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Determinants of Technical Inefficiency of Food Crop Producers in the *Fadama* of Southern Guinea Savanna of Nigeria

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ABSTRACT: The study examined technical inefficiency of food crop production in the *Fadama* of southern guinea Savanna of Nigeria. A two- stage simple random sampling technique was used to obtain 149 food crop farming households interviewed for the study. A single- stage Cobb-Douglas based Stochastic Frontier Model using Maximum Likelihood Estimate (MLE) was used for analysing the data. The MLE of the Stochastic Frontier Model revealed the presence of short run increasing return to scale with a mean technical efficiency of 68%. This result indicated the possibility of improving efficiency of sampled *fadama* households by 32% with the existing resources and technology. The result of the inefficiency model shows that farm size, farm experience, access to credit, educational level and extension contact had negative and significant ($p< 0.05$). This implied that increase in these variables would lead to less inefficiency. Household size had positive and significant ($p<0.05$) relationship on inefficiency which implies that increase would lead to higher inefficiency. Mixed cropping, consolidation of household resources, increased use of animal traction and organic fertilizer as well as integrated pest management is recommended

Keywords: Technical Inefficiency, Fadama.

Introduction

Agricultural growth is a catalyst for broad based economic growth and development in most low-income countries: Agricultural linkages to the non-farm economy generate employment, income and growth in the remaining part of the economy. Very few countries have experienced rapid economic growth without strong agricultural growth. Agricultural growth and development also help meet growing food needs driven by rapid population growth and urbanization. Therefore, maintenance of sustainable productivity in the agricultural sector is the pivot of development. However, most developing economies have witnessed substantial decrease in productivity of agricultural sector and food import has continued to increase (World Bank, 1996).

Federal Ministry of Agriculture (1993) estimates that annual supply of food crops would have to increase at an average annual rate of 5.9% to meet food demand and reduce importation significantly but food production is known to be growing at about 2.8% per annum (Ajibefun and Abdulkadir, !999). Nigeria imported rice worth over $US 700 million when unrecorded trade (smuggling) is considered (Bello,2004). Food self-sufficiency ratio (SSR) calculated as the total domestic supply divided by total domestic demand (SSR=DS/DD) is less than one for the period of 1990-2004 (Rahji and Omotesho, 2006).The reality is that Nigeria has not been able to attain self-sufficiency in food crop production. The major sources of changes in food crop production include changes in hectares of various crops cultivated annually, changing production technologies which affect variation in the yields, and the productivity of inputs used in crop production (Olayemi, 1997). The long term success of any effort to raise the productivity of food crops in Africa would depend on the ability of agricultural research bodies to find new ways to maintain the productivity of the land under continuous cultivation. Therefore, sustainability was recognised as a critical pre-condition for putting food production in Sub-Saharan Africa on the path towards steady improvement (IITA, 1992).

Statement of Problem

Fadama are relatively more fertile than the surrounding upland areas. They reduce the risk of crop failure and have potential for longer period of agricultural activities in a year. They present a unique opportunity towards reversing the declining per capita food production in Nigeria. If the potential of the inland valleys for intensive crop production could be realized, they might serve as a kind of safety valve for relieving pressure in other agro ecosystem particularly the humid forest and moist savanna (World Bank, 1992). The *fadama* size of Nigeria is estimated at about 4.6 million hectares. Major part of the fadama land in Nigeria is in the savannah ecological zones. (Ingawa, 1998).

The quest for harnessing the benefit of *fadama* land has ushered in technological innovations such as development of small irrigation pumps, small earthen dams and shallow tube wells. This has led to intensification in the use and management of *fadama* for agricultural activities. The Ministry of Water Resource and National *Fadama* Development Project (Fadama II, World Bank and African Development Bank assisted project) is especially active in *fadama* development in eighteen (18) states of the country. By and large the inland valleys are cultivated by small holders whose land utilization and management with limited resources are aimed at achieving farm level objectives in term of food security, and economic viability.

According to Saka *et al.* (2005), given the natural endowment of human, material resources and the available technology, Nigeria should be self sufficient in production of rice. This will however, depend on a sustained efficient use of production resources at the farm level. Therefore, within the foregoing context, some questions become fundamental in the assessment of *fadama* land for food crop production; Are *fadama* food crop farming households efficient in the use of inputs? What are the factors that determine the level of inefficiency of the farming household?

The main objective of the study is to analyse the technical inefficiency and sustainability of food crops production in the fadama of Southern Guinea Savanna of Nigeria. The specific objectives are : to determine the technical efficiency and productivity of resources used by *fadama* farming households and identify the determinants of technical inefficiency of *fadama* farming households

Issue in the Literature on Stochastic Frontier Production Functions Application

A number of empirical work Kalijaran (1991); Parikh and Shah (1994); Liewelyn and Williams (1996); Ray (1998); Ajibefun and Daramola (2000); Ajibefun and Abdulkadir (2002); Awoyemi and Adekanye (2004); Awoyinka and Ikpi (2004); have investigated the determinants of technical efficiency among firm in different industry by regressing the predicted efficiencies, obtained from an estimated stochastic frontier on a vector of farmer specific factors such as age of farmer, level of education, access to extension etc in a two stage regression. Ekanayake (1987) suggested that technical efficiency index must be transformed into natural logarithm of the ratio of the technical efficiency to technical inefficiency as transformed technical efficiency before the second stage regression is estimated. Admassie(1999) and Rahji(2005) used this approach to estimate determinant of technical efficiency in different studies.

The identification of factors that influence the level of technical efficiency is a valuable exercise because the factors are important for policy formulation. However, Coelli (1995) has identified a fundamental contradiction in the two-stage approach. In the first stage the efficiency factors are assumed to be independently and identically distributed while, in the second stage, they are assumed to be a function of a number of firm-specific factors which implies that they are not independently distributed. Battese and Coelli (1995) resolved the inconsistency in the two-stage approach by specifying stochastic frontier models in which the inefficiency factors are made an explicit function of the firm-specific factors and all parameters are estimated in a single-stage maximum likelihood procedure. This single stage approach is less objectionable from a statistical point of view and is expected to lead to more efficient estimator. This work used this single stage model to estimate the parameters of the stochastic frontier function model using the computer program FRONTIER version 4.1 (Coelli, 1996).

Methodology

Area of Study

The study was carried out in the *fadama* areas of Niger State, in the Southern Guinea Savanna of Nigeria. Niger State has the largest fadama land in the southern guinea savannah of Nigeria and the production practices is atypical of all other state in the zone.

The *fadama* along river Niger and river Kaduna and other minor rivers and floodable plains in Niger State were used for the study. Niger State lies between longitude 8° 11' and 11° 20' north of the equator and between 4° 30' east of the equator. It covers an estimated land area of 4240 km sq. The vegetation of the state is mainly Southern Guinea Savanna. The mean annual rainfall ranges between 1110 mm in the north and 1600 mm in the south. The average annual number of raining days ranges between 187 and 220 days. The rain starts in late April and ends in October with the peak being in July. The average minimum temperature is about 26°C while the average maximum temperature is about 36°C. The mean humidity ranges between 60% (January to February) and 80% (June to September). The vegetation supports the cultivation of root crops and grains. The predominant crops are; rice, sorghum, millet, yam, groundnut and cotton. (NCRI, 1997)

Method of Data Collection

Data used for this study were from both primary and secondary sources. The relevant primary data were obtained through a farm management survey of *fadama* food crops farming households conducted between August 2004 and September 2005. The main instrument for data collection was structured questionnaire. These were administered on head of *fadama* food crop farming households by trained enumerators under the supervision of the researcher. The data covers farming activities for the 2004 cropping season. Data collected covers information on *fadama* food crop farming households head characteristics (age, level of education, family size etc), land use and management practices, input and output data, as well as their prices, crop combination and diversification etc.

Sampling Procedure

The target population for this study is the *fadama* food crops farming households in Niger State, Southern Guinea Savanna, Nigeria. A two stage simple random sampling technique was used to select sample for the study. The first stage involved the random selection of *fadama* farming villages in the three ADP zones of the State. The 1991 *fadama* village and households listing of Niger State Agricultural Development Project (NSADP) served as the sampling frame for the selections. About five percent of the total *fadama* farming villages were randomly selected for the study.

The second stage of sampling involved the random selection of *fadama* farming households. About ten percent of the *fadama* farming households in each of the selected villages were sampled for the study. The villages and households selections was based on the proportion of *fadama* food crop farming households in the NSADP zones and the villages respectively.. A cross sectional data from 149 *fadama* food crop farming households were collected for study.

Method of Data Analysis

The production frontier model derived from the composed error model of Aigner *et al.* (1977); Meeusen and Van den Broeck (1977) and Forsund *et al.* (1980) as used by Coelli and Battese (1996) was adopted for this study. The frontier production model begins by considering a stochastic production function with a multiplicative disturbance term of the form.

$$Y = f(X_i ; \beta)\, e^{\varepsilon} \tag{1}$$

Where;

Y = quantity of agricultural output in grain equivalent.
X_i = vector of input quantities.
β = vector of parameters.
e = error term

Where ε is a stochastic disturbance term consisting of two independent element V and U where

$$\varepsilon \quad = \quad V - U \qquad (2)$$

The symmetric component V, accounts for random variation in output due to factors outside the farmer's control such as weather and diseases. It is assumed to be independently and identically distributed as $N \sim (0, \delta_u^2)$

A one – sided component $U \leq 0$ reflect technical inefficiency relative to the stochastic frontier, $f(X_{i;}\ \beta)\ e^{\varepsilon}$. Thus, $U = 0$ for a farm output which lies on the frontier and $U < 0$ for output which is below the frontier as $N \sim (0.\delta_u^2)$ hence, the distribution of U is half normal.

The frontier of the farm is given by combining equation (1) and (2) as

$$Y = f(X_{i\,;}\ \beta)\ e^{(v-u)} \qquad (3)$$

The variance of e is therefore,

$$\delta^2 = \delta_u^2 + \delta_v^2 \qquad (4)$$

The ratio of two standard deviations is defined by

$$\lambda = \delta_u / \delta_v \qquad (5)$$

Jondrow *et al.* (1982) have shown that measuring efficiency at the individual farm level can be obtained from the error term ε = V - U for each farm, the measure is the expected value of u conditional on ε i.e.

$$E(u/\varepsilon) = \frac{\delta u.\delta v}{\delta} \quad \frac{f(\varepsilon_i \lambda\delta}{1-F(\varepsilon_i \lambda/\delta)} - \frac{(\varepsilon i\, \lambda)}{\delta} \qquad (6)$$

where f and F are the standard normal density function and the standard normal distribution function respectively, evaluated at ε λ/δ. Estimation values for ε, λ and δ are used to evaluate the density and distribution functions.

Measures of efficiency for each farm can be calculated as;

$$TE = [\varepsilon(u/\varepsilon)] \qquad (7)$$

$$\text{Technical inefficiency} = 1 - [\varepsilon(u/\varepsilon)] \qquad (8)$$

The production technology of *fadama* food crop farming household is assumed to be specified by Cobb-Douglas frontier production function defined as follows:

$$\ln Q = a_0 + \sum_{i=1}^{9} ai \ln Xi + \sum_{j=1}^{3} ajDj + (V_i - U_i) \qquad (9)$$

Where ;

Q = Output of crops measured in grain equivalent per household

Physical Inputs(X) - X_1 = Farm size in hectares, X_2 = Family labouring man-days, X_3 = hired labour in man-days, X_4= capital in N, X_5 = cost of purchased inputs in N, **Land Use Variables(T)-** X_6 = crop diversification index (CDI), X_7 = nutrient intake index , **Land Management Practices Variable(M) -** X_8 = length of fallow in years, X_9 = quantity of fertilizer used in kilogramme, D_1= tillage used $D_1 = 1$ for conventional tillage and $D_1 = 0$ for zero tillage, **Land Resource Quality Variable(R) -** D_2 = drainage measure as dummy $D_2 = 1$ for well drained land and 0 otherwise, D_3 = terrace measured as dummy D_3=1 for flat topography and 0 otherwise, a_i = Vector of parameters,

V_i = Random error due to mis-specification of the model and variation in output due to factors outside the farmer's control such as weather and diseases,

U_i = Inefficiency component of error term. It is assumed that the inefficiency effects are independently distributed and U_i truncation (at zero) of the normal distribution with mean 0 and variance δ_u^2 where U_i is specified as:

$$Ui = a_0+a_1 lnZ_1+a_2 lnZ_2+a_3 lnZ_3+a_4 lnZ_4+a_5 lnZ_5 \quad (10)$$

Where;

Ui = Technical inefficiency of *fadama* food crop farming household.
Z_1 =Access to credit expressed as a dummy, 1 for access and 0 for no access.
Z_2= *Fadama* farming experience expressed in years.
Z_3 =Highest educational level expressed in years.
Z_4= Number of extension contact in years.
Z_5 = Household size expressed as the number of people in a household.
a_0, $a_{i,\, i = 1 \longrightarrow 5}$ are parameters estimated.

Since the dependent variable of the inefficiency model represent the mode of inefficiency, (i) a positive sign of an estimated parameter implies that the associated variable has a negative effect on efficiency and this implies inefficiency and (ii) a negative sigh indicates that the reverse is true i.e. it has posive effect on efficiency and this means a reduction in inefficiency (Yao and Liu, 1998).

Elasticity of Production and Return to Scale Measurement

Other estimates derived from our stochastic equation (9) for food crops farming household in the *fadama* are elasticity of production (EOP) and return to scale (RTS).
EOP is the same as the estimated coefficients of the independent variables (Kumbhakar, 1994)

$$RTS = \Sigma EOP_i \qquad i = 1\ldots,n \quad (11)$$

Inferentially, RTS < 1, decreasing return to scale
RTS > 1, increasing return to scale

Results and Discussion

The production frontier was estimated using maximum likelihood estimation approach (MLE) through the FRONTIER 4.1 program developed and licensed by Coelli (1996).

Diagnostic Statistics

Table 1 shows the MLE of the stochastic production function (Eq 9) for all the sampled farm households during the study. The estimate of sigma-square (δ^2) is 0.6959. This is large and statistically significant at 0.01. Lambda (λ) estimated at 6.3785 which is greater than one indicates a good fit and the correctness of the specified distributional assumption of the composite error term (Tradesse and Krishmamoorthy, (1997). The variance ratio represented by gamma (γ) is estimated as 97.59 percent. This suggests that systematic influences that are unexplained by the production function are the dominant sources of random error. That is to say that the presence of technical inefficiency among the sampled farm explains about 98 percent variation in error observed in the estimated stochastic production frontier. The generalised likelihood ratio is significant at 0.01 levels suggesting the presence of the one sided error component. This implies that technical inefficiency is significant and a classical regression model of production function based on OLS estimation techniques would be inadequate representation of the data. Thus, the results of the diagnostic statistics confirm the relevance of stochastic parametric production frontier and maximum likelihood estimator for this work.

Table 1: Stochastic Frontier Estimation (MLE) Result.

Variable	**parameter**	**Coefficient**	**Standard Error (SE)**	**t-ratio**
Physical Input (x_i)				
Constant (x_0)	β_0	3.9530**	1.6910	2.337
Farm size(x_1)	β_1	0 .2435**	0.0977	2.492
Family labour (x_2)	β_2	0.1320**	0.0569	2.3216
Hired labour (x_3)	β_3	0.0995**	0.0394	2.5240
Capital (x_4)	β_4	0.1948**	0.0975	1.9989
Cost of purchase input (x_5)	β_5	1.5505***	0.3374	4.5960
Land use variables				
Crop diversification index (x_6)	β_6	0.0048**	0.0019	2.5260
Nutrient intake index (x_7)	β_7	- 0.3590***	0.1133	-3.1686
Land Management Variable				
Length of fallow (x_8)	β_8	0.0594**	0.0283	2.0989
Fertilizer used (x_9)	β_9	0.1146***	0.0269	4.2682
Tillage used (D_1)	β_{12}	-0.1213	0.3856	-0.3146
Land resource Quality variable				
Drainage (D_2)	β_{10}	0.1289**	0.0654	1.9870
Terrace (D_3)	β_{11}	0.0017	0.1153	0.0147
Inefficiency model				
Constant Term	a_0	0.2847	0.2315	1.2298
Credit (Z_1)	a_1	-0.1341**	0.0606	2.2129
Farming Experience (Z_2)	a_2	-0.3624**	0.1828	1.9821
Education (Z_3)	a_3	-0.2074**	0.0841	2.4663
Extension Contact (Z_4)	a_4	-0.1695**	0.0735	2.3061
Household size (Z_5)	a_5	0.4373**	0.2213	1.9761
Diagnostic statistics				
Sigma square	δ^2	0.6959***	0.1346	5.1706
Gamma	γ	0.9759***	0.0355	27.5327
Lambda 6.3785	λ			
Likelihood ratio (H_o) -97.3668				
Likelihood ratio (H_1) -111.8277				
LR Test 28.92***				
δu^2 = 0.6762				
δv^2 = 0.0167				

*** Significant at 1%, ** Significant at 5 %
Source: Summarised from computed output of Frontier 4.1

MLE Estimates of the Parameter of the Stochastic Production Function

The estimated parameters and the related statistical test result from the analysis are presented in Table 1. All the parameters in the model have the expected sign and many of the coefficients are statistically significant at 5 percent level of probability or less. The coefficients can be interpreted as the elasticity of the output with respect to input at the data point (Kumbhakar, 1994). The estimated coefficients for methods of tillage and drainage were not discussed because they were not significant in explaining the estimated stochastic production frontier.

The stochastic frontier results indicate that the coefficient of physical inputs- land (X_2), family labour(X_3), capital input(X_4), and cost of purchase input (X_5) are 0 .2435, 0.1320, 0.0995, 0.1948 and 1.5505 respectively. These coefficients are significant at 5% level. It could be observed that hired labour has a higher elasticity relative to family labour. This tend to suggest that unit increase in hired labour add more to output relative to a unit change in family labour. The product elasticity of cost of purchased input (X_5) is the highest among physical input followed by capital input. This shows that there exists high scope for increasing output per by increasing the use of purchase input especially when improved seed and land augmenting material such as fertilizer/ manure are adequately applied.

The coefficient of land use variables are 0.0048 and -0.3590 for CDI and NII respectively. The significant positive estimate for CDI indicates that higher level of crop diversification is associated with increasing output (GE) of combined crop. This result supports the finding of Spio (1996); and Alamu and Coker (2005) who reported higher stability of yield and review in mixed crop enterprise. The significant negative estimate of NII shows that output decrease with increase in NII. This is consistent with a priori expectation that crops which have heavy soil nutrient depleting abilities would have lower aggregate yield when soil is poor in status and land augmenting resources is sparsely added to soil (Fageria, and Baligar,1993)

The land management variables coefficients are estimated as 0.0594 and 0.1196 for length of fallow and fertilizer used respectively. Elasticity of output is higher with use of fertilizer than fallow which shows that land productivity can be improved only marginally with fallow only. The use of land augmenting materials in addition to proper farm management practice is important to restore nutrient to *fadama* farmland.

The only significant land resource quality variable is drainage with a coefficient of 0. 1289 that is significant at 5% percent. The result is consistent with a priori expectation that coefficient of drainage is positive for well-drained soil. This implies that yield increase as the drainage condition improves. This is very true of the *fadama* area which can be waterlogged very easily.

Determinants of Technical Inefficiency

The determinants of technical inefficiency in food crop production in the *fadama* of Southern Guinea Savanna, Niger State, Nigeria are presented in Table 1. The coefficient of household size came up positive and significant at 5% level. All the other coefficients in the model are negative and significant also at 5% level. Assess to credit shows negative relationship with technical inefficiency which implies that it can improve level of technical efficiency of sampled household head. This result agrees with those of Bravo-Ureta and Evenson (1994); Onyenweaku and Nwaru (2004). However, the result disagrees with those of Okike (2000) who found a negative relationship between credit and technical efficiency and Rahji (2005) who found no significant relationship between access to credit and technical efficiency.

Fadama Farming Experience (Z_2) shows negative and significant relationship at 5 percent level with technical inefficiency. This result implies that households with more experience tend to be less inefficient. These might be because most of the household head have more than fifteen years experience in *fadama* farming and might be receptive to innovations. This result is in line with that of Ajibefun *et al.* (2002) who reported a negative and significant relationship between farming experience and technical inefficiency. However, it differs from that of Onu *et aI.* (2000) whose result shows a positive relationship between farming experience and technical inefficiency.

The coefficient of educational level (Z_3) is negative and significant related to technical inefficiency. This implies that access to quality education can reduce the technical inefficiency of the *fadama* farming household, which will invariably increase sustainability of *fadama* as a result of higher productivity. This result agrees with those of Kalijaran and Shand (1986), Bravo-Ureta and Pinheiro (1993), and Rahji (2005). However, the result disagrees with Kalijaran and Shand (1985), Bravo-Ureta and Evanson (1994), Onyenweaku and Effiong (2005) Rahji (2006) and Fatoba (2007) whose result showed no significant relationship between education and technical efficiency.

The coefficient of extension contact (Z_4) is negative and significantly related to the technical inefficiency at 5 percent. This is in accordance with the a priori expectation that extension contact leads to more efficient transmission of information to farmers as well as enhancing the adoption of innovation. This implies that more extension contact would lead to lower technical inefficiency and higher productivity of the farming household. This result is similar to that of Rahji (2005) who reported a positive and significant relationship between extension contact and technical efficiency.

The coefficient of household size (Z_5) is positively related to technical inefficiency and significant at 5% level. The implication is that increase in the number of farming household will increase technical inefficiency. Household size, which can be a proxy for labour supply, is presently at an average of 17 people. So any increase may lead to excess labour supply.

Technical Efficiency

The technical efficiencies differ substantially among the sampled *fadama*-farming households ranging between 0.06 and 0.95 with a mean technical efficiency index of 0.58. This leaves an inefficiency gap of 0.42. This is expected since the technical inefficiency effect in the estimated model is significant. This suggests that reasonable marketable output is sacrificed and there is resource wastage. The result implies that about 42 percent higher production could be achieved without additional resources or inputs could be reduced by 42 percent to achieve the same level of output. The distribution of the technical efficiencies is presented in Table 2.

Table 2: Distribution of farm specific Technical Efficiency indices among Sampled *Fadama* Farming Households.

Class interval of efficiency indices	Frequency	Percentage
0.01 - 0.10	3	2.01
0.11 - 0.20	4	2.69
0.21 - 0.30	8	5.37
0.30 - 0.40	10	6.71
0.41 - 0.50	29	19.46
0.51 - 0.60	30	20.13
0.61 - 0.70	20	13.42
0.71 - 0.80	19	12.75
0.81 - 0.90	19	12.75
0.91 - 1.00	7	4.70
Total	149	100

Mean = 0.58 Standard deviation 0.20
Min value = 0.06 Maximum value 0.95
Source: Summarized from MLE result frontier 4.1

From Table 2, the frequencies of occurrence of the technical efficiency in deciles ranges indicate that the highest number of farming household have technical efficiencies between 0.5 and 0.6. The sample frequency distribution indicates a gradual rising from left to highest; it then falls to the right of the distribution. The modal class did not fall into any of the extreme classes. Therefore, the assumption of a general truncated normal distribution for the inefficiency term (u_1) is therefore justified.

Although, there is a wide range between the maximum and minimum values of technical efficiencies, the estimated technical efficiencies clustered around 0.5 and 0.6 ranges, with reasonable spread among the range. About 64 percent of the farming households have technical efficiency value of 0.50 and above while only 17 percent have technical efficiency value of less than 0.40. This result is an indication of a fairly efficient group of farming households. Given the wide variation in the level of technical efficiency, there appears to be considerable room for improvements in the technical efficiencies of sampled *fadama* food crops farming households. The distribution of efficiency estimates over a wide range agree with previous works carried out in other peasant farming settings (see Ali (1996); Parikh and Shah (1995); Coelli and Battese (1996); Ajibefun *et al.* (1998); Udoh (2000); Amaza (2000); Amaza and Olayemi (2002); Oyenweaku and Effiong (2004); Okoruwa and Ogundele (2005); and Fatoba (2007). It should be noted that the estimated efficiencies are purely output oriented technical efficiency derived as the ratio of observed to maximum feasible output, condition on technology and observed input usage.

Distribution of Production Elasticity

Table 3: Distribution of Production Elasticity among the Variables.

Set of variables	Estimated value	Scale of Production
Physical inputs	2.2203	SR-Increasing return to scale
Land use and land management variables	-0.3015	SR-Decreasing return to scale
Total (V)	1.9188	Increasing return to scale

Source: Computed from MLE result of Frontier 4.1

From the estimates in Table 3, return to scale measured as the sum of production elasticity of all variables ($\sum\beta_i$), is greater than one. The return to scale parameter (1.9188) indicates the presence of short run increasing return to scale. This implies that every addition to production input would lead to more than proportionate addition to the output. Thus, *fadama* food crops farming households could still get more output by intensifying on the use of there resources until they are able to achieve economic optimum. This result is in line with the findings of Ajibefun *et al. (2002)*; Awotunde and Ikpi (2004) who reported a short-run increasing return to scale among smallholder food crop farmers in Oyo State and Sugarcane farmers in Jigawa State, Nigeria respectively.

Conclusion and Recommendations

The study assessed the determinant of technical inefficiency of Rice production in the fadama of Southern Guinea Savanna of Nigeria. The farm specific technical efficiency was estimated using Stochastic Frontier Production Function The estimated production frontier fulfilled the attributes of well-behaved production frontier and the diagnostic statistics suggested the presence of component error term, thus the use of stochastic parametric estimation.

The estimates of all physical input have required sign and are statistically significant at 5 percent or less. The MLE estimate of technical efficiency revealed a general truncated normal distribution with a minimum efficiency index of 0.06 and the maximum efficiency value of 0.95. The average technical efficiency in the sample was 0.58 leaving an inefficiency gap of 0 .42. The return to scale parameter (2.7058) indicates the presence of short run increasing return to scale. This implies that every addition to production input would lead to more than proportionate addition to the output. Thus, *fadama* food crops farming households could still get more output by intensifying on the use of there resources until they are able to achieve economic optimum.

Farm size, family labour, hired labour, capital, cost of purchased inputs, length of fallow, quantity of fertilizer used, crop diversification index, drainage and nutrient intake index were factors that significantly ($P< 0.05$) influenced the estimated technical efficiency. Access to credit, *fadama* farming experience, educational level of head of households, and extension contact had negative and significant relationship ($P< 0.05$) with inefficiency level. This implies that increase in these variables would lead to less inefficiency. Household size had positive and significant relationship ($P< 0.05$) on inefficiency which implies that increase would lead to higher inefficiency.

The authors recommend the use of animal traction to reduce labour usage in fadama food crop production systems. Education was revealed to significantly affect the technical inefficiency of producers in the fadama. When farmers are educated, they can better appreciate improved technologies and even use them appropriately, thereby enhancing better resource use. Efforts at mobilizing farmers into viable cooperative groups should also be pursued vigorously. This will help mobilize rural savings that can be readily available to the farmers. Farmers, if capacitated financially can easily afford necessary inputs like the fertilizer, which was shown to significantly influence food crop production. In addition land and labour saving technologies should be researched into and extended to food crop producers in the fadama.

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