor processing/storage equipment is the leading challenge of all the challenges to livelihood activities of women in the area. The result is suggestive of continuous deforestation in the process of gathering firewood needed for drying the fishes and other products. Other challenges identified by the respondents as leading challenges include high cost of processing/storage equipment (17%), inadequate capital/credit facilities (6%) and high cost of fishing equipment (4.5%).

These challenges to livelihood activities of women have implications for sustainable livelihood, agriculture and environment. They reduce livelihood outcomes causing a short-fall in their ability to meet households' livelihood needs. To cope with this short-fall, environment, the stock of natural capital is further exploited. The uncontrolled exploitation of the environment leads to its degradation and inability to sustain agriculture and livelihood. The immediate and long term effects of this web of relationship are low and unsustainable livelihood outcomes, unsustainable agriculture and environmental degradation.

Table 3: Distribution of Respondents According to Challenges to Livelihood Activities

Challenge	Not a Challenge	Minor Challenge	Major Challenge	Leading Challenge
High cost of fishing equipment	150 (75.0)	22 (11.0)	28 (14.0)	9 (5.5)
Low processing capability	147 (73.5)	19 (9.5)	34 (17.0)	1 (0.5)
Poor processing/storage equipment	58 (29.0)	29 (14.5)	113 (56.5)	64 (32.0)
High cost of processing/storage equipment	93 (46.5)	35 (17.5)	72 (36.0)	34 (17.0)
Water pollution	64 (32.0)	22 (11.0)	114 (57.0)	72 (36.0)
Deforestation	156 (78.0)	31 (15.5)	13 (6.5)	0 (0.0)
Insufficient land	193 (96.5)	5 (2.5)	2 (1.0)	0 (0.0)
Poor marketing structure	91 (45.5)	57 (28.5)	52 (26.0)	5 (2.5)
Poor/obsolete farm tools	188 (94.0)	9 (4.5)	3 (1.5)	0 (0.0)
Inferior cultivar/breeds of agricultural input	181 (90.5)	12 (6.0)	7 (3.5)	0 (0.0)
Poor soil structure/fertility	151 (75.5)	40 (20.0)	9 (4.5)	0 (0.0)
Inadequate capital/credit facilities	71 (35.5)	55 (27.5)	74 (37.0)	12 (6.0)
Poor extension services	184 (92.0)	12 (6.0)	4 (2.0)	0 (0.0)
Poor transportation network	102 (51.0)	55 (27.5)	43 (21.5)	3 (1.5)

Source: Field Survey, 2008

Analysis of the relationship between personal characteristics of the respondents and identified leading challenge to livelihood activities of women is presented in Table 4. The table shows that age of the respondent (χ^2 = 9.397, p < 0.05) was significantly related to the identified leading challenge to livelihood activities of women in the area. This suggests that women of various age groups in the study area have peculiar challenge and disposition to what constitutes leading challenge to livelihood activities of women in the area. This could be a direct influence of the length of time spent in the area, on their various livelihood activities and the experience gathered overtime. Marital status (χ^2 = 2.346, p > 0.05), household headship (χ^2 = 3.221, p > 0.05), years of formal education (χ^2 = 4.043, p > 0.05), household size (χ^2 = 0.265, p > 0.05) and monthly income (χ^2 = 1.528, p >.0.05) were not significantly related to identified leading challenge to livelihood activities of women in the area.

Table 4: Analysis of the Relationship between the Personal Characteristics and Identified Leading Challenge to Livelihood Activities of Women in the Area

Variable	χ^2	cc	p	Remarks
Age	9.397	0.168	0.044	S
Marital status	2.346	0.143	0.483	NS
Household headship	3.221	0.067	0.768	NS
Years of formal education	4.043	0.107	0.611	NS
Household size	0.265	0.071	0.520	NS
Monthly income	1.528	0.048	0.092	NS

NS = Not significant

S = Significant at 0.05%

Table 5 shows that there is a significant relationship between the major livelihood activities of the respondents and identified leading challenge (χ^2 = 5.292, p < 0.05). The result suggests that the difficulties encountered in the execution of the major livelihood activity of a respondent influence the leading challenge to the livelihood activities identified by the respondents. The implication is

that as majority of the respondents engage in activities that are dependent on the environment, the identified leading challenge will also be environment oriented. Therefore, if effective and sustainable relief to the challenge is not provided, there is bound to be a continuous exploitation and consequent degradation of the environment.

Table 5. Chi-square Analysis of the Relationship between Major Livelihood Activity and Identified Leading Challenge to Livelihood Activities of Women in the Area

Variable	χ^2	cc	p	Remark
Major livelihood Activity	5.292	0.211	0.025	S

NS = Not significant
S = Significant at 0.05%

CONCLUSION AND RECOMMENDATIONS

Women in Eastern Obolo Local Government Area engaged in multiple activities to make a living. These activities face a lot of challenges, leading to declining livelihood outcomes and unsustainable environment. It is therefore recommended that efforts be made to improve the livelihood portfolios of women in the area to make them sustainable. This could be achieved by controlling water pollution caused by oil exploration and exploitation activities, provision of modern processing/storage facilities and provision of credit facilities at low interest rate. Good roads and a responsive marketing structure should be put in place. Policies should also be directed towards creating enabling environment for diversification to other livelihood activities that are not directly dependent on the environment.

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Determinants of Poverty among Fish Farming Households in Osun State, Nigeria

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Abstract: The study covered two ADP zones from the three ADP zones in Osun state. The state was purposively chosen for the study based on the highest proportion of fish farmers found in the state compared with other states in South-western Nigeria. Out of the total 906 fish farmers in the Southwest, Osun State had the highest fish farmers of 300 followed by Oyo with a total of 234 fish farmers. The primary data were collected via structured questionnaire from fish farmers in the study area. The study employed multistage sampling techniques for the selection of the respondents. Sample sizes of 145 respondents out of 150 copies of questionnaire administered were finally accepted for the study. Data were analysed using descriptive statistics, distance function, FGT Poverty measure and logit regression model.

The poverty distribution of fish farmers in the study area showed that about 12 percent of fish farmers were non poor, about 15 percent were moderately poor and about 74 percent were core poor. On the determinants of poverty, age, marital status, years of schooling, credit, contact with extension agent, membership of association and primary occupation in non farming had an inverse relationship with the level of moderate poverty level while household size, age square, sex, pond size, years of experience and primary occupation in farming had direct relationship with the level of moderate poverty. Pond size was significant at 1% level while household size, years of schooling and credit were significant at 5% level. On the core poverty, age, years of schooling, pond size, credit and primary occupation in non-farming had an inverse relationship while household size, age square, sex, marital status, years of experience, contact with extension agent, membership of association and primary occupation in farming had direct relationship with the level of core poverty. Household size, years of schooling and credit access were significant at 1% level in the study area.

Key words: Core poor, moderately poor, determinants of poverty, distance, Logit model

INTRODUCTION

Nigeria is predominantly an agrarian country where the greatest percentage of the population is engage in farming. The vital role that agriculture plays in the economic development of Nigeria cannot be over emphasised. It provides the bulk of employment, income and food to the populace and it also provides raw materials for the agro-allied industries as well as market for industrial goods. Despite this, some of the realities of Nigerian economy in recent years have been the continuous shortages and the high prices of foodstuffs (FAO, 2000).

Furthermore, Nigerian Agriculture currently employs about two-third (2/3) of labour force and contributes about one-third (1/3) of the GDP (Gross Domestic Product). The average contribution of fishing sector to the agricultural GDP rose from 2.6% in 1980 to 3.7% in 1990 and was estimated at about 4% for the year 1994. It has

been said earlier on that Agricultural practice **i**s to ensure food production and security of livelihood. The economy, which could be secured by growing food crops and diversifying its activities over a wide range of agricultural venture in pursuance of income generating techniques or procedure through the optimum use of under used resources, therefore accounts for the foundation of fish acculturation (FAO, 2000).

Fisheries constitute an important sub-sector of agriculture and have been playing a significant role in nutrition, employment, foreign exchange earnings and food supply etc. Agriculture contributed 32.24% to the gross domestic product (GDP), and the fishery sub-sector contributed 3.10% to GDP in 1998 -99. About 12.05% of the population depends directly, or indirectly, on fishing and ancillary occupation. The fishery sub-sector provides full time employment to over 12 million people, which constitute about 3% of the active population, another 11 million people indirectly earn their livelihood from activities related to fisheries (FAO, 1999).Fishery sub-sector of agriculture recorded the fastest growth rate in the relative contribution made by various sub-sector of agriculture to the GDP (World Bank, 1998). Meanwhile, the growing aquaculture industry has attempted to fill the gap between supply and demand. But as the global appetite for fish continues to increase, current trends in the fish sector pose serious risks to the environment, to the well-being of poor people, and to the viability of fish sector itself (Delgado *et al*, 2003).

Poverty in Nigeria is a grave problem and has been on the increase for many decades, being endemic in rural areas where the main occupation is farming. In recent times, technological advancement especially in agriculture has been very instrumental in reducing the poverty problem. The conceptual debate around poverty arises when taking up the nature of that missing thing. The debate on the nature and level of what should not be lacking to anybody and to define a minimal level below which a member of the society is characterised as “poor”.

The capability approach is used in a wide range of fields, most prominently in development thinking, welfare economics, social policy and political philosophy. It can be used to evaluate a wide variety of aspects of people’s well-being, such as individual well-being, inequality and poverty (Robeyns, 2003). The core characteristics of the capability approach is its focus on what people are effectively able to do and to be, that is, on their capabilities. This contrasts with philosophical approaches that concentrate on people’s happiness or desired-fulfillment, or on theoretical and practical approaches that concentrate on income, expenditures, consumption or basic needs fulfillment. People's lives are not measured by income alone (Women Aid International, 1996). Poverty should be viewed as the deprivation of basic capabilities rather than merely the lowness of income (Iceland and Bauma, 2004). The capability approach focuses on the information that we need to make judgments about individual well-being, social policies, and so forth, and consequently rejects alternative approaches that it considers normatively inadequate, for example, when an evaluation is done exclusively in monetary terms and also be used for poverty analysis (Robeyns, 2003).

Poverty assessment studies in Nigeria showed that 87% and 67% of core poor in 1985

and 1992 respectively, were engaged in agriculture, and that all basically resided in rural areas (Canagarajah, and Thomas, 2001). It was revealed that many of the poor have very little land on which to sustain their rapidly growing families, lack basic inputs and in most cases, experience declining growth in their agricultural production and productivity. These are usually resorted to the exploitation of very fragile environments and a cycle of low production, low income and poverty in a bid to make up for declining production. One sure way of increasing the welfare of these farmers is the intensification of agricultural production. This will be possible only if they are able to take full advantage of aquaculture production. Omonona *et al* (2006) observed that poverty in Nigeria is an overwhelmingly grave problem and has been on the increase for many decades, being endemic to rural areas where the main occupation is farming. In recent times, technological advancement especially in agriculture has been very instrumental in reducing the poverty problem. The specific objective of the study is to analyse the determinants of probability of being poor as a function key functioning (durable asset, health related issue, leisure time, housing condition, empowerment and participation) in the study area.

Capabilities and its relationship to poverty

The capabilities approach is useful for examining the overlapping concepts of poverty. According to Sen (1993); an individual's well being or quality of life should be assessed in terms of the individual's capabilities, the ability or potential to achieve certain things or functioning's. Functioning range from elementary such as being socially integrated based on how individuals attach weights to these functioning. The capability of an individual reflects the different combinations of functioning the person is able to achieve dependent on their particular circumstances.

Sen (1999) argues in support of a capability approach to poverty. This represents a non-welfarist approach, which use basic achievements (such as the ability to meet basic needs by converting goods) rather than actual goods or utilities as the means for comparing well-being (Ravallion, 1996). To focus upon an individual's opportunity to pursue his/her objectives, one must consider not only those primary goods possessed by that individual but also the relevant personal characteristics governing individual's ability to promote his/her ends (Sen 1999). Building on this perspective, the capabilities approach for understanding poverty is illustrated by (Sen. 1993). The capabilities approach is concerned with evaluating an individual's advantage in terms of "actual ability to achieve various valuable functioning as a part of living" (Nussbaum and Sen, 1993).

Deutsch and Silber (2005) clearly stated that the information that one may have on the types and amount of goods with which various individuals are endowed does not necessarily allow us to draw conclusion as to their standard of living or quality of life. Conceptualising the idea of quality of life is in fact not a simple task. Sen (1985) made such an attempt when he introduced the notions of "capability" and "functioning" to translate empirically Sen's ideas. Lovell *et al* (1994) advocated the use of efficiency analysis and Deutsch *et al* (2003) repeated their attempt using more detailed and recent data.

Input Distance Function Analysis

We used a technique originally proposed by Lovell *et al* (1994) based on the concept of distance functions in order to estimate first indices measuring the level of achievement reached by the individual fish farmer in each of the dimensions distinguished, e.g. Education, revenue, membership of cooperatives, and nature of housing and second an index aggregating these various achievement levels into an overall index of wellbeing or human development. In accordance to Sen's (1984) "capability approach" we see the standard of living primarily as a basket of multiple resources—commodities—and the quality of life as a basket of functioning. A functioning is an achievement of a person: what he or she manages to do or to be, and reflects a part of the "state" of that person.

An input distance function is the minimal proportional contraction of the input vector, given an output vector. For the analysis of human development, the input vector contains all constituent elements of the different dimensions or domains of our fish farmer's capability, here the vector of their durable goods and total output. Economists have traditionally identified well-being with market command over goods, thus, confounding the "state" of a person —well-being— with the extent of his or her possessions —being well-off (Deutsch and Silber, 2005).

Let us illustrate the concept of (input) distance function with a simple example where two constituent elements (inputs), X_1 and X_2 are used in the production of an achievement level (output) vector, u. In Figure 1, the input set,

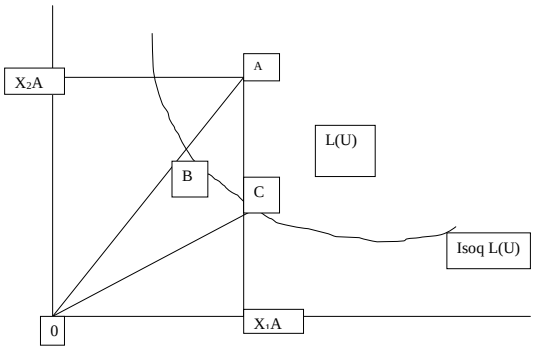

Fig 1.The Concept of Distance Function

L(U), is the area bounded from below by the isoquant, Isoq-L(U). The value of the distance function for point A (using input quantities X_1A and X_2A to produce (U) is equal to the ratio 0A/0B. That is, it is the amount by which the input vector x must be divided in order to bring it on to the isoquant curve Isoq-L(U). Hence, when the input vector lies exactly on the isoquant curve (as in point B or C) the distance function shows a minimum value of 1. To put it differently, production activity A is inside of the input requirement set and thus inefficient. In terms of distance, the Farrel measure of technically efficiency is given by 0B/0A and the Shephard's distance function is the inverse OA/OB. When the observation is efficient, both the Farrel measure and the distance function equal 1. The Farrell measure varies between zero and 1, and the distance function is equal to or greater than 1. The (input) distance function is non-decreasing, positively linearly homogeneous and concave in X, and decreasing in U; properties which are especially attractive in the present context and thus strengthen the argument for using distance functions.

In Figure 1 let q' be the input vector corresponding to OB and q be that corresponding to OA. Let ρ be equal to the ratio OB/OA. In other

words q' is obtained by a proportional change ρ in the input quantities defined by q. Assume the prices of the inputs are given by a vector p0. Nothing guarantees then that the input contraction defined by the distance function ρ will yield the cheapest cost, at input prices P0 of producing the output level y0 defined by the isoquant BC. There exists however at least one vector price p for which this distance function ρ = OB/OA will yield the cheapest cost of producing this output level y0. There is therefore a clear link between the concepts of distance and cost functions because $D_{in}(q', y_0) = Min_p pq'$ such that the cost function $c(y_0, p) = 1$. The distance and cost functions are clearly dual to one another: just as the cost function seeks out the optimal input quantities given y0 and p0, the distance function finds the prices that will lead the consumer to reach the output level y0 by acquiring a vector of quantities proportional to q.

Estimation Procedures

Let us take as a simple illustration the case of a Cobb–Douglas production function. Let ln yi be the logarithm of the output of a fish farmer i = 1 to I and xi a vector, whose first element is equal to one and the others are the logarithms of the N inputs used by the firm. We may then write that

ln (yi) = xi.β - ui, i = 1, …,I

…… (vi)

where β is a (N + 1) vector of parameters to be estimated and u a nonnegative random variable, representing the technical inefficiency in production of firm i.

The ratio of the observed output of firm i to its potential output will then give a measure of its technical efficiency Ti so that

$$T_i = y_i / \exp(x_i.\beta) = \exp(x_i.\beta - u_i) / \exp(x_i.\beta) = \exp(-u_i)$$ …….. (vii)

One of the methods allowing the estimation of this output-oriented Farrell measure of technical efficiency Ti (Farrell, 1957) is to use an algorithm proposed by Richmond (1974) which has become known as corrected ordinary least squares (COLS). This method starts by using ordinary least squares to derive the (unbiased) estimators of the slope parameters. Then in a second stage the (negatively biased) OLS estimator of the intercept parameter b_0 is adjusted up by the value of the greatest negative residual so that the new residuals have all become non-negative. Naturally the mean of the observations does not lie any more on the estimated function: the latter has become in fact an upward bound to the observations.

One of the main criticisms of the COLS method is that it ignores the possible influence of measurement errors and other sources of noise. All the deviations from the frontier have been assumed to be a consequence of technical inefficiency. Aigner *et al*. (1977) and Meeusen and van den Broeck (1977) independently suggested an alternative approach called the stochastic production frontier method in which an additional random error v is added to the non-negative random variable u.

$$In(y_i) = x_i.\beta + v_i - u_i$$ …….. (viii)

The random error v is supposed to take into account factors such as the weather, the luck, etc. *i* is assumed to be independently and normally distributed, normal random variables with mean

zero and constant variance σ_v^2, independent of u, the latter being taken generally to be independently and normally distributed, exponential or half-normal random variables. In the latter case where u is assumed to be independently and normally distributed, truncations (at zero) of a normal variable N(0, σ), Battese and Corra (1977) suggested to proceed as follows. Calling σ^2 the sum they defined the parameter $\gamma = (\sigma^2 / \sigma_s^2)$ (so that γ has a value between zero and one) and showed that the log-likelihood function could be expressed as

$$In(L) = -(N/2)In(\pi/2) - (N/2)In(\sigma_s^2) + \sum_{i=1}^{I}[1-\Phi(z_i)] - [1/(2\sigma_s^2)]\sum_{i=1}^{I}(Iny_i - x_i\beta)^2$$

where $z_i = [(In\, y_i - x_i.\beta)/\sigma_s].\sqrt{(\gamma/(1-\gamma))}$ *and* $\Phi(.)$ *is the distribution function of the standard normal random variable.*

…..(ix)

The Maximum Likelihood estimates of β, σ_s^2 *and* γ *are* obtained by finding the maximum of the log-likelihood function defined previously where this function is estimated for various values of γ between zero and one. More details on this estimation procedure are available in programs such as FRONTIER (Coelli, 1992) or LIMDEP (Green, 1992) which is used in this study.

Applying These Ideas to the Measurement of Poverty

Estimating the standard of living index on the basis of information on the ownership of durable goods and farmers revenue.

Let x= (x1,…,xN) $\in \square_{++}^{N}$ denote the resources vector and u = (u1, . . . , uM) $\in \square_{++}^{M}$ denote the functioning vector. Then an individual's resources and functioning are denoted by the pair (xi, ui), i = 1, . . . I. A theoretical standard of living index SL can be estimated using a Malmquist input quantity index (Coelli., 1998):

$$SL(u, x^s, x^t) = D_{in}(u, x^s) / D_{in}(u, x^t) \quad \text{…….. (x)}$$

Where x^s and x^t are two different resource vectors and D_{in} is an input distance function.

The idea behind the Malmquist index is to provide a reference set against which to judge the relative magnitudes of the two resource vectors. That reference set is the isoquant L(u) and the radially farther xi is from L(u) the higher its standard of living, for xi must be shrunk more to move back onto the reference set L(u). Individuals with resource vectors onto L(u) share the lowest standard of living, with an index value of unity, whereas individuals with large resources vectors will then have higher standards of living, with index values above unity. To estimate the distance function, let λ = $(1/x_N)$ and define a (N - 1) dimensional vector z as

$z = \{z_j\} = \{x_j / x_N\}$ *with* $j = 1, ..., N-1$. *Then* $D_{in}(z, e) = (1/x_N)$ *and* , *since* $D_{in}(x, e) \geq 1$, *we have*

$$(1/x_N) \leq D_{in}(z, e) \quad \text{……} \quad \text{(xi)}$$

This implies that we may also write

$$(1/x_N) = D_{in}(z, e).\exp(\varepsilon), \varepsilon \leq 0. \quad \text{……} \quad \text{(xii)}$$

Estimates of the coefficients a*i* and a*j* may be obtained using COLS (corrected ordinary least squares) or Maximum Likelihood methods while the input distance function *Din*(*zi*, *e*) for each individual *i* is provided by the transformation assuming that Din(e, z) has an exponential functional form, we have

$$In(y_i) = x_i.\beta + v_i - u_i \quad \text{…….. (xiii)}$$

The subscripts i and j refer to the i^{th} farmers and ji^{th} observation respectively. We employed prospect index on the basis of relative importance (PI_{RI}) has been developed by Singh and Sain (2003)

METHODOLOGY

Study Area - The study is carried out in Osun State. Osun State has 3 agricultural development project (ADP) zones, Osogbo, Iwo and Ife/ Ijesha. The ADP headquarters is at Iwo. The study covered two ADP zones in all. Osun State has 300 fish farmers which is the highest in Southwestern Nigeria. (Aquaculture and inland fisheries project, 2005). This study made use of both primary and secondary data. The study employed multistage sampling technique for the selection of the respondents. From the three OSSADEP zones in Osun State (Osogbo, Iwo and Ife/Ijesha) two (Osogbo and Ife/Ijesha) were chosen marking the first stage. The random selection of 8 Local Government Areas from the 12 Local Government Areas in Osogbo zone, 7 Local Government Areas from the 11 Local Government Areas in Ife / Ijesha zone totaling 15 Local Government Areas from the whole 30 Local Government Areas in Osun State formed the second stage. The third stage was the random selection of 10 fish farmers each from the randomly selected Local Government Areas. From Osogbo ADP zone in Osun State, a total of 80 respondents were selected and from Ife/Ijesha in Osun State a total of 70 respondents were selected summing up to a total of 150 respondents from Osun State. However, a sample size of 145 respondents out of 150 respondents in Osun State was finally accepted for processing.

Data - Total durable asset dimensions combines both aquacultural and non-aquacultural assets. Weights were assigned to each one according to their priorities. Security dimension was measured in terms of numbers of attack within a year (Deutsch and Silber, 2005). The information concerning work-life balance came from answers to two questions on the satisfaction with ones amount of leisure time and with that spent with children. To assess the economic status, we used per capita income. This measures household income per household size. Standard of living index was measured bearing in mind the three basic necessities of life (clothing, feeding and shelter). It takes on the values in the interval (0, 1), where zero denotes minimum level of standard of living and one complete attainment of standard of living. Y = standard of living index, X_1= log of per capita income, X_2 =health related issues, X_3= educational dimension, X_4 = water poverty, X_5= housing conditions, X_6= total durable Assets, X_7= security, X_8= work-life balance

The poverty line

This is a pre-determined and well-defined standard of income or value of consumption. In this study, the relative poverty line was based on the output of the input distance function of the households. A distance function is the transformation of output of the stochastic frontier model for measuring technical efficiency as proposed by Green (1992). A relative approach was used in which a household was defined as poor relative to other in the same society or economy ($^1/_3$, ½ or $^2/_3$ of the population). Two thirds of the mean of the output of the input distance function was used as the moderate poverty lines while one third of the mean was taken as the line for core poverty. The mean was obtained by dividing the sum of all values obtained from the output of the input distance function by the number of households surveyed. The coefficient of the output of the technical efficiency was transformed by finding the inverse of that coefficient. Instead of

using the common money metric approach of expenditure, this transformed coefficient was used as the basis for measuring the respondents' capability. The categorisation of the poverty line is given as: Core poor; below 1/3 of mean, moderately poor: below 2/3 of mean and Non-poor: above 2/3 of mean (Omonona et. al, 2006)

Determinants of Poverty

The analysis utilised the Logit regression model as stated below:

$qi = pi = \beta Xi + \mu i$

$qi = Pi = \beta Xi + \mu I,$

$i = 1,2,3\ldots\ldots\ldots\ldots 145$

qi is the dependent variable. It is one when the household is not poor and zero when poor. Xi is a vector of explanatory variables, β is the vector of unknown coefficients, and it's an independently distributed error term.

X_1 = household size, X_2 = age of head of household, X_3 = square of age of head of household, X_4 = sex 2 dummies, X_5 = marital status 3 dummies, X_6= years of schooling, X_7 = pond size, X_8 = credit access, X_9 = experience, X_{10} = extension agent contact, X_{11}= fish farmer association, X_{12} = primary occupation 2 dummies.

RESULTS AND DISCUSSION

Functioning and Capability Poverty analysis

Table1 was derived from the result of the transformation data for the capability approach. Instead of using the common expenditure usually known as the money metric approach, these transformed data usually called the capability approach was used as the basis for measuring the poverty level of the respondents. Two poverty lines were drawn, 1/3 and 2/3 of the mean were used and percentages was employed to arrive at those that were core as well as moderately poor. The approach was in line with the study of Lovel *et al* (1994).

Table 1 presented the capability-poverty distribution of fish farmers in the study area. It was revealed that 12, 15 and 74 percent were non poor, moderately poor and core poor respectively in the study area. Based on this finding, the respondents were poor in the study area. In the overall, majority of them were poor in terms of functioning and basic capability. The findings was quite the opposite of the findings of Deustch and Silber (2005) who found out that majority of their respondents were non poor in terms of their capability poverty analysis in Israel. This finding was in line with the findings of Balestrino in 1996 that concluded policy wise that for pure functioning poor, in-kind transfers would be more effective to fight poverty than cash transfers. It also corroborated the findings of Lovell *et al* (1994) which stated that, all individuals were equally proficient in transforming resources into functioning.

Table 1: Distribution of farmers based on Functionings and Capability Poverty analysis in Osun State

Poverty	Frequency	Percentage%
Non poor	17	11.72
Moderately poor	21	14.48
Core poor	107	72.79
Total	145	100.00

Source: Field Survey, 2007

Results of the Logit Regressions: These results were given in Table 2, giving successively the results of the estimations derived on the basis of the distance function approach to poverty measurement. The explanatory variables that have been introduced have generally a significant impact. Thus households whose head had a higher educational level had, ceteris paribus, a lower

probability of being core poor, an inverse relationship. The probability of core poor decreases with the age of the household head. Other things constant we also observe that the probability that a household is considered as core poor is lowest among heads of household that are male, an inverse relationship. Also, pond size, access to credit and primary occupation in non-farming had probability of reducing core poverty among fish farmers in the study area. This probability is highest when the head of the household is married. Age square, years of experience, contact with extension agent, fish farmer association, household size and primary occupation are farming had a direct relationship with the probability of core poor. The probability of core poor increases as those factors increases. Years of schooling, pond size and access to credit were significant at 1% level as the significant factors for reducing core poverty.

Table 2: Result of the Logit Regression model based on the distance function on the determinants of core poor households in Osun state n=124

Variables	**Coefficient**	**T-value**	**Sig. level**
Intercept	1.06752	2.10	0.36
Household size	0.59616	-0.06	-0.96
Age of head of household	-0.20570	-1.05	0.30
Square of age of head of household	0.25329	1.18	0.24
Head of household is male	-0.87146	-1.20	0.22
Head of household is Married	-2.56142	3.88	0.60
Head of household is divorced or separated	0.95631	4.62	0.45
Head of household is single	0.78624	5.06	0.34
No of years of schooling	-0.71261	-12.11	0.01
Pond size	-0.11198	-2.09	0.04
Credit	-0.19935	-2.64	0.01
Experience	0.14441	1,17	0.24
Extension contact	0.81796	1.45	0.15
Membership of Association	0.84710	1.41	0.16
Primary occupation is farming	0.11071	0.18	0.86
Primary occupation is non farming	-59616	-0.06	0.96
Actual versus	**predicted values**	**(percentage)**	
		Predicted Value	
Actual Value	**0**	**1**	**Total**
0	52.40	7.00	59.40
1	20.40	20.20	40.60
Total (in %)	**72.80**	**27.20**	**100.00**

Source: Field Survey 2007

The results for the determinants of moderate poverty were given in Table 3, giving the results of the estimations derived on the basis of the distance function approach to poverty measurement. The explanatory variables that have been introduced have generally a significant impact. Thus households whose head had a higher educational level have, ceteris paribus, a lower probability of being moderately poor, an inverse relationship.

Other things constant we also observe that the probability that a household is considered as moderately poor is lowest among heads of household that had access to credit, an inverse relationship. Also, pond size, fish farmer association and primary occupation is non-farming

had probability of reducing moderate poverty among fish farmers in the study area. This probability is also lowest when the head of the household is married. The probability of moderate poor increases with the size of the household as well as with the square of age of the head of the household a direct relationship. Years of experience, contact with extension agent and primary occupation is farming also had a direct relationship with the probability of moderate poor. Years of schooling and access to credit were significant at 10% while pond size was significant at 1% level as the significant factors for reducing moderate poverty.

Table 3: Result of the Logit Regression model based on the distance function on the determinants of moderately poor households in Osun state. n=38

Variables	**Coefficient**	**T-value**	Sig. level
Intercept	2.02325	0.52	0.61
Household size	0.37263	0.50	0.62
Age of head of household	-0.69156	-0.44	0.66
Square of age of head of household	0.77811	0.44	0.66
Head of household is male	0.553823	1.00	0.32
Head of household is Married	-0.75139	-1.31	0.19
Head of household is divorced or separated	0.25601	8.62	0.15
Head of household is single	0.32624	4.06	0.94
No of years of schooling	-0.77187	-1.81	0.07
Pond size	-1.91483	-2.83	0.05
Credit	-1.05431	-1.86	0.06
Experience	0.84166	1,55	0.12
Extension contact	0.77194	1.47	0.14
Membership of Association	-0.24123	-0.45	0.65
Primary occupation is farming	0.95108	0.20	0.85
Primary occupation is non farming	-20570	-1.05	0.30
Actual versus	**predicted values**	**(percentage)**	
		Predicted Value	
Actual Value	**0**	**1**	**Total**
0	42.40	7.00	49.40
1	30.40	20.20	50.60
Total (in %)	**72.80**	**27.20**	**100.00**

Source: Field Survey 2007

CONCLUSION AND RECOMMENDATION

This study shows how distance functions, a tool typically employed in production economics to measure the distance between a set of inputs and a set of outputs, can be employed to approximate a composite multidimensional measure of standard of living. It also illustrates how to implement the methodology originally put forth by Lovell *et al* (1994), using data originally collected from aquaculture. Number of years of schooling, age, sex, pond size, access to credit and primary occupation is non farming had probability of reducing household core poverty while age, marital status, numbers of years of schooling, pond size, access to credit, fish farmer association primary occupation in farming had probability of reducing moderate poverty.

Based on the research findings of this study, the following policy measures are thereby recommended to increase the production of fish in the study area. We found out that not all the individuals were equally proficient in converting resources into functioning, as it was depicted that majority of them were functioning and capability poor .It is therefore, recommended that individuals should be concerned with how they convert their

achievement into various functioning rather than mere achievement. Schooling level decreases poverty, therefore everybody should be encouraged to be educated as well as improve on their level of education. Since it was shown that the more educated they are the lower the poverty. Access to credit should be given priority among fish farmers in the study area. Construction of more fish ponds by fish farmers should be given priority in the study area.

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Effect of price and income changes on farmers' cassava marketed surplus in Edo state, Nigeria

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Abstract: The study investigated the effect of price and income changes to cassava farmers' marketed surplus in Oredo and Egor Local Government Areas of Edo State, Nigeria. To achieve this objective, the study examined the price elasticity of home consumption, the income elasticity of marketed surplus of cassava and the total price elasticity of cassava marketed surplus. The study used mainly primary data. Cross-sectional data were collected from 352 cassava farmers using the simple random sampling technique through well-structured questionnaire. The questionnaire contained questions that bothered on consumption, total production, and marketed surplus, price of cassava and income of farmers. The model used specified the consumption decision as a function of price of cassava and the farmer's income, and marketing was treated as residual using marketed surplus as a measure of marketing. Using the two Stage Least Square (2SLS) estimation method, the result suggested that the farmers were price and income responsive as consumers, and higher prices resulted in larger quantities being marketed with income elasticity of consumption of 0.59. This value implies that percentage change in consumption per unit percentage change in income is 0.59. For every percentage increase in income, there was a less than proportional increase in consumption. Thus a policy of attempting to stimulate output through higher prices which will reduce consumption by producers, as a result of increase in their income, will also be consistent with evoking a larger proportion of the output produced for non-farm consumers such as the urban industrialists.

Keywords*: production, consumption, output, marketed surplus, elasticity*

INTRODUCTION

Cassava is Africa's second most important food staple, after maize, in terms of calories consumed. Cassava is a major source of calories for roughly two out of every five Africans. According to Jones (1959); Fresco (1986); Dostie *et al* (1999); and Haggblade *et al* (2003), cassava is consumed daily and sometimes more than once a day. In the Democratic Republic of Congo, cassava contributes more than 1000 calories per person per day to the diet and many families eat cassava for breakfast, lunch, and dinner. Cassava is consumed with a sauce made with ingredients rich in protein, vitamins, and minerals. In the Congo, Madagascar, Sierra Leone, Tanzania and Zambia, cassava leaves are consumed as a vegetable (Jones, 1959; Fresco, 1986; Dostie *et al*, 1999; and Haggblade *et al*, 2003). Cassava leaves are rich in protein, vitamins, and minerals (Latham, 1979). Nevertheless, in Africa, cassava is a marginalised crop in food policy debates because it is burdened with the stigma of being an inferior, low-protein food that is uncompetitive with the glamour crops such as imported rice and wheat. Many food policy

analysts consider cassava an inferior food because it is assumed that its per *capita* consumption will decline with increasing per capita incomes. In some East and Southern African countries, such as Malawi, Tanzania, and Zambia, British colonial policies forced indigenous farmers to plant cassava as a famine-reserve measure and subsidised maize grown by settler farmers (Jones, 1959). Over the past 50 years, smallholders in Nigeria have increased the production of cassava as a cash crop, primarily for urban markets. In the 1990s, Africa produced half of the world cassava output, primarily because Nigeria increased her production fourfold. Thus, Nigeria has replaced Brazil as the world's leading cassava producer (Nweke, 2004). This shift to commercial production for urban consumers, livestock feed, and industrial uses can be described as the cassava transformation. During the cassava transformation, high-yielding cassava varieties increase yields while labor-saving and improved processing technologies reduce the cost of producing and processing cassava food products to the point where they are competitive with food grains such as wheat, rice, maize, and sorghum for urban consumers. Looking ahead, as the costs of cassava production, harvesting, processing, and marketing are reduced, one can expect cassava to play an expanded role as a source of livestock feed and industrial raw material in Africa as well as a source of foreign exchange earnings through the export of cassava pellets for livestock feed. The cassava transformation**,** as described in detail by Nweke *et al* (2002), encompasses four stages: Famine Reserve, Rural Food Staple, Urban Food Staple, and Industrial Uses and Livestock Feed. In a war situation, cassava has several advantages over yam production. For example, the establishment cost of cassava production for home consumption is generally low because stem cuttings and family labor are the main inputs. Cassava generates a high yield of carbohydrate per hectare and it requires labour only at planting weeding and harvesting with little or no fertiliser application. Since the roots can be stored in the ground for several months and even up to four years without deterioration, there is a possibility that a displaced population can find their cassava fields un-harvested upon their return home. At the average monthly exchange rate of 17 Naira to US$1.00 (1993 exchange rate) and the average of 11 persons per household in Collaborative Study of Cassava in Africa (COSCA), the mean cash income per person in the COSCA households was equivalent to US$177 which amounted to 120 percent of agricultural GDP per capita in the same year. That the cash income of the COSCA households is greater than the agricultural GDP per capita can be a paradox. But the chaos that exists in Nigeria's agricultural production statistics is exceptional (Berry, 1993).

The main objective of the study is to examine the effect of price and income changes to farmers' cassava marketed surplus in Oredo and Egor local government areas of Edo state in Nigeria. To achieve this objective, the study examined the price elasticity of home consumption, the income elasticity marketed surplus of cassava and the total price elasticity of cassava marketed surplus

LITERATURE REVIEW

Marketable Surplus refers to the quantity of produce which can be made available to the non-farm population, that is, the residual left with the

producer/farmer after meeting his requirements for family consumption, seeds, feed for cattle, payment to labour in kind, payment to artisans (carpenter, blacksmith, potter, mechanic), payment to landlord as rent and social and religious payments in kind is the quantity of produce which the producer/farmer actually sells in the market, irrespective of his other requirements. "Surplus" in the sense that buyers do not exhaust supply at any price acceptable to sellers is standard usage in economics. With food, the term denotes that a few countries have become net exporters of certain food-stuffs around which there is intense sales competition on the world market. While this is an important consideration for American agriculture, which produces many of those foodstuffs and competes on the world market, it says nothing about whether the world's growing human population can be adequately fed by any likely increases in food production. Used in connection with world population, world carrying capacity, or sustainable production, "food surplus" is misleading or worse. Unfortunately, the erroneous connection is widely made (Abelson, 1987). Only from the producers' point of view is there surplus. From many potential consumers' standpoint there is shortage. Some go hungry even in countries that are net exporters of food (Poleman, 1975). There is surplus largely because millions of malnourished persons do not have the financial wherewithal to create an economic demand sufficient to acquire a nutritionally adequate share (Wortman, 1980). The real costs associated with producing the marketed surplus suggest that far more than a distributional problem is involved. "New and better crop varieties" are cited as the most important factor in the increase in world food supplies (Abelson, 1987).

METHODOLOGY:

Study Area: the study was carried out in Uselu, Ugbiyiokho and Useh communities of Oredo and Egor Local Government Areas of Edo state, Nigeria.

Source of Data: The study used primary data only. Cross-sectional data were collected on 352 cassava farmer in Oredo and Egor Local Government Areas of Edo State.

Sampling Technique: The simple random sampling technique was used to collect data through the use of well-structured questionnaire. The questionnaire contained questions that bothered on consumption, total production, and marketed surplus, price of cassava and income of farmers.

Method of Data Analysis: The simple descriptive and inferential statistic was used in the study. The descriptive statistics used the frequency counts and percentages while the inferential statistics used the two Stage Least Square (2SLS) regression. The model used in this study is the same as that used by Bardhan (1970) and modified by Walter (1975). The total production (supply) of cassava (S) is allocated among consumption by cultivators (C), marketing (M), and other net disposals to non–cultivators (T) which consist of payments in kind for rent, wages and the like. The identity is given as:

$S \equiv C + M + T$ [1]

The farmer's short run decision is to allocate S –T = Q between consumption and sales.

$$C = f(P,Y) \quad \ldots\ldots [2]$$

and

$$M = Q - C(P,Y) = f(P,Y,Q) \quad \ldots..[3]$$

where Q = the net production

Y = net income of farmers which includes the income from cassava consumed and sold less all costs, i.e. sale (PQ) + other income (y^o)

P = price of the commodity in the market.

The linear functional form for estimating the consumption equation is given as:

$$C = \alpha_0 + \alpha_1 p + \alpha_2 Y + \mu_i \quad \ldots. \ [4]$$

Substituting [4] into [3] for marketing gives

$$M - Q = -C = -\alpha_0 + \alpha_1 P + \alpha_2 Y - \mu \quad \ldots \ [5]$$

The total price elasticity of marketed surplus is given as

$$\eta_p = \frac{dM}{dP}.\frac{P}{M} = \varepsilon_{mp} + r\varepsilon_{my} = -b\left(\varepsilon_{cp} + r\varepsilon_{cy}\right)$$

where $\varepsilon_{cp} = \frac{dC}{dP}.\frac{P}{C}$ represents farmer's price elasticity of demand for cassava, $\varepsilon_{cy}\frac{dC}{dY}.\frac{Y}{C}$, for income elasticity of farmer, $r = \frac{PQ}{Y}$ and $b = \frac{C}{M}$ is the ratio of consumption to marketed surplus.

The estimation method simply treated P and Y an endogenous and either of equation [4] or [5] was estimated by the method of two–stage least squares (2SLS).

RESULTS AND DISCUSSION

The summary statistics of production, consumption, net disposal and marketed surplus is presented in Table 1. The Table showed that the average total farm production of cassava is 38500 tonne with a standard deviation of 100 .8, which is highest among the small-scale farmers (56.27) and least among the medium-scale farmers (15.13). The large variability by the standard deviation implies that the farmers operated at different levels of farm sizes, as shown by the different size categories, which tend to affect their output level. The means consumption was 15600 with a standard deviation of 36.6. The variability in consumption measured by the standard deviation is due to the changes in consumption pattern under the production season. The mean total marketed surplus for marketing was 22772.75 with a standard variation of 27.17. This low variability implies that the farmers, on average, operated at different levels of net disposal to non-cultivator (a measure of the cost structure) which tend to affect their output level and marketed surplus. This low variability is also shared by the small-scale farmers (1.11). Among the different farm size groups, positive trend was noticed in respect of output, quantity consumed and marketable and marketed surplus of cassava. The proportion of marketed surplus to marketable surplus showed the declining trend with increasing farm size. The proportion of revenue to income is about the same for all categories of farm size, suggesting the non-dependence of revenue on farm size, and non-profitability of cassava in the study area, given the same market price. There is a greater variability in output among the farmers than there is in consumption, though with a higher variation in output among the small-scale farmers. This result is reflected in their income in which there is great variation in the entire sample with the small-scale farmers displaying higher variability. The reverse is the case with revenue in which variation is more noticed among the large-scale farmers.

Table1: Summary Statistics of Variable of Production, Consumption, Net Disposal and Marketed Surplus

Variable	Farm size			Entire Sample
	Small	Medium	Large	
Output	10582	26504	36106	38500
	(57.27)	(15.13)	(54.12)	(100.8)
	100.0%	100.0%	100.0%	100.0%
Consumption	8642.32	11171.44	11214.52	15600
	(0.19)	(12.17)	(2.11)	(36.6)
	81.67%	42.15%	31.06%	40.52%
Kind wages	267.72	924.99	1433.41	1378.3
	2.53%	3.49%	3.97%	3.58%
Farm need	130.16	564.54	621.02	1790.25
	1.23%	2.13%	1.72%	4.65%
	1541.80	13843.04	22837.05	19731.25
Marketable surplus	14.57%	52.23%	63.25%	61.25%
	2032.80	16363.57	24490.70	22772.75
Marketed surplus	(1.11)	(11.28)	(21.01)	(27.17)
Marketed surplus as % of output	19.21	61.74	67.83	59.15
% of marketed to marketable surplus	131.85	118.21	107.24	115.41
Income	9114.25	22793.44	31051.16	44700
	(121.17)	(79.10)	(101.15)	(432.10)
Price	21400	21400	21400	21400
Revenue (PQ)	3590.47	8992.81	12250.77	13061.92
	(0.03)	(9.07)	(17.11)	(132.09)

Figures in parentheses are standard errors
Source: Author's calculation from Field Survey, 2008.

The sign of estimates conform to *a priori* expectations and all parameters are significant at 5% level of significance as shown in Table 2. The result showed that the consumption of cassava will increase by 0.206 unit for every unit increases in the farmer's income while consumption will decrease by 1.23 for every unit increase in the price of cassava for the entire sample. This decrease in consumption as price increases implies that the farmers will have more for the market, *ceteris paribus*. The disproportionate increase in the consumption of cassava as income increases shows that cassava is an inferior commodity. These observations are also shared by all categories of farm size except that the decrease in consumption is highest among the large-scale farmer (-1.57) for unit increase in the price of cassava. Similarly, the proportionate increase in the consumption of cassava as income increases is highest among the large-scale farmers.

Table 2: the 2SLS Estimate of the Consumption Function.

Variable	Parameter	Estimate
Entire sample		
Constant	α_0	163.15
		(51.12)
Price	α_1	-1.23
		(0.56)
Income of farmer	α_2	0.206
		(0.0021)
Small farm size		
Constant	α_0	150.01
		(7.13)
Price	α_1	-1.02
		(0.97)
Income of farmer	α_2	0.209
		(0.039)
Medium farm size	α_0	
Constant		111.03
		(10.12)
Price	α_1	-1.41
		(0.76)
Income of farmer	α_2	0.317
		(0.064)
Large farm size		
Constant	α_0	57.19
		(21.19)
Price	α_1	-1.57
		(0.93)
Income of farmer	α_2	0.513
		(0.071)

Source: Author's calculation from Field Survey, 2008.

Table 3 shows the estimates of the elasticities of consumption and marketing. The Table showed that the income elasticity of consumption, 0.59, is inelastic since it is less than one. This value implies that percentage change in consumption per unit percentage change in income is 0.59. It implies that increase in income leads to a less than proportionate increase in consumption. The positive sign implies that income affects the consumption of cassava, but proportionate change in consumption is less than the proportionate change in income. This implies that farmers will retain a smaller percentage and make a larger percentage available for off-farm consumption (marketing). The 1.15 represent the direct price effect of marketing, while the -0.40 shows the indirect effect of income on marketing induced by a change in price. Estimate of total price elasticity of 1.03 indicates that as the price increases, the farmers will market more of cassava. The small-scale farmers tend to market more of their produce than any other category of farmers. This is contrary to the result of Bardhan (1970) who found the price elasticity of marketing to be negative. The result in this study, however, is in agreement with Walter (1975).

Table 3: Estimate of Price and Income Elasticities of Consumption and Marketing

Elasticity	Estimate			
	Farm size			Entire Sample
	Small	Medium	Large	
ε_{cp}	-2.53	-2.70	-3.00	-1.69
ε_{cy}	0.22	0.65	1.42	0.59
ε_{mp}	10.74	1.84	1.37	1.15
ε_{my}	-0.52	-0.44	-0.65	-0.40
η_p	10.54	1.67	1.11	1.03

Source: Author's calculation from Field Survey, 2008.

CONCLUSION

The study examines the price and income elasticities of home consumption and marketed surplus of cassava. A model concerning the decision to allocate the net production of cassava between consumption and marketing was used. The model specified the consumption decision as a function of price of cassava and the farmer's income, and marketing was treated as residual using marketed surplus as a measure of marketing. Using the 2SLS estimation method, the evidence suggests that the farmers are price and income responsive as consumers, and higher prices will result in larger quantities marketed. Thus a policy of attempting to stimulate output through higher

prices will also be consistent with evoking a larger proportion of the output produced for non-farm consumers such as the urban industrialists.

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Farmers' Perception of the Factors Militating Against Rubber Production in Edo and Delta States of Nigeria

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Abstract: The study investigated the perception of rubber farmers on the factors militating against rubber production in Edo and Delta states of Nigeria. Ikpoba-Okha and Ethiope-west Local Government Areas were purposively selected from Edo and Delta states respectively. A simple random sampling technique was used in selecting 120 rubber farmers as respondents for the study. Data were analysed using descriptive statistics such as frequency counts, percentages, means, and standard deviation. The Pearson Product Moment Correlation was the inferential statistics used. Findings reveal that 76.7% of the rubber farmers are male, 55.0% are within the age range of 36 to 45 years and are educated to the primary level of education respectively. Also, 85.0% are married with 48.3% having a farm size of between 6 to 10 hectares. Furthermore, friends/relatives ($\bar{x}$ =3.48) and radio/television ($\bar{x}$ =2.53) were the major sources of production information, while family/relatives ($\bar{x}$ =3.72) and hired labour ($\bar{x}$ =3.03) were the major sources of farm labour. The use of formic acid (85.8%) and clean coagulating pans (70.0%) were the main rubber production technologies adopted in the study area. The predominant factors militating against rubber production were credit for production ($\bar{x}$ =2.93), low prices of coagula ($\bar{x}$ =2.63) and unavailability of land ($\bar{x}$ =2.41). Age, (r=-0.001; p>0.05), household size, (r=-0.137; p>0.05) educational level, (r=-0.084; p>0.05) and farm size, (r=-0.175; p0.05) were not significant factor to their perceived constraints militating against rubber production. It was recommended that farmers should be guided on obtaining loans from financial institutions and the land reform agenda of the government should be intensified to enhance easy access to land by small scale farmers.

Keywords: Rubber, constraints, militating, production.

INTRODUCTION

Natural rubber (*Hevea brasiliensis*) which is traditionally native to the Amazon jungle of South America was introduced to Nigeria from England around 1895, with the first rubber estate established in Sapele in the present day Delta State in 1903, (Giroh *et al*, 2004). By 1925 there were already thousands of hectares of rubber estates that were predominantly owned by Europeans in Southern Nigeria.

It should be noted that Nigeria has a very vast potential for rubber production especially in many of the southern States in the country where the vegetative and climatic conditions are suitable for its production. Aigbokaen *et al* (2000), Abolagba and Giroh (2006) noted that rubber can be grown extensively in Edo, Delta, Ogun, Ondo, Abia, Anambra, Akwa-Ibom, Cross River, Imo, Ebonyi and Rivers states where the annual rainfall range between 1800mm and 2000mm per annum.

Rubber contributes basically three functions in the Nigerian economy in terms of providing raw materials for agro-based industries, foreign exchange earnings and in the provision of employment. With regards to the provision of raw materials, it should be noted that the uses to which rubber can be put is almost innumerable. The latex from rubber is a vital material in the automobile industry as it is used in the manufacture of tyre, car bumpers, transmission belt, car mat, seats etc. The latex is also used for the manufacture of adhesive, baby feeding bottle teat, condom, domestic and industrial gloves, balloons, balls, eraser among others (Abolagba *et al*, 2003).

Furthermore, the rubber seeds when processed produce oil alkyd resins used for paints, soap, skin cream and hair shampoo. The rubber seed cake left as residue after oil is extracted from the seed is also valuable in compounding livestock feeds (Fasina, 1998).

It is however pathetic that with the enormous potential resources that can be generated from rubber production the crop has been neglected over the years. According to Abolagba and Giroh (2006), Nigeria's production of rubber has witnessed a steady decline over the years from 155,000 metric tonnes in 1991 to 46,000 metric tonnes in 2004. Mgbeje (2005) asserted that there is a decline in planted area with the over-aged trees abandoned. This has led to many rubber processing companies folding up and huge resources lost in the process. It is therefore apparent that measures should be put in place to halt the huge resources being lost. Hence, this study was undertaken to examine factors associated with the decline in rubber production.

Objective of the study

The general objective of the study was to investigate factors considered by rubber farmers as militating against rubber production in Edo and Delta States. The specific objectives were to:

1. Ascertain the personal characteristics of rubber farmers.
2. Determine the rubber farmers' sources of production information.
3. Ascertain the level of adoption of selected production technologies among rubber farmers.
4. Investigate constraints perceived by rubber farmers as militating against rubber production in the study area and ascertain rubber farmers' perceived solutions to these problems.

Hypothesis of the study

The hypothesis of the study is stated in null form that "there is no significant relationship between the farmers' personal characteristics and the perceived factors affecting rubber production"

METHODOLOGY

The study was conducted between June and July 2008 in Edo and Delta states of Nigeria, which are located in the south-south geo-political zone of the country. The area is predominantly

made up of the rainforest and the mangrove swamp. The total land area of the two States is about 35,502km^2 with food and tree crops such as cassava, yam, maize, plantain, oil palm, cocoa and rubber predominantly cultivated. One major rubber producing local government area was purposively selected from each State. Ikpoba-okha LGA.was selected from Edo state and Ethiope-west L.G.A. was selected from Delta State. Ikpoba-okha LGA has 5 rural communities noted for rubber production from which 3 communities were randomly selected and the communities are Obayantor, Obagienevbosa and Okha. On the other hand, Ethiope-west L.G.A. has 6 rural communities noted for rubber production from which 3 communities were randomly selected and the communities are Ovade, Otefe and Otumara. A simple random sampling technique was used in selecting 20 farmers from each of the selected communities, giving a total of 120 rubber farmers that were used for this study.

Data for this study was gathered with the use of copies of a questionnaire administered as an interview schedule due to the low educational level of the respondents. Respondents' adoption of recommended improved rubber production technologies was ascertained using a 3 point rating scale of: adopted and still using (3 points), adopted but discontinued (2 points), not adopted (1 point), on a list of 12 recommended practices. Perceived factors affecting rubber production was measured using a 3 point rating scale of: high constraint (3 points), low constraint (2 points) and no constraint (1 point) on a list of 9 production constraints. Respondents' perceived solutions to the problems were ascertained using a 5 point rating scale of: Strongly agree (5 points), agree (4 points), undecided (3 points), disagree (2 points) and strongly disagree (1 point) on a list of 9 plausible solutions to the problems. Data were analysed using frequency counts, percentages, mean, standard deviation and Pearson Product Moment Correlation (PPMC).

RESULTS AND DISCUSSION

Personal characteristics of respondents

The personal characteristics of the respondents are presented in Table 1. Table 1 indicates that 55.0% of the respondents of this study are between the ages of 36 to 45 years age. This implies that many of the respondents are in their active age and should be favourably disposed to the adoption of technologies. It also shows that 76.7% of the respondents are male, which is an indication that rubber production is male dominated. Also, 85.0% of the respondents are married, which is not unexpected because of the importance attached to the marriage institution and family labour is still very important for many small-scale farmers. Furthermore, 51.7% of the respondents have a family size of between 4 to 6 people, with 48.3% having 6 to 10 hectares of rubber plantation. This may be regarded as small because rubber plantations are usually in large hectares. Furthermore, Table 1 shows that 55.0% of the respondents have primary level of education and this may be considered as a low level of education which is also not unexpected because of the low literacy level in many rural area of the country. Finally, Table 1 reveals that 41.7% of the respondents are engaged in craftwork as the major non-farm activity, which is necessary to augment the income from their farms.

Table 1: Personal characteristics of rubber farmers (n = 120)

Personal characteristics	Frequencies	Percentages
Age (Years)		
Below 25	3	2.5
26 to 35	25	20.8
36 to45	66	55.0
46 to 55	24	20.0
Above 55	2	1.7
Gender		
Male	92	76.7
Female	28	23.3
Marital status		
Married	102	85.0
Single	13	10.8
Widowed	4	3.3
Divorced	1	0.8
Household size		
Less than 3	8	6.7
4 to 6	62	51.7
7 to 9	34	28.3
Above 9	16	13.3
Farm size (hectare)		
Below 5	50	41.7
6 to 10	58	48.3
11 to 15	11	9.2
Above 15	1	0.8
Level of education		
No formal education	6	5.0
Primary	66	55.0
Secondary	32	26.6
OND/NCE	11	9.2
B.Sc./HND	5	4.2
Non farm occupation		
Handicraft	64	53.3
Petty trading	42	35.0
Teaching	2	1.7
Driving	2	1.7
Student	1	0.8
No response	9	7.5

Source: Field survey, 2008

Sources of production information

The different sources from where respondents obtain production information are presented in Table 2. Findings in Table 2 indicates that friends/relatives ($\bar{x}$ = 3.48) and radio/television ($\bar{x}$ = 2.53) are the major sources from where the respondents obtain production information. Banmeke and Olowu (2005) and Oladele (2006) have noted that friends/relatives, radio and television are the important sources from where farmers obtain agricultural information.

Table 2: Sources of production information

Sources	Means	Standard deviations
Friends/relatives	3.48	0.60
Radio/Television	2.53	0.68
ADP	1.68	0.65
Newspaper	1.66	0.80
Rubber Research institute of Nigeria	1.59	0.61
Michelin Plc	1.29	0.54
Buyers	1.22	0.73

Scale: Regularly = 4, occasionally = 3, rarely = 2, never = 1. Source: Field survey, 2008.

Adoption of rubber production technologies by farmers

The adoption of rubber production technologies by the respondents is presented in Table 3. The Table reveals that the use of formic acid for coagulation (85.8%) and clean coagulating pans (70.0%) are the major rubber production technologies adopted by the respondents in the study area. The use of ethrel to stimulate latex production and latexo meter which is used to determine the quality of latex were not adopted by the farmers, which may be attributed to the fact that the farmers do not test the latex for quality.

Table 3: Adoption of rubber technologies

Technologies	Adopted	Discontinued	Never adopted
Use of formic acid for coagulation of latex	(85.8)*	(12.5)	(1.7)
Use of clean coagulating pan	(70.0)	(22.5)	(7.5)
Tapping at 30 degrees	(49.2)	(32.5)	(18.3)
Half spiral third day tapping	(47.5)	(30.8)	(21.7)
Use of fire trace	(45.8)	(29.2)	(25.0)
Use of metal spout and hanger	(35.0)	(50.0)	(15.0)
Intercropping with arable crops	(26.7)	(26.7)	(46.7)
Use of latex sieve	(1.7)	(25.8)	(72.5)
Use of ammonia for preservation	(0.8)	(24.2)	(75.0)
Use of ethrel to stimulate latex flow	-	-	(100.0)
Use of herbicides	-	(1.7)	(98.3)
Use of latexo meter	-	-	(100.0)

*Figures in parenthesis are percentages. Source: Field survey, 2008.

Perceived factors affecting rubber production by farmers

The factors considered to be affecting the production of rubber by the respondents are presented in Table 4. Table 4 indicates that credit for production ($\bar{X}$ = 2.93), low prices of latex/coagula ($\bar{X}$ = 2.63) and unavailability of land ($\bar{X}$ = 2.41) are some of the major factors affecting the production of rubber in the study area. Abolagba (1997) noted that rubber production is both labour and capital intensive, with many small holder rubber farmers having no access to production credit needed in rubber business. Also, fluctuations in the international price of rubber, especially low prices affects the production of rubber significantly as most of the product is often exported because of the very limited number of industries in the country that utilise it.

Table 4: Perceived factors affecting rubber production

Factors	Means	Standard deviations
Credit for production	2.93	0.28
Low prices of latex/coagula	2.63	0.67
Unavailability of land	2.41	0.67
Old age of rubber plantation	2.30	0.72
Lack of production information	2.18	0.62
Unavailability of planting materials	2.08	0.69
Wind hazard on rubber trees	2.08	0.74
Fire outbreaks on plantation	1.93	0.73
Unavailability of experienced tappers	1.70	0.74

Source: Field survey, 2008.

Solutions suggested by rubber farmers to production constraints

Suggested solutions to the production constraints by the respondents are presented in Table 5. Respondents of the study are of the opinion that some of these suggestions can ameliorate the production constraints. The suggested solutions include: credit at minimal interest rates should be provided to farmers' cooperatives ($\bar{X}$ = 4.38), extension organised training for farmers ($\bar{X}$ = 4.27) and provision of

land by government for the establishment of new plantations ($\bar{X}$ = 4.26). It is important that the farmers constitute themselves into cooperative societies and approach relevant authorities in order to obtain loans for their production activities. Also, it is apparent that extension agents mainly focus on arable crop farmers, while tree crop farmers are often neglected. There is also an urgent need to review the land use act in the country so as to make land available for productive ventures.

Table 5: Suggested solutions to the production constraints

Suggestions	Means	Standard deviations
Provision of credit to farmers cooperatives at low interest rates	4.38	0.79
Extension agents organised training programmes for farmers	4.27	0.95
Government provision of land to farmers	4.26	0.87
ADP and research institutions reaching out to the farmers to understand their problems	4.11	0.94
Replanting of plantation	4.10	0.99
Sale of budded stumps to farmers at subsidised rates	3.87	1.07
Organising effective market information network to enhance prices	3.77	1.20
Use of fire trace during dry season	3.67	1.21
Planting of wind resistance clones	2.38	1.27

Source: Field survey, 2008.

Relationship between farmers' personal characteristics and their perceived constraints to rubber production

The test of the relationship between respondents' personal characteristics and the perceived constraints to rubber production was determined using PPMC and the result presented in Table 6. Findings in Table 6 indicate that there is a negative correlation, though not significant, between the ages of the respondents and the perceived constraints to rubber production (r = -0.001: p>0.05). This implies that young farmers have a higher perception of constraints to rubber production than the older farmers. This may be because the older farmers are more experienced, those factors considered by the younger farmers may not be considered as problems by them. Also, household size, (r = -0.137: p>0.05), farm size (r = -0.175: p>0.05) and educational level (r = -0.084: p>0.05) all had a negative and no significant relationships with the perceived constraints to rubber production. The results imply that the lower the household size, the more the perceived constraints, the less the farm size, the more the perceived constraints and respondents with lower level of education had higher perception of the constraints. Those with few household sizes may not have enough hands to assist on the farm and therefore face more constraints on their farms; respondents with small farm sizes may also tend to experience more constraints as they may be unwilling to incur further cost to purchase improved farm techniques; while those with low level of education may experience more constraints because they lack the ability to interpret production information accurately.

Table 6: Relationship between personal characteristics of respondents and perceived constraints to rubber production

Variables	Correlation coefficient	Probability level	Decision
Age	-0.001	0.988	Not significant
Household size	-0.137	0.135	Not significant
Farm size	-0.175	0.056	Not significant
Educational level	-0.084	0.363	Not significant

Source: Field survey, 2008.

CONCLUSION AND RECOMMENDATIONS

The study has shown that friends/relatives, radio and television are the major sources from which rubber farmers often obtain production information. Rubber farmers in the study area have also adopted technologies such as the use of formic acid and clean coagulating pans. The major factors affecting rubber production are credit for production, low prices of latex, and unavailability of land. The respondents are of the opinion that provision of credit to cooperative societies, training by extension personnel and provision of land for cultivation would go a long way in addressing some of these problems. Based on the foregoing it is recommended that rubber farmers should form cooperative societies and be guided on how to obtain credit from financial institutions. The government should intensify the land reforms as stipulated in the seven point agenda of the Federal Government of Nigeria to facilitate access to land by small holder farmers. Rubber processing industries should be established in these areas as a means of checking the low prices and at the same time reduces unemployment which can check the militancy among youths in the region.

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Profit efficiency of small scale cowpea farmers in Niger state, Nigeria

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Abstract: The study examined the estimation of profit efficiency of small scale cowpea farmers in Niger State, Nigeria: A stochastic profit frontier approach. Data used for the study were obtained using structured questionnaire administered to 100 randomly selected cowpea farmers from Paiko and Gurara Local Government Areas of the State. The study showed that the levels of profit efficiency ranged from 11.62% to91.90% with mean of 77.75% suggesting that an estimated 22.25% of the profit was lost due to a combination of both technical and allocative inefficiency in cowpea production. From the results obtained, although farmers were generally relatively efficient, they still have room to increase the profit efficiency in their farming activities as about 23 percent efficiency gap from optimum (100%) remains yet to be attained by all farmers. The result further showed that, age, farmers' educational level, and years of farming experience significantly influenced the farmers' efficiency positively. It is recommended that investments in rural education through effective extension delivery program in the current political and economic environment in Nigeria should be provided

Keywords: Stochastic profit frontier, profit efficiency and cowpea production, Niger state

INTRODUCTION

The rapid increase in the country's population from about 60 million in 1963, to a recent figure of about 140 million in 2006 coupled with increase in the standard of living and other economic and political factors have greatly raised the demand for food. The importance of legume crops is becoming clearer to most of farmers and citizenry in the recent years. For most of the major food crops of the world, a lot of information is already available, however, legumes such as cowpeas, Soya bean, bean and groundnut which are widely used as a good source of plant protein in the diet of both man and livestock, have been largely neglected. The growth in cowpea production has been primarily due to rapid population growth, large internal market demand complemented by the availability of high yielding improved varieties of cowpea, relatively well developed market access infrastructure, then existence of improved processing technology and an international movement structure (Rowland 1993).

Almost all the vegetable cowpea and seed are valuable food and source of vitamins and protein. This provides household food security, compared to other grains; cowpea is more tolerant to soil fertility and thrives well in warm climate with moderate and evenly distributed rainfall. Cowpea provides income and employment opportunities for most people in the rural communities, particularly

women who are entirely responsible for its processing and marketing. It provides them additional earning opportunity to contribute to the household food security.

Resource allocation and productivity is an important aspect of increased food production which is also associated with the management of the farmers who employ these resources in production. Furthermore, efficiency in the use of available resources is a major pivot for a profitable farm enterprise. Therefore, inefficiency in the use of resources, wrong choice of enterprise combination and cropping systems constitute the major constraints to increased food production in Nigeria (Okorji and Obiechina, 1985).

The subject of economic analysis of cowpea production in Nigeria has received considerable attention in the literature, however few of such studies from the study area had estimated profit efficiency as well as determined economic efficiency in cowpea production. Also, little attention has been given to measuring profit efficiency of farmers even when the prices of output and input are known in an attempt to examine the allocative efficiency of the farmers. The physical productivity considerations are important improvement in production efficiency, but profit efficiency will lead to greater benefits to agricultural producer in the country. Given this backdrop this study sets out to analyse profit efficiency of small scale cowpea farmers in Niger State, Nigeria using a stochastic profit frontier approach and to identify farm-specific characteristics that explain variation in the efficiency of individual farmers.

Conceptual Framework

Production inefficiency is usually analysed by its two components – technical and allocative efficiency. In a production context, technical efficiency relates to the degree to which a farmer produces the maximum feasible output from a given bundle of inputs (an output oriented measure), or uses the minimum feasible level of inputs to produce a given level of output (an input oriented measure). Allocative efficiency, on the other hand, relates to the degree to which a farmer utilises inputs in optimal proportions, given the observed input prices (Coelli *et al*., 2002). The popular approach to measure efficiency, the technical efficiency component, is the use of frontier production function (e.g. Battese and Coelli, 1995 and Battese, 1992). However, Yotopoulos *et al* (1973) and others argue that a production function approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowments (Ali and Flinn, 1989). This led to the application of stochastic profit function models to estimate farm specific efficiency directly (e.g., Ali and Flinn, 1989; Sanzidur, 2003 and Ogundari, 2006).

Coelli, (1996); Battese and Coelli (1995) extended the stochastic production frontier model by suggesting that the inefficiency effects can be expressed as a linear function of explanatory variables, reflecting farm-specific characteristics. The advantage of Battesse and Coelli (1995) model is that it allows estimation of the farm specific efficiency scores and the factors explaining efficiency differentials among farmers in a single stage estimation procedure. The present paper utilises Battesse and Coelli (1995) model by postulating a profit function, which is assumed to

behave in a manner consistent with the stochastic frontier concept. Profit efficiency is a broader concept since it takes into account the effects of the choice of vector of production on both costs and revenues.

The stochastic profit function is defined as

$$\pi = f(P_{ij}, Z_{ik}) \bullet \exp(\varepsilon)$$

The error term ε_i is assumed to behave in a manner consistent with the frontier concept (Ali and Flinn, 1989), i.e. $\varepsilon_i = V_i + U_i$

where π_i is normalised profit of the ith farm defined as gross revenue less variable cost, divided by farm specific output price; P_{ij} is the price of j^{th} variable input faced by the i^{th} farm divided by output price; Z_{ik} is level of the k^{th} fixed factor on the i^{th} farm. V_i's are assumed to be identically and normally distributed with mean zero and constant variance as $N(0,\delta^2 v)$. U_i is the one-sided disturbance form used to represent profit inefficiency and it is independent of V_i; and i = 1,2 ….., n, is the number of farms in the sample.

The production/profit efficiency of farm *i* in the context of the stochastic frontier profit function is defined as

$$EFF = E[\exp(U)] / \varepsilon_i = E[\exp(\delta_0 + \sum_{d=1}^{D} \delta_d W_{di})] / \varepsilon_i$$

where W_{di} is the d^{th} explanatory variable associated with inefficiencies on farm *i*, δ_0 and δ_d are the unknown parameters and E is the expectation operator. This is achieved by obtaining the expressions for the conditional expectation U_i upon the observed value of ε_i. The method of maximum likelihood is used to estimate the unknown parameters, with the stochastic frontier and the inefficiency effects functions estimated simultaneously. The likelihood function is expressed in term of the variance parameters, $\sigma^2 = \sigma v^2 + \sigma u^2$ and $\gamma = \sigma u^2 / \sigma^2$ (Battesse and Coelli, 1995). .The parameter γ represents the share of inefficiency in the overall residual variance with values in interval 0 and 1. A value of 1 suggests the existence of a deterministic frontier, whereas a value of 0 can be seen as evidence in the favour of OLS estimation.

METHODOLOGY

Study Area: The study was conducted in Niger State of Nigeria. The state is located within latitudes 8^o – 10^o north and longitudes 3^o – 8^o east of the prime meridian with land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2008). The state is agrarian and well suited for production of arable crops such as cowpea, yam, cassava and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranges from 23^oC and 37^oC (NSADP, 1994). The vegetation consist mainly of short grasses, shrubs and scattered trees.

Sampling Techniques: The data mainly from primary sources were collected from two Local Government Areas (LGAs) which were purposively selected because of prevalence of the crop in the area using multistage sampling technique. The LGAs include Paiko and Gurara LGAs. The second stage involved a simple random selection of 50 farmers from each of the two LGAs, thus, making 100 respondents. Data were collected with the use of structured questionnaire administered in the sampled farms to collect data relating to yield, a unit cost of labour per man day, land area under cultivation (ha), inputs prices such as price per kg of fertiliser, price per kg of seeds, average price of agro-chemical per litre and

average price of farm implements/tools. Data were also collected on the socioeconomic variables such as age, educational level (year of schooling), farming experience, number of extension contact and household size. The data collected (on quantity of cowpea harvested and output price) were used to compute farm total revenue as **P×Q**, where **P** is the price of the output and **Q** is the quantity produced while the farm level profit (π) was computed as difference between the total revenue and total variable cost expended on producing the cowpea i.e. [Gross Margin (π) = TR - WX].

Stochastic Profit Frontier Model Specification:

Profit efficiency in this study is defined as profit gain from operating on the profit frontier, taking into consideration farm-specific prices and factors. Given a farm that maximises profit subject to perfectly competitive input and output markets and a singular output technology that is quasi-concave in the (n x 1) vector of variable inputs, and the (m x 1) vector of fixed factors, Z the actual normalised profit function which is assumed to be well behaved can be derived as follows:

Farm profit is measured in term of Gross Margin (GM) which equals the difference between the Total Revenue (TR) and Total Variable Cost (TVC).That is:

$$GM(\pi) = \ddagger\text{''}(TR \quad TVC) = \ddagger\text{''}(PQ \quad WX_i)$$

To normalise the profit function, gross margin (π) is divided on the both side of the equation above by P which is the market price of the output (cowpea).That is:

$$\frac{\pi(p,z)}{P} = \frac{\ddagger\text{''}(PQ \quad WX_i)}{P} = \frac{Q \quad WX_i}{P} = f(X_i, Z) \quad \ddagger\text{''}p_i X_i$$

Where: TR represents total revenue, TVC represents total variable cost, P represents price of output (Q), X represents the quantity of optimised input used, Z represents price of fixed inputs used, $p_i = W/P$ which represents normalised price of input Xi while f(Xi, Z) represents production function.

The Cobb-Douglas profit function in implicit form which specifies production efficiency of the farmers is expressed as follows:

$\pi = f(P_{ij}, Z_{ik}) \bullet \exp(V_i \quad U_i)$, i = 1, 2,……..n .Where, π , pi , z, V_i and U_i are as defined above.

The profit efficiency is expressed as the ratio of predicted actual profit to the predicted maximum profit for a best-practiced cowpea farmer and this is represented as follows:

Profit Efficiency

$$(E\pi) = \frac{\pi}{\pi^{\max}} = \frac{\exp[\pi(p,z)]\exp(\ln V)\exp(\ \ln U) \quad \theta}{\exp[\pi(p,z)]\exp(\ln V) \quad \theta}$$

Firms specific profit efficiency is again the mean of the conditional distribution of U_i given by $E\pi$ and is defined as: $E\pi = E[\exp(\ U_i)/E_i]$

$E\pi$ takes the value between 0 and 1. If $U_i = 0$ i.e. on the frontier, obtaining potential maximum profit given the price it faces and the level of fixed factors. If Ui > 0, the firm/farm is inefficient and losses profit as a result of inefficiency.

However, for this study, Coelli (1996) model was used to specify the stochastic frontier function with behaviour inefficiency components and to estimate all parameters together in one step maximum likelihood estimation. The explicit Cobb-Douglas functional form for the cowpea farmers in the study area is therefore specified as follows:

$$\ln\pi = \ln\beta_0 + \ln\beta_1 Z_{1i} + \ln\beta_{2i} P_{1i} + \ln\beta_{3i} P_{2i} + \ln\beta_{4i} P_{3i} + \ln\beta_{5i} P_{4i} + \ln\beta_{6i} Z_{2i} + (V_i \quad U_i)$$

Where: Π represents normalised profit computed as total revenue less variable cost divided by farm specific cowpea price; Z_1 represents Farm size (ha); P_1 represents average

price per man day of labour; P_2 represents average price per kg of fertiliser; P_3 represents average price per kg of seed; P_4 represents price per litre of agro-chemical; Z_2 represents average price of farm tools.

The inefficiency model (Ui) is defined by:

$$U_i = \delta_0 + \delta_1 L_{1i} + \delta_2 L_{2i} + \delta_3 L_{3i} + \delta_4 L_{4i} + \delta_5 L_{5i}$$

Where L_1, L_2, L_3, L_4 and L_5 represent age, educational level, farming experience, household size and number of extension contact respectively. These socio-economic variables are included in the model to indicate their possible influence on the profit efficiencies of the cowpea farmers (determinant of profit efficiency)

The estimate for all parameters of the stochastic frontier profit function and the inefficiency model are simultaneously obtained using the program FRONTIER VERSION 4.1c (Coelli, 1996).

RESULTS AND DICUSSION

The summary statistics of the variables used appears in Table 1. The mean yield of 2,403.02 kg per ha of cowpea was recorded over the sampled area with a standard deviation of 1231.20kg/ha. Also an average of N 115.75 per kg of cowpea was recorded in the sampled area as price of output. Table 1 also showed the mean gross margin of ₦38, 879.30 with standard deviation of ₦24, 263.75. The average level of education of the farmers is less than eight years and the average years of experience in cowpea production are approximately 11 years.

Table1: Summary Statistics of the Variables in Stochastic Frontier Model

Variables	Minimum	Maximum	Mean	Standard Deviation
Cowpea Output (kg)	500.00	6,100.00	2,403.02	1,231.20
Gross Margin (₦)	3,059.59	113,365.20	38,879.3	263.74
Farm Size (ha)	0.75	4.00	2.13	0.91
Labour wage(₦/Man-days)	124.38	663.39	395.62	131.05
Fertiliser Price (₦/kg)	50.00	90.00	66.12	8.45
Agrochemical Price (₦ /Litres)	266.67	800.00	487.89	95.18
Seed Price (₦/kg)	115.57	200.00	141.69	23.72
Average Farm tools (₦)	600.00	1,300.00	1,057.79	146.14
Age (years)	20.00	70.00	35.77	9.06
Household Size	1.00	6.00	2.66	1.30
Education Level (years)	0.00	19.00	7.88	6.58
Years of Experience	2.00	40.00	11.34	7.80
Number of Extension Contact	0.00	4.00	2.28	0.71

Source: Field Survey, 2008

The result of the generalised likelihood ratio which is defined by the chi square distribution is presented in Table 2. The null hypothesis in the Table is Ho: $\gamma = 0$, which specifies that the inefficiency effects in the stochastic profit frontier are not stochastic. The null hypothesis is rejected. This implies that the traditional response function (OLS) is not an adequate representation of the data

Test of Hypotheses and Diagnostic Statistics

Table 2: Generalised likelihood ratio test of hypothesis for parameters of the stochastic profit frontier for small scale cowpea production in Niger State.

Null Hypothesis	Log likelihood	No. of Restrictions	χ^2 Statistics	Critical value	Decision
Ho: $\gamma = 0$	-71.78	7	14.12	14.07	Rejected

Source: Computed from MLE Results

The stochastic profit frontier function estimates of cowpea producers in Niger State are presented in Table 3. The Table showed that the estimated coefficients of the parameters of the normalised profit function are positive except the cost of labour. This indicated that a unit increase in prices of these inputs will lead to increase in the gross margin of cowpea.

Furthermore, the estimated gamma parameter (γ) of model 2 of 0.8222 in Table 2 was highly significant at 1 percent level of significance. This implies that one-sided random inefficiency component strongly dominates the measurements error and other random disturbance indicating that about 82 percent of the variation in actual profit from maximum profit (profit frontier) between farms mainly arose from differences in farmers' practices rather than random variability.

The parameters estimates for determinants of profit efficiency were reported in the lower part of Table 2. However, the analysis of inefficiency models shows that the signs and significance of the estimated coefficient in the inefficiency model have important implication on the profit efficiency of the farmer. And based on this, age, educational level and farming experience in the inefficiency model have negative coefficients, meaning that as these variables increase the profit inefficiency of the farmer decreases.

Table 3: Maximum Likelihood Estimates of the Stochastic Profit Frontier Function for Cowpea Production in Niger State.

Variables	**Parameters**	**Coefficients**	**t-ratio**
General Model			
Constant	$ß_0$	3.241	2.370**
Farm Size (ha) (Z_1)	$ß_1$	5.609	4.693***
Average Price per man-day of labour (P_1)	$ß_2$	-0.170	$-1.130^{N.S}$
Average Price of Fertiliser (kg) (P_2)	$ß_3$	0.249	1.773*
Average Price of Herbicide (Litres) (P_3)	$ß_4$	0.560	2.116**
Average Price of Seeds (kg) (P_4)	$ß_5$	0.493	2.205**
Average Price of Farm tools (kg) (Z_2)	$ß_6$	0.212	$0.746^{N.S}$
Inefficiency Functions			
Constant	δ_0	0.532	$0.305^{N.S}$
Age (years)	δ_1	-131	-1.904*
Household Size	δ_2	0.101	1.798*
Education Level (years)	δ_3	-0.306	-1.924*
Farming Experience (years)	δ_4	-0.190	-1.960*
Extension Contact	δ_5	0.745	$1.225^{N.S}$
Diagnosis Statistics			
Sigma-square σ^2		0.5762	1.799*

Gamma γ Log likelihood function LR Test	$\sigma^2 = \sigma_u{}^2 + \sigma_v{}^2$ $\gamma = \frac{\sigma_u{}^2}{\sigma_u{}^2 + \sigma_v{}^2}$ -71.78 14.12	0.8222	11.907***

Source: Computed from MLE Results
* = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level.
NS = Not significant

Profit Efficiency Estimates of the Farmers

The distribution of profit efficiency of cowpea production is presented in Table 4. The average profit efficiency score is 0.7775 implying that the average farm producing cowpea could increase profits by 22.25% by improving their technical and allocative efficiency. Some farmers demonstrated a range of profit efficiency of 0.9190 (91.90%) while the worst farmer had a profit efficiency of 0.1162 (11.62%). Despite wide variation in efficiency, about 83% of modern cowpea farmers seem to be skewed towards profit efficiency level of 71% and above. Nevertheless, the results imply that a considerable amount of profit can be obtained by improving technical and allocative efficiency in cowpea production in the area.

Table 4: Distribution of Profit Efficiency Indices among Farmers in the Study Area

Efficiency Class Index	Frequency	Percentage
0.00 - 0.10	0	0
0.11 – 0.20	1	1
0.21 – 0.30	1	1
0.31 – 0.40	1	1
0.41 – 0.50	0	0
0.51 – 0.60	3	3
0.61 – 0.70	11	11
0.71 – 0.80	33	33
0.81 – 0.90	47	47
0.91 – 1.00	3	3
Total	100	100
Mean	0.7775	
Maximum value	0.9190	
Minimum value	0.1162	
Standard Deviation	0.1268	

Source: Computed from MLE Results

SUMMARY AND CONLUSION

This empirical study is on estimation of profit efficiency among small scale cowpea farmers in Niger State, Nigeria: A stochastic profit frontier approach. . A Cobb-Douglas profit frontier was estimated by maximum likelihood estimation method to obtain ML estimates and inefficiency determinants. The MLE results revealed that profit efficiency of small scale cowpea farmers varied due to the presence of profit inefficiency effects in cowpea production. The results further revealed all the inputs have positive sign on the profitability of cowpea production in the study area except the unit cost of labour per man-day.

The distribution of the profit efficiency indices as shown that cowpea farmers were fairly efficient in their resources allocation, judged by the fact that more than half of the farmers having profit efficiency of 0.71 and above with an average profit efficiency of 0.77 suggesting that considerable amount of profit is gained due to the relative level efficiency of observed in the sample area. The results of the inefficiency model showed that the age, years of education and farming experience significantly increased the farmers' profit efficiency.

This study showed that small scale cowpea farmers were not fully efficient in their resource allocation and therefore there is allowance of efficiency improvement by addressing some important policy variables that could negatively and positively influence farmers' levels of profit efficiency in the area.

In conclusion, the investments in rural education through effective extension delivery program in the current political and economic environment in Nigeria will provide farmers with skills essential to increasing efficiency.

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The impact of transportation on agricultural production in a developing country: a case of kolanut production in Nigeria

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Abstract: Transport is regarded as a crucial factor in improving agricultural productivity. It enhances quality of life of the people, creates market for agricultural produce, facilitates interaction among geographical and economic regions and opened up new areas to economic focus.

This paper therefore looks critically at the crucial role transportation plays in Kolanut production in Nigeria. A total of 100 respondents were randomly selected and interviewed which represent 20% of the registered Kolanut farmers in Remo land, Ogun state with 40% of the respondents from Sagamu local government area and 30% each from Ikenne and Remo North local government areas respectively while the data collected were analysed using descriptive statistics such as Tables of frequencies and percentage distributions.

This study revealed that an improved transportation will encourage farmers to work harder in the rural areas for increased production, add value to their products, reduce spoilage and wastage, empower the farmers as well as having positive impact on their productivity, income, employment and reduce poverty level in the rural areas since it will be easier to move inputs and workers to farm as well as products to markets and agro-allied industry.

Key words: Transportation, Agricultural Production, Kolanut product

INTRODUCTION

Agricultural production is very important to the economy of developing nations as a whole and Nigeria in particular. It is the major occupation of the inhabitants and people of the country while it provides employment directly or indirectly for at least 60% of the people in Ogun State according to Aihonsu (1992). Most of the rural dwellers are traditional peasants, whose individual contribution is insignificant but collectively form an important bed - rock for economy of the state which represent 90% of food and fibre produced in Nigeria. The major agricultural products found in the area are cash crops like cocoa, kola-nut, rubber, palm-oil, citrus trees and the arable crops such as yam, maize, cassava, rice, coco-yam, sugar-cane and melon to mention a few. These products serve as food for man and raw materials for agro-allied industries within and outside the state while they also provide revenue to farmers and generate foreign exchange to the government.

Despite the fact that Nigeria is basically an agrarian nation and the majority of the goods to be transported are mostly agricultural products which according to Igben (1977) are by nature often bulky, low-priced, highly perishable. They must be conveyed from their area of production to their zone of consumption with minimum delay and

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cost, as well as widely dispersed over the available land area (Upton, 1988). It therefore requires a correspondingly wide-spread transport net-work to take produce from farm to market. Ajiboye (1995) observed that inadequate supply and high cost of food stuff is as a result of inefficient transportation and distribution. Inadequate transport provision leads to the total waste of 25% of the total agricultural foodstuff produced (Olajide, 1972). Idachaba (1980) in his study of food production problems in the rural areas contended that transportation among other factors represents the most serious constraint to agricultural product and development in Nigeria.

The role of transport is very crucial. It is a phase in production process which is not complete until the commodity is in the hands of the final consumers (Adefolalu, 1977). Availability of transport facilities is a critical investment factor that stimulates economic growth through increased accessibility, its efficiency and effectiveness (Ajiboye, 1994).All affects the basic function of production, distribution, marketing and consumption in many ways. Transportation also influences the cost of commodity consumed and the purchasing power of the consumers.

It is therefore against this background that an attempt is made in this paper to examine in depth how the transport situation in the study area affects agricultural products with emphasis on Kolanut production.

Kolanut as a cash crop

Kolanut is generally believed to be indigenous to West Africa and is of more than forty varieties of which four are commonly and widely cultivated and edible (Lovely, 1980). These are 'Cola acuminate', 'Cola nitida', 'Cola vertiaillata' and 'Cola anomala'. Only the first three have relevance for kola trade in Nigeria.

There are two major types of Kolanut in Remo land namely Cola 'nitida'- (kola of commerce), otherwise referred to as 'gbanja/ goro nuts' and 'Cola acuminata'(kola of social and traditional significance) known as 'abata nuts'. Nigeria produces about 120,000 tonnes of Kolanut annually according to Komolafe *et al* (1970) and Ajiboye (1995), they are mostly found in the south-western region of the country, covering Ogun, Ondo, Oyo, Osun and Lagos State. Kolanut contains about 2 percent caffeine and is chewed by many people as stimulant while it is also used in the manufacture of dyes and cola group of beverage drinks such as Coca-cola, Pepsi-cola, Afri-cola, Sena-cola to mention a few. A substantial quantity is exported to other African countries as well as to Europe and North America which generate the necessary foreign exchange earning to the government (Akinbode, 1982). It also employs a greater percentage of the people as Kolanut farmers, assemblers-processors, bulking agents, wholesaler, exporters, importers and retailers.

METHODOLOGY

Study area - Remoland is one of the four major divisions of Ogun State, Nigeria with population of 427,058 (FGN) and it is made up of three local government areas which are Ikenne with 113,735 people and Remo North with 59,911 in population while Sagamu is with population figures of 253,412 respectively according to Federal Government of Nigeria Gazettee (2007).

It is a semi-urban area with an urban population of about 64% according to Ajiboye and

Olaogun (2006). Among the major settlements in the study area are Sagamu, Iperu, Isara which are designated as urban by the Ogun State government in 1988 while other prominent ones include Ikenne, llishan, Ogere, Ode-Remo, Akaka, Irolu, Ilara, Ode-Lerno, Ewu-Osi, Ewu-Ode and Ipara.

The area is bounded in the east by Odogbolu and Ijebu-North local government areas, in the north by Oyo State, in the south by Lagos State and in the West by Obafemi/Owode and Ifo Local Government Areas. It has an absolute location of latitude 6° and 7° north of the Equator and longitude 2°45 and 4° east of Greenwich meridian and a land area of 97,298.34 hectares. It is one of the areas that occupy a strategic position in Ogun State being that it is situated midway between west and east.

The study area is an important commercial and industrial area. Apart from agriculture a considerable number of people of Remoland have shown interest in trading especially kolanut trading. There are 20 daily, periodic and night markets in the land which serves as outlets for agricultural produce and other goods from within and outside. Prominent of these markets are Sabo-Ofin, Awolowo, Falawo and Oja Oba in Sagamu, Ifepade, and Magbon in Isara, Aketan in Iperu while Sabo-Ofin market is the largest market noted for kolanut and general goods merchandise according to Ajiboye (1995).

The availability of infrastructural facilities such as pipe borne water, electricity, telephone, postal services and good network of roads at the major towns encourage the industrial and general development of the Remo land. A lot of the urban inhabitants are mostly engaged in non agricultural activities such as business and commerce, black and gold smith, tailoring, wood and steels works, mat and basket weaving and cloth weaving etc. Furthermore, there are some industrial establishments which are urban based. This includes the West African Portland Cement Company (WAPCO), Pipeline and Products Marketing Company (PPMC) Limited, Masimi, Sagamu.

Road transport is the most predominant mode of transportation in Remoland and this is a confirmation of the crucial role transport plays in the socio-economic development of a nation, be it developed or developing, rural and urban especially in the movement of people, goods and services, Jegede (1992) further said that road transport has the most complex network, covers a wide range, physically convenient, highly flexible and usually the most operationally suitable and readily available means of movement of goods and passenger traffic over short, medium and long distances in Ogun State.

The method of investigation for this study was essentially both descriptive and analytical in nature. One hundred respondents were selected using the random sampling method which represents 20% of the registered Kolanut farmers in Remoland with 40% from Sagamu local government area and 30% each from Ikenne and Remo North local government areas while hundred percent return rate was recorded. The questionnaire sought information on the socio-economic characteristics of the respondents, the type and quality of production and frequency of modes of transportation used and the effects of transport on Kolanut production. Data collected were analysed using descriptive statistics such as Tables of frequencies and percentages.

The respondents are Kolanut farmers, either on full time or part-time basis as some of them produce Kolanut along with some other crops such as cocoa, cassava, cocoyam, maize, melon and yam as well as some vegetable plants. Fifty-eight percent of the respondents said they do produce the commercial type of *'gbanja'* kolanut only and another 26% of them specialise in producing social type of Kolanut *"Abata/Gidi"* while the remaining 16% indicated that they produce both varieties of the crop.

The farmers were also asked about the length of period they have been engaged in farming with more emphasis on Kolanut production. The responses were grouped into five classes namely below 5, 6-10, 11-15, 16-20 and above 20 years. From Table 1 below 6%, 15%, 18%, 26% and 35% of the respondents are in the above categories and the minimum year recorded is 1 year while the maximum year recorded is 45 years. This revealed that majority of them are experienced Kolanut farmers with 77% spending above 10 years in the production of the crop.

As for the reasons given by the respondents for producing Kolanut, 32% of them produce strictly for commercial reason, 18% for consumption only, 13% for social and traditional reasons and 37% of the respondents produce because of the three reasons put together. From the field survey, it was discovered that some Kolanut farms are meant for the communities and their Kings "*Oko Oba"* and the Kolanut from such a farm are often not for sale but rather used for entertaining, social and ritual purposes. These types of farms are common at Makun, Ewu-Osi, Irolu and Ilishan among others.

The quantity of Kolanut production by each farmer varies from one farm to another and from one season to another and these are based on so many variables such as the climatic and physical conditions, availability of transport and market facilities, disease and pest infections, the size of the farms and their maintenance, farm inputs and seedlings as well as the labour supply. Some 4% of the respondents claimed that they do produce above 5 tonnes, 33% produce between 100-1000kg while the rest 7% claimed that they only produce less than 100kg of Kolanut per annum. On the farm size, this tallies with the level of production. Those with Kolanut farms above one hectare produce more than a tonne of kolanut while those with small holdings produce less than a tonne annually.

The mode of transportation often used in transporting Kolanut from the source to destination was also identified through the information supplied by the farmers. The means of transportation identified as being available and mostly used in the study area are head porterage, bicycle, motor-cycle, taxi, public transport (pick-up van and buses) and Lorries as shown in Table 1. From this Table, it shows that the most available means of transport for Kolanut from one place to another is head porterage being the most predominant means of conveyance of Kolanut. It could be seen from the Table that 67% of the respondents use head porterage as a dependable means of transport to carry Kolanut from one place to another. This is explained by the relative short distance from the place of origin to the destination, relatively scarce vehicles and the high cost of transport. The use of foot and head porterage decreases as the farmers move from the farms to

the divisional headquarters which are relatively longer in distance.

Motor cycle usage followed head porterage with 11% of the sampled farmers. This is attributed to the introduction of motorcycle as a mode of public transportation in Nigeria including the rural areas as well as its low fuel consumption, low maintenance costs and its high flexibility. Bicycle haulage come next with percentage of 10% and this was followed up by public transport (i.e. buses and pick-up van), taxi and lorry with 6%, 5% and 1% respectively. In the rural areas where vehicles are found and used, they only ply the roads on the market days and/or on the periodic days while on ordinary days traffic is generally very light and the frequency of patronage is often reduced to zero during the rainy season.

The distance covered by the Kolanut farmers from their farms to the nearest motorable roads and their houses to farms and markets were also analysed. On the distance between their farms and the nearest motorable roads, 84% of the respondents as shown in Table 2 have their farms within a radius of 0-3kms and above. The Table also shows that the more the distance the farm is to a motorable road the fewer the people who would want such a land to farm and this is in consonance with the finding of Ogundana (1972) and Ajiboye (1994).

Table 1: Available and Mostly Used Means of Transportation

Type Of Trip	Lorries	Public Transport	Taxis	Motor-Cycle	Bicycle	Head Porterage	Total
Farm to Farm	-	-	-	-	3	97	100
Farm to Farmstead	-	-	-	1	7	92	100
Farm to Village	-	-	-	3	12	85	100
Farmstead to Village	-	1	2	5	15	77	100
Village to Village	2	5	5	14	15	59	100
Village to Town	3	15	10	20	12	40	100
Town to Headquarter	1	21	18	32	10	18	100
Total	6	42	35	75	74	468	700
Percentage	1%	6%	5%	11%	10%	67%	100
Mean	1	6	5	11	10	67	

Table 2: Distances Involved in Point-To-Point Transportation of Kolanut from the farms

Distance	Farm to Motorable Road %	Farm to House %	Farm to Market %
Below 1km	21	10	12
1-2 kms	21	12	20
2-3 kms	42	35	22
3-4 kms	13	31	17
4-5 kms	2	8	15
Above 5 kms	1	4	14
Total	100	100	100

Source: Adopted from Ajiboye (1995), Ajiboye and Olaogun (2006)

From the Table above, the distance covered by the farmers on the daily journey to farm from their various houses were shown. Only 57% of the respondents have their farms within the radius of 0-3kms and 31% covered an average distance of 3 to 4kms before reaching their farms, 8% of them covered 4 to 5kms and the remaining 4% have their farms located at least 5kms from home. By the time they trekked to their various farms (see Table 1.2) they have become exhausted as explained by the respondents while more precious time and energy are wasted and lost which could have been used for other meaningful activities.

Furthermore, Table 3 also shows the distance covered by the farmers to get their products to the markets and collecting centres. Fifty- four percent of the respondents have the market within the radius of 0-3kms and 17% cover an average distance of 3-4kms to their respective farms while about 29% have a distance of above 4kms before they could dispose of their kolanut product.

Easy accessibility and mobility are some of the variables to determine the level of development in a given environment according to Mabogunje (1971). But from the sampled farmers, many of them complained about the distance they have to cover, the hours/time and amount spent daily in getting to farms and markets in order to farm, buy farm inputs and implements as well as sell their kolanuts. Forty-four percent of them concluded that their farms and markets are far (Above 3kms) and 28.5% are close by (2-3kms) to their houses and the remaining 17% said they are very close.

From the analysis, it was discovered that a large percentage of the respondents trekked to and from their farms everyday and even when the facilities are available, many of them could not afford it because of their low income. However, some privileged ones among them go to their farms on bicycles, motor cycles and on public transport. However, the cost of transporting the farmers and their products are considerably high and increasing everyday according to the respondents. For instance, an average of N100 is paid as fare per kilometer of road. However 32% of them said they paid as much as N50 for transporting themselves only to and from their farms per day and 48% agreed that they paid as much as between N100-N200 to and from their farms while 16% of them paid as much as N200 and above and the remaining 4% declined to make any comment on the fare.

On the transportation of kolanut per tonnage, 40% of the respondents confirmed that they pay between N200 and N1000, 54% pay between N1000 and N1500 and remaining 6% pay above N1500. Ajiboye and Ayantoyinbo (2009) observed that the factor responsible for disparity of prices varies from one community to another and from one farmer to another. However, the following are issues raised by the respondents, vis-à-vis the poor condition of the roads which make some places inaccessible, high fuel price, high price for acquiring new or fairly used vehicles which resulted in inadequate supply of transport facilities, periodic availability of vehicles on some roads, high cost of spare-parts and maintenance.

The respondents also confirmed the general belief that transportation has an effect on the production level of the farmers as well as the price of the crops. Thirty percent of the respondents very much agreed that the above statement is true, another 48% mentioned they agreed, 20% slightly agreed and the remaining 2% do not agree at all. This further shows the importance of transportation in agricultural development. If there are no good transport facilities, the farmers would not be able to produce more since they would not be quite sure of how they would evacuate the products from their farms and the price of the little available crops in the markets would be very high as many people would not be able to afford it. Similarly, it would affect the health of the citizenry, the production level of the agro-based industries as well as the general economy.

The frequency and methods of selling of kolanut by the farmers were also focused upon.

The response given by 48% of the respondents was that they sell their kolanut on daily basis, 20% sell theirs on seasonal basis, 18% on weekly basis, while the remaining 9% and 5% of the respondents sell on monthly and quarterly basis respectively. However, it is generally believed that the best period for a farmer to sell kolanut is between May and July before the harvesting of kolanut which commences in late July to September of each year. On the mode of selling, 40% of the respondents said they sell through the middlemen that come around and visit the farmers at their farms and homes and buy the processed nuts, while another 35% of them sell their own products at the specialised kolanut markets. Another 13% indicated they always take their kolanuts to the urban market (Sabo, Sagamu) to sell while the last group of respondents which make up the remaining 12% indicated they sell their fresh unprocessed nuts directly on the farm and home to the itinerant female assemblers who later sell to the local consumers and these conclude a three link channel as identified by Onakomaiya (1975). The majority of the kolanut farmers that sell their products on the farm indicate reasons for this which is to minimise transportation cost and problem involved in trying to process the kolanuts.

The farmers gave their opinion on the issue that inadequate transportation facilities have a negative effect on the production and price charged on kolanut. Some 72% of the respondents believed that an improvement on the road condition among other factors can motivate them to grow more kolanut and this in essence will mean more improvement in transport services and will also attract more buyers into the region as well as possible higher profit margins for the kolanut. However, 28% of the sampled farmers were in contrary on the ground that there are other factors to be put in place such as the enlargement of the farm size, prompt maintenance of the farm and control of pest and diseases.

The views of the respondents on the ways the improvement on road condition can benefit them most were also analysed. It could be observed from Table 3 below that 42% of the respondents believed that an improvement in the condition of the road will help them have easier access to markets for their kolanut, 27% believed that it would help their crop to attract higher prices by increasing the demand, 7% believed that it will help them to have easier accessibility to farms, 3% was of the opinion that it will help to reduce damaged and spoilage of crops before getting to the markets while 21% of them believed that it will help to reduce majority of the problems they have been having in their farm work.

TABLE 3: Respondents View on the Ways the Improvement on Road Condition can benefit the farmers

Benefits	Percentage
Easier access to farm	7
Easier access to market	42
Product to attract higher price	27
Reduce spoilage on crops	3
All of the above points	21
Total	100

CONCLUSION

Transport plays a significant role in the structure of food production and marketing and that easy transport to market can make all the difference in the level of rural incomes. From the analysis, it could be deduced that an improved transportation will encourage farmers to work harder in the rural areas for increased production, add value to their products, reduce spoilage and wastage, empower the farmers as well as having

positive impact on the productivity, income, employment level and reduce poverty level in the rural areas. Finally, transport is also seen as a facilitating factor in the mobilisation of the farmers and other allied workers in the overall national development of the nations.

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The Interactive Effect of Different Land Conditions and Management System on Crop Production in South-Western Nigeria

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Abstract: The soil constitutes the core of the problems of agricultural production. Neither modern machinery/farm implement nor improved marketing arrangement, not even improved hybrid seed alone can bring about the desired increase in crop productivity unless the soil is in the right condition to support the needs of different crops. The study therefore examined the interactive effect of different land conditions and management system on crop production in South-Western Nigeria .A total of 360 respondents were selected from the three agro-ecological zones of Osun State typical of Nigeria South-Western States. A three-stage random sampling procedure was adopted in proportionately selecting 71 respondents from Iwo (Savannah zone), 109 respondents from Osogbo (Derived savannah zone) and 180 respondents from Ife/Ijesha (Rainforest zone) zones of the State. Analysis of data was done using descriptive statistics and a production function based on transcendental logarithmic model was developed to capture economic and land management variables considered.

The result showed that 90 percent of the farmers are male and married while 85.5 percent of their household members are literate. About 40 percent of the farmers are within 36-45 years of age. Mixed cropping constituted the major cropping pattern in the area and cassava, maize, pepper, okra and yam were the most preferred crops. The joint action of materials and crops diversification index (0.215) have a positive effect on output level at 10% significant level, the coefficient of joint action of land and fertilisation (0.146) as well as land and length of fallow (0.307) are statistically significant at 5 and 10 % level respectively. The estimated coefficient of crop diversification index and extension visit has a negative effect on the output level (-0.231) at 10 % level of significance but the interaction with the length of fallow shows a positive (0.581) and significant relationship with output level. In conclusion the farming system practiced in the area is moving towards permanent cultivation as against declining fallow period.

Keywords: Land Conditions, Management System, Interactive Effect and Mixed Crop Enterprises.

INTRODUCTION

More than ever before in human history, the way in which land is being used and managed has become a source of widespread concern. The population of the world exceeds 6 billion; hence the demand for accessible and safe food is higher than ever (Borlaug and Dowswell, 2004; Borlaug, 2003; Rosegrant and Cline, 2003), while the negative impacts of food production on the quality of the natural resources are increasingly recognised (Daily *et al*., 1998). Income, especially of the urban population, continues to increase, leading on

the one hand to changing diets with the associated impacts on land requirements for food production (Gerbens-Leenders and Nonhebel, 2002; Smil, 2000) and on the other to higher demands for alternative land uses, such as nature, recreation and employment. At the same time, globalisation leads to increasing pressure on the economic viability of food production systems, resulting in a search for more remunerative land uses and management by farmers, in both the developed and developing world and the eventual abandonment of land (Breman and Debrah, 2003; Bouma *et al*., 1998).

Nigeria's food problem shows both in quantity and quality. Tied to low agricultural production and productivity is the increasing relative and absolute poverty of the farming population in Nigeria. The need for increased food production calls for better management of available production inputs, land, labor, capital and entrepreneurship.

Soil fertility can be viewed in an economic framework, in the context of derived demand emanating from farmers' objectives for utility through farm product sales and consumption. The demand for the services that farm land or farm soil offers is thus largely derived from the need that land as an input to farm production, whether of crops directly or indirectly of livestock through pasture, planted forages or crop residues. Soil fertility management practices can be seen as management of soil services, to increase the quality and durability of those services. Increased demand for soil services is likely to lead to increased use of soil fertility management practices.

The understanding of the quality, use and management interaction of land in crop production is therefore key indications of the sustainability of the resource. A good management objective that is hinged on proper knowledge and the right attitude is a *sine qua non* to sustainable land use. Land use and management practices affect the fertility of the soil to the extent that the clamour for conservation farming system and management has been a re-awakening issue among researchers and policy makers. Land use and management practices affect human health directly and indirectly. It affects fauna and flora, contributes to local, regional, and global climate changes and is the primary source of soil, water and land degradation (Sala *et al*., 2000; Pielke, 2005). Study on the use and management of an economically valuable but exhaustible resource like land has policy relevance in agricultural development.

Also land is the major resource for the livelihood of the poor. In Nigeria, a typical villager recognises land in its entirety. According to Fabiyi (1990), land to a farmer, is home and work place and shares it with the entire biotic complex. As a result, data collected on the relationship among the use of the different land management practices are good reference materials that would guide agricultural economists and extension workers wishing to plan a strategic agronomy-based extension service delivery for farmers.

Within the foregoing context, the following questions are fundamental;

(i) what are the socio-economic characteristics of the farmers ?

(ii) what are the distribution of area cultivated to mixed crop enterprises and

(iii) of what effects are the different land conditions and management system on crop production?

The main objective of the study is to determine the interactive effect of different land conditions and management system on crop production in south-western Nigeria.

The specific objectives are to;

i. identify the socio-economic characteristics of the farmers,
ii. highlight the distribution of area cultivated to mixed crop enterprises and
iii. measure the interactive effect of different land conditions and management systems on crop production.

The working hypothesis stated in null form is that there is no significant relationship between the interaction effect of land use and management variables and the output level.

METHODOLOGY

The study was conducted in Osun State in South-Western Nigeria that is made up of three agro-ecological zones, characterised of the South-Western States of the federation.The State has six administrative zones and thirty local government areas. The predominant farming system in the area is shifting cultivation with mixed cropping and crop rotation. A three-stage sampling procedure was adopted. In the first stage, the State was divided into three agroecological zones namely Ife/Ijesha (Rainforest), Osogbo (Derived savannah), and Iwo (Savannah) from which 20% of the total Local Government Areas(LGAs) were selected. This resulted in randomly selecting two LGAs from each of the agro-ecological zones in the second stage. Then one tenth (10%) of the 2006 projected household members, estimated from the 2006 populations figures were selected in the third stage as respondents resulting in proportionately selecting 71 respondents from Iwo (Savannah zone), 109 respondents from Osogbo (Derived savannah zone) and 180 respondents from Ife/Ijesha (Rainforest zone) zones of the State. This was facilitated by the lists of rural communities with their population figures in each selected LGA collected from the main office of the National Population Commission (NPC), Osogbo. Out of the 360 copies of questionnaire administered, 301 were found to be very useful for the study.

Data collected include the respondents' demographic characteristics that reflect the non-crop income, the level of education and gender of the household members, household size and the primary source of income of the household head among others. Also the quantities and prices of production inputs used, data on land management and land resource quality variables as well as farm output and their prices were collected. The primary data collected was subjected to both descriptive and inferential statistics. The descriptive statistics used are frequency and percentage distribution, mean and standard deviation to describe the socio-economic characteristics of the respondents while transcendental logarithmic (translog) production function that expresses the logarithm of output as a quadratic function of inputs was used to measure the productivities of resources, indices of land use and management as well as the interactive effect of different land conditions and management system on crop production. The regression model specification in the transcendental logarithmic form is explicitly stated as follows;

$$LnQ=lna_0 +a_1lnX_1 +a_2lnX_8 +a_3lnX_9 +a_4lnX_3 +a_5lnX_4 +a_6lnX_5 +a_7lnX_6 +a_8lnX_7+a_9D_1+a_{10}D_2 +a_{11}D_6+a_{12}D_3+a_{13}D_4+a_{14}ln(X_1)^2+a_{15}ln(X_2)^2+a_{16}ln(X_3)^2+a_{17}ln(X_4)^2+a_{18}ln(X_1*X_2)$$

$+a_{19}\ln(X_1*X_3) +a_{20}\ln(X_1*X_4) +a_{21}\ln(X_1*X_5)$
$+a_{22}\ln(X_2*X_5) +a_{23}\ln(X_4*X_5) +a_{24}\ln(X_1*D_2)$
$+a_{25}\ln(X_1*D_6) +a_{26}\ln(X_1*X_7) +a_{27}\ln(X_7*D_5)$
$+a_{28}\ln(X_1*D_1) +a_{29}\ln(X_5*D_6) +a_{30}\ln(X_5*X_7)$
$+a_{31}\ln(X_5*D_2) +e$

The total number of possible interaction is 78 ($^{13}C_2$) but this has been reduced to eighteen in addition to thirteen sets of variables. This is necessary to ease computation burden and reduce the risk of multicollinearity and also to ensure that only economically meaningful and theoretically plausible interactions are retained. This also facilitates the use of OLS estimates as against the maximum likelihood estimates (MLE), moreso that the sample size is lesser than 400.

Q = output (in naira)
X_1 = land (in hectare)
X_2 = total labor (in man-day)
X_3 = capital (in naira)
X_4 = cost of planting (in naira)
X_5 = crop diversification index
X_6 = nutrient intake index
X_7 = length of fallow (in years)
X_8 = family labor (in man-day)
X_9 = hired labor (in man-day)
D_1 = livestock
D_2 = fertiliser
D_3 = terrace
D_4 = ecological zone
D_5 = sex
D_6 = extension visit
e = error term

RESULTS AND INTERPRETATION

Table 1.0 reveals that about 69.8 percent of the farmers are between 16-45 years of age, showing that they are in active age brackets. The mean age is 46.81 and this has implication on the available family labor and productivity of the labor because age has a direct bearing on the availability of farm labor and the ease with which improved agricultural practices are adopted. The gender distribution of the farmers depicts more male (94.01%) than female owning farms. This result conforms with the cultural setting in the study area where male have more access to land than female.

Also the main occupation of most of the sampled farmers is farming and most (84%) of them depend on crop production for daily existence. This result has effect on the level of cropping pattern and intensity with which the agricultural land is used. Majority (95.10%) of the respondents are married, 4.3 percent are single and just 0.3 percent each are widowed and divorced.

Most of the farmer's households (85.8%) male and female have at least a primary education. Those households with tertiary education probably constitute the civil servants who engaged in part-time farming in the area. This is expected in line with *a priori* expectation, to have significant impact on productivities, income earning opportunities and ability of farmers to effectively adopt better management practices.

Table 1: Distribution of Respondents by their Socio-economic Characteristics

Characteristics	Frequency	Percentage
Age group (years)		
16-25	14	4.7
26-35	77	25.6
36-45	119	39.5
46-55	36	11.9
56-65	44	14.6
>66	11	3.7
Gender		
Male	283	94.0
Female	18	6.0
Occupation		
Crop production	253	84.1
Livestock production	7	2.3

Non-farm activities	41		13.6
Marital status			
Single	13		4.3
Married	286		95.1
Widowed	1		0.3
Separate	1		0.3
Household Educ. Level			
No schooling	M	79	6.6
	F	91	7.7
Primary level	M	222	18.7
	F	210	17.7
Secondary level	M	235	19.7
	F	166	13.9
Tertiary level	M	145	12.2
	F	39	3.5

Source; Field Survey, 2005/2006

Table 2.0 reveals that the combination of maize and cassava is the most preferred enterprise, accounting for 39 percent of the total area under mixed crop enterprises. This is closely followed by maize/cassava/vegetable and maize/yam enterprises, accounting for 19percent and 16.1 percent respectively. However, when consideration is given to the proportion of farmers that grow the various mixed crop enterprises, the order of ranking is altered slightly. In this regard, farmers that grow maize/cassava account for 51.4 percent of the sampled farmers, followed by maize/yam and maize/yam/vegetable accounting for 17.4 percent and 13.0 percent respectively.

The current cropping system is generally characterised by the practice of growing crops in mixtures. Some farmers grow 4 to 5 crops on the same plot. The cropping system reveals the prevalence of cassava, maize, and vegetable as the 3 most important crops grown by the farmers. The dominance of cassava and maize may be explained by the fact that they are the predominant stapled food crops in the study area. Farmers' dual objectives of producing most of their basic food requirements and, at the same time generating marketable surplus accounts for their preference for the growing of these crops.

There are at least 3 likely reasons for farmers' preference for mixed cropping rather than mono-cropping. First, some crops are more susceptible to insects when grown in pure stand (Singh, 1988). The consideration for risk minimisation is a second major factor accounting for the practice of mixed cropping (Just and Candler, 1985) while the objective of farm gross margin maximisation may be the third objective.

Table 2: Distribution of Area Cultivated (ha) to Mixed Crop Enterprises in the Area

Enterprises	No of Plots	Percentage of Total no of Plots	Ranking	Area Cropped (ha)	Mean Area Cropped (ha)	Percentage of Total Area Cropped	Ranking
Maize/Cassava	186	51.4	1st	227.8	1.2	39.0	1st
Maize/Yam	63	17.4	2nd	94.3	1.5	16.1	3rd
Maize/Cocoyam	23	6.4	4th	41.5	1.8	7.1	5th
Maize/Cassava/Vegetable	47	13.0	3rd	111.5	2.4	19.1	2nd
Maize/Legumes/Vegetable	15	4.1	6th	57.2	3.8	9.8	4th
Maize/Cassava/Veg./Citrus	21	5.8	5th	33.5	1.6	5.7	6th
Maize/Cassava/Veg./Cocoa	4	1.1	7th	14.3	3.6	2.4	7th
Maize/Cass/Veg./Cocoa/Citr	3	0.8	8th	4.7	1.6	0.8	8th
Total	362	100.0		584.8	17.5	100.0	

Source; Field Survey, 2005/2006

Table 3.0 shows the ordinary least square result for all the farms in the study area. The selected model is an exponential quadratic function with an adjusted R^2 of 0.926. This implies that the independent variables 92.6 percent of the time jointly explain the variability in the level of

outputs. Apart from this, most of the coefficients of its variables are of the right signs and magnitudes. Over 64 percent of the estimates are statistically significant at different critical values. These coefficients can be interpreted as the elasticity of output with respect to the inputs.

Interaction of Physical Input and Land Use Variable

Materials and Crop Diversification: The estimated coefficient (0.215) is statistically significant at $\propto$=0.10 showing that the joint action of crops diversification index have a positive effect on output level. Therefore output of crops would increase when the diversification practice is optimal and adequate provision is made in term of planting materials, agrochemicals etc.

Interaction of Physical Input and Land Management Variables

The coefficient of joint action of land and fertilisation (0.146) and land and length of fallow (0.307) are statistically significant at $\propto$=0.05 and 0.10 respectively. It then follows that when a farm is adequately fertilized, the output level of the farm would be increased. But the interesting fact from this result is that if the same piece of land is left to fallow for ten years, it will produce more than 2 times increase in output than fertilization would produce. This, in line with the assertion of USDA (2005), and Gracia and Magistris (2008) would be a good environmentally sustainable agricultural practice. It also supports the call of "European Action Plan for Organic Food and Farming" (European Commission, 2004) and that of "National Action plan for Organic Food and Farming" enacted in November, 2004 in Italy (MIPAF, 2005).

Interaction of Land Use Variable and Land Management Variable

Crop Diversification Index and Extension Visit: The estimated coefficient (-0.231) is statistically significant at $\propto$=0.10 and has a negative relationship with output. It therefore implies that as more crops are grown without the adequate knowledge of the required agronomic practices for such diversification, the benefit derivable from practice of crop diversification in terms of increased farm output could not be obtained. The result shows that though the extension agents might be visiting but the required emphasis has not been placed on land use and land management practices.

Crop Diversification Index and Length of Fallow; this interaction has a positive effect on the output level. The estimated coefficient (0.581) is statistically significant at $\propto$ = 0.05 and has a positive relationship with output. This implies that more crops can be grown on a piece of land that has considerable fallow period and still produce high output level. It further confirms the earlier fact that the expected increase in output from crop diversification can be obtained under better fallow management system in a low-external-input agriculture.

Table 3: Analysis of Ordinary Least Square Estimation

Variables	Parameters	Estimated Values
Physical Inputs		
Land (ha)	a_1	0.356***
Family labor (manday)	a_2	0.317*
Hired labor (manday)	a_3	1,283**
Capital (naira)	a_4	0.215
Materials (naira)	a_5	0.173*
Land Use Variables		
Crop Diversification Index (CDI)	a_6	-0.395***
Nutrient Intake Index	a_7	0.142***
Land Management Variables		
Length of Fallow (year)	a_8	0.373**
Livestock (dummy)	a_9	0.107**
Fertilization (dummy)	a_{10}	0.652*
Extension Visit (dummy)	a_{11}	-0.018**
Land Resource Quality Variables		
Terrace (dummy)	a_{12}	0.004
Ecological Zone (dummy)	a_{13}	0.056
Square Terms		
Land X Land	a_{14}	0.183**
Labor X Labor	a_{15}	1.960*
Capital X Capital	a_{16}	0.188
Material X Material	a_{17}	0.021***
Interaction among Inputs		
Land X Labor	a_{18}	0.708**
Land X Capital	a_{19}	-0.871
Land X Material	a_{20}	-0.026***
Interaction of Physical Inputs and Land Use Variables		
Land X CDI	a_{21}	-0.435
Labor X CDI	a_{22}	0.887
Material X CDI	a_{23}	0.251
Interaction of Physical Inputs and Land Management Variables		
Land X Fertilisation	a_{24}	0.146**
Land X Extension Visits	a_{25}	0.025
Land XLength of Fallow	a_{26}	0,307*
Gender X Length Fallow	a_{27}	-0.005
Land X Livestock	a_{28}	-0.008
Interaction of Land Use and Management Variables		
CDI X Extension Visit	a_{29}	-0.231*
CDI X Length of Fallow	a_{30}	0.581**
CDI X Fertilisation	a_{31}	-0.507

Source; Field Survey, 2005/2006

CONCLUSION AND RECOMMENDATIONS:

In conclusion the farming system practiced in the area is moving towards permanent cultivation as against declining fallow period. Sole and mixed cropping are the common cropping patterns. There were altogether 13 different crop enterprise combinations, 5 as sole and 8 as crop mixtures during the cropping seasons. Among the sole crops, cassava is the dominant and the most preferred crop and it is cassava/maize combination under the mixed crop enterprise.

It was therefore recommended that adequate provision should be made in term of planting materials; agrochemicals etc so as to

increase output of crops when the diversification practice is optima. Environmentally sustainable agricultural practices like fallowing should be encouraged in the study area as more crops can be grown on a piece of land that has considerable fallow period and still produce high output level. Thus the expected increase in output from crop diversification can be obtained under better fallow management system in this low-external-input agricultural area. Also, the extension agents should lay more emphasis on land use and management practices, play active role in disseminating information on the usefulness of these practices and motivate the farmers to change, if need be.

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The use of indigenous knowledge systems (IKS) in rice production by farmers in Ekiti state, Nigeria

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Abstract: This study investigated the use of Indigenous Knowledge Systems (IKS) in rice production by farmers in Ekiti State of Nigeria. Multistage sampling technique was employed to select 266 rice farmers registered with the Ekiti State Agricultural Development Programme. Trained enumerators administered pre-tested and validated interview schedule to obtain data. The data were subjected to descriptive (percentage, mean) and inferential (Chi-square and correlation) statistics. About 75% of the respondents were full time farmers while 11.7% were artisans. About 88% cultivated between one and three hectares of rice, hence, most of them were small holders. The most patronised IKS were bush slashing without burning (98.1%), burying of carbide on the farm for termite control (54.1%), setting of traps for grass cutter control (95.9%), and use of human bird scarers (83.4%) for bird control. A high patronage of IKS was recorded with 43% of the rice farmers using between 20 and 26 IK methods. There was significant relationship between IKS utilisation and age ($r=0.359$, $\rho \leq 0.05$), rice income ($r=0.399$, $\rho \leq 0.05$), farm size ($r=0.380$, $\rho \leq 0.05$). A strong factor in favour of IKS utilisation was the support of extension agents. Farers expressed fears about the extinction of some of the herbs used in IKS preparation.

INTRODUCTION

Rice production started in Nigeria in 1500 B. C. with the low yielding indigenous red grain specie, *Oryza glaberrima*, which was widely grown in the Niger Delta area The high-yielding white grain, *Oryza sativa*, was introduced in about 1890 and by 1960 had accounted for more than sixty percent of the rice grown in the country. Today, rice is cultivated in virtually all the agro-ecological zones of Nigeria. Adewale (2002) observes that the emphasis on rice consumption has shifted from its ceremonial status to a staple food in the country.

In spite of the widespread cultivation and consumption of rice in Nigeria, the local production has been found to be always short of the demand for the commodity (Wudiri and Fatoba, 1992). In order to improve the output of domestic rice production, programmes embodying imported technologies have been introduced and executed. Such programmes include Special Rice Scheme, National Accelerated Food Production Programme (NAFPP), and River Basin Development Programme. In spite of these programmes, rice production level remains unsatisfactory. Adewale (2002) suggests this might be due to the neglect of the development of appropriate technology for

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local rice farmers based on their indigenous knowledge and practices. Adekunle and Okunlola (1997) observe that despite the fact that Nigerian rural communities (which produce the greatest amount of food for the country and excess for export) have produced their own food, made their own farm implements, and conducted their own farming activities, the role of indigenous knowledge (IK) used has not been appreciated. Kolawole (2002) claims that rural people to which all research development efforts are directed have their own body of knowledge that enables them arrive at decisions which would better their lots. Brokensha *et al* (1980) had warned "to ignore rural people's knowledge, otherwise known as indigenous knowledge, which respects the expertise of indigenous people has come to be regarded as a major contribution to development thinking" (Osunade, 1996).

Researchers have observed that indigenous agricultural practices are cost-effective and pose less production risks and environmental degradation (Hansen and Erbaugh, 1987; Vanek, 1989; and Alcorn, 1991).

Considering the ever growing importance of rice in the diet of Nigerians and the desire for sustainable local production, this study focused on the use of indigenous rice production knowledge system among rice farmers in Ekiti State of Nigeria. The personal characteristics of the rice farmers were examined, various indigenous knowledge practices identified and the factors associated with the use of such systems investigated. It was hypothesised that there was no relationship between the personal characteristics of farmers and their use if IKS.

METHODOLOGY

The study was carried out in Ekiti State, one of the 36 States of Nigeria. The State is located between longitude $4^{o}2'$E and $5^{o}4'$E and Latitude $6^{o}2'$and $8^{o}1'$N. Approximate population according to 2006 census was 2,384,212 with approximate land mass of 10,898.68 sq.km. Majority of the people are Christians, while the major occupation is farming and both cash crops (such as cocoa and kolanut) and food crops (such as yam, cassava, cocoyam, and plantain) are grown in the state. The rainy season is between March and October, while at peak, 1800mm of rain may be recorded in the Southern part of the State.

Multi-stage random sampling technique was used to select the respondents for the study. Five of the sixteen Local Government Areas (LGAs) of the State were purposively selected based on the level of rice production. The selected LGAs are Efon Alaye, Ekiti West, Ijero, Oye and Irepo/Ifelodun. Two communities were then randomly selected from each of the LGA, making a total of 10 communities. Respondents were then selected from each community using a ratio based on the number of registered rice farmers in the communities. In all, two hundred and sixty-six farmers were selected for the study.

Data were collected through the administration of pre-tested and validated structured interview schedule. Trained enumerators administered the instrument under the supervision of the researchers. Indigenous knowledge utiliation scores were procured for each respondent and this was measured as the number of IKS utilised by each respondent.

Frequency, Percentage and mean were used in presenting the data while Chi square and

Correlation were used in analysing the relationship between Indigenous Knowledge use and selected personal characteristics of the farmers.

RESULTS AND DISCUSSION

Personal Characteristics of the farmers

The findings on personal characteristics are shown in Table 1.

Age – About 56% of the respondents were below 50 years old, while 21% were above 55 years of age. This shows that participation in rice cultivation cuts across all age groups. The older ones are there to impart expertise, which comes with experience, on the younger farmers. The mean age for all respondents was 48 years.

Sex – More males (87.6%) were involved in rice cultivation than females (12.4%). This is in line with the assertion that crop husbandry is a male-dominated venture in South-western Nigeria. However, this finding has not underscored the importance of women in agriculture especially in the area of food crop cultivation and livestock domestication.

Marital status – About 81% of the respondents were married, while only 13.2% were single. The married respondents were likely to have taken advantage of family labour in their farming enterprises.

Educational level: Data indicate that 72.6% were literate. About 37% had secondary education. The high level of literacy would enhance better farm management especially when coupled with relevant experience.

Occupation – Data from the study indicate that about three-quarter of the respondents were full-time farmers, while 11.7% were artisans by primary occupation.

Farm-size – Investigation revealed that 87.6% of the rice farmers cultivated between one and three hectares of rice, while only 0.7% had above 7 hectares. This indicates that majority of the farmers were small plot holders.

Income level – More than half of the respondents were in the low income category, earning less than 41,000 Naira yearly, while about 17% earned more than 1 00,000 Naira annually from their rice enterprise. The low earning of majority of the rice farmers would not enable their households to live well. Hence, any intervention that would improve their income should take into consideration their present mode of operation while introducing the necessary modifications.

Table 1: Distribution of Respondents by Personal Characteristics **n = 266**

Variable	Frequency	Percentage
Age (years)		
20 – 34	60	22.6
35 – 49	86	32.3
50 – 64	64	24.1
> 64	56	21.0
Sex		
Male	233	87.6
Female	33	12.4
Marital status		
Married	215	80.8
Single	35	13.2
Separated	9	3.4
Divorced	5	1.9
Widowed	2	0.7
Religion		
Christianity	231	86.8
Islam	33	12.4
Traditional	2	0.8
Educational Level		
Primary	78	29.3
Secondary	98	36.8
Post secondary	17	6.5
No formal education	73	27.4
Occupation		
Farming	200	75.2
Trading	24	9.0
Schooling	11	4.1
Artisans	31	11.7

Farm size (ha)		
1 – 3	233	87. 6
4 – 6	31	11.7
> 6	2	0.7
Rice income Level ('000/annum)		
Up to 40	155	58.3
41 – 100	66	24.8
> 100	45	16.9

Source: Field survey, 2008

Use of indigenous knowledge system

Table 2 shows the distribution of the farmers by the types of IKS utilised. Seven categories of IKS were identified, each following the various stages of rice cultivation, processing and storage. The categories are land preparation, soil fertility management, weeding, pests (termite, grass cutter and birds) control, harvesting, processing and storage.

The most patronised IKS under land preparation and management were bush slashing without burning (98.1%), slashing with burning of debris (95.9%), bush fallow (97.4%), shifting cultivation (87.6%), use of hoe (91%) and cutlass (87.6%) for weeding.

For pest control, termites, grass-cutters and birds are the most notorious and destructive pests of paddy rice. The most utilised termite control methods were the burying of carbide on the farm (54.1%) and the use of effluent of locust bean solution (53.4%). For grass cutter control, setting of traps (95.9%) and the use of a mixture of lime and gunpowder (46%) were the most employed methods. For the control of birds, all the four indigenous practices were highly utilised. These are use of human bird scarers (83.4%), use of catapult by human bird scarers (80%), scare crows (62.4%), and use of traditional medicine (51.9%). The use of traditional medicine, though acclaimed to be the most effective by the farmers, was used least because of the "fetishness" attached to it which was claimed to be at variance with modern religious practices. For harvesting, knife was mostly used (95.1%), while the stick was mostly used (92.5%) for threshing. Storage in jute bags was the most commonly adopted method by 68.4% of the respondents.

Table 2: Distribution of respondents by the types of IKS utilised

Type of IKS *	Frequency	Percentage
Land clearing		
Slashing without burning	261	98.1
Slashing with burning of debris	255	95.9
Soil fertility management		
Bush fallow	259	97.4
Shifting cultivation	233	87.6
Cover cropping	148	55.6
Organic fertilisation	102	38.3
Weeding		
Hoe	242	91.0
Cutlass	233	87.6
Termite control		
Burying of carbide on the farm	144	54.1
Use of effluent from locust bean	142	53.4
'Gegemu' fruit solution	118	44.4
Burying of dog corpse on the farm	78	29.3

Grass cutter control		
Setting of traps	255	95.9
Lime + Gunpowder	122	45.9
Digging of trench round farm	95	35.7
Root of jatropha + salt pelter+ common salt	89	33.4
Bird control		
Human bird scarer	222	83.4
Use of catapult +human bird scarer	213	80.0
Scare crows	166	62.4
Traditional medicine	138	51.9
Harvesting		
Knife	253	95.1
Sickle	140	52.6
Processing		
Threshing with stick	246	92.5
Hulling with mortar & pestle	98	36.8
Storage		
Jute bag	182	68.4
Basket	111	41.7

Source: Field survey, 2008

* Multiple responses

Number of IKS methods utilised

Data in Table 3 indicate a very high patronage of the indigenous knowledge systems among the rice farmers in the study area. About 43% of the respondents were using between 20 and 26 indigenous methods, 32.3% were using between 10 and 14, while only 5.7% were in the very low category of patronage (less than 10 IKS).

Table 3: Distribution of Respondents by the number of IKS utilised

IKS Utilisation score	Frequency	Percentage
0 – 4	5	1.9
5 – 9	10	3.8
10 – 14	86	32.3
15 – 19	53	19.9
20 – 26	112	42.1
Total	**266**	**100.0**

Source: Field survey, 2008

Reasons for Using IKS

Table 4 indicates the reasons why the respondents adopted the various indigenous methods rather than the modern methods. The most mentioned reason was that materials for the preparation of concoctions or devices used for the indigenous knowledge practices were always available (91.7%). About 86% asserted that modern methods were more expensive than IKS while about 76% mentioned that indigenous methods were less hazardous. Seventy percent of the respondents even testified that extension agents supported the use of these IKSs. The implication of all these is that the rice farmers have over the years perfected the use of their choice IKS while their extension agents knew about the systems and encouraged the farmers to continue the usage. Any crop improvement methods should take cognisance of the importance of the IKS and rather focus on the hectarage expansion or productivity.

Table 4: Distribution of Respondents by Reasons for Utilising IKS in Rice Production n = 266

Reasons *	Frequency	Percentage
Modern methods are expensive	228	85.7
Resources for IKS always available	244	91.9
More familiar with IKS than Western tech	222	83.5
IKS is less hazardous	202	75.9
IKS usage supported by ext. agents	186	70.0
IKS easy to use	186	70.0

Source: Field survey, 2008

* Multiple Responses

Problems Associated with IKS Utilisation

Data in Table 5 reveals that majority (83.5%) of the respondents indicated that much time and energy were consumed in processing and utilising most of the IKS identified. About 50% opined that elders who were the major custodians of these IKS were not willing to divulge the knowledge; hence most of them would die with the details. A very serious view expressed by about 93% is that environmental degradation was making most of the herbs for the preparation of the indigenous knowledge practices which involved concoctions go into extinction. About 75% of the respondents were of the view that land tenure arrangements, to a large extent, restricts the adoption of IKS practices especially in soil fertility management such as bush fallow and shifting cultivation.

Table 5: Distribution of Respondents by Problems associated with Use of IKS

Problems*	Frequency	Percentage
Much time & energy consumed in IKS preparation	222	83.5
Most herbs for IKS preparation going into extinction	211	79.3
Land Tenure arrangement	200	75.2
Custodians of IKS unwilling to divulge details	133	50.0

Source: Field survey, 2008

*Multiple responses

Hypothesis Testing

Result of Chi-square Analysis - The result shows that only occupation was significantly related to IKS utilisation. Since farming is the primary occupation of most of the respondents (75.2%), they would adopt many of the IKS practices which they have verified over time to be effective.

Results of Correlation Test – Table 5 indicates that Age ($r = 0.359$, $\rho \leq .05$), rice income ($r = 0.399$, $\rho \leq .05$, and Farm size ($r = 0.380$, $\rho \leq .01$) were positively correlated with IKS utilisation. The implication of this result is that the higher the variation in the personal characteristics, the more the number of IKS utilised.

CONCLUSION

Indigenous knowledge methods are highly utilised by rice farmers in Ekiti State. Majority of them use indigenous methods solely in the production, harvesting, threshing and storage of rice and this is being transmitted through the generation. The IKS mostly patronised by the rice farmers included bush fallow, burying of carbide

on the farm for termite control, setting of traps for grass cutter control, use of human bird scares for bird control and threshing of harvested rice stalks with stick. Reasons adduced for high patronage of IKS included the expensiveness of modern western methods, especially in the use of tractors and chemicals; availability of resources involved and the ease with which the methods could be implemented. Another strong reason in favour of IKS use is the support of the agricultural extension agents; this will sustain the use and ensure the spread, even among generations. One fear the farmers expressed has to do with the near extinction of many of the herbs used in preparing portions for some of the IKS due to indiscriminate deforestation.

RECOMMENDATIONS

1. Both basic and applied research should be encouraged to promote the use of IKS and propagate the herbs used in their preparation to forestall the extinction of such useful plants
2. Extension agents should mix properly with the custodians of IKS, learn the rudiments and propagate same among the farmers. As long as our farmers operate small plots many of the modern technologies such as use of tractors and combine harvesters may be impossible.

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