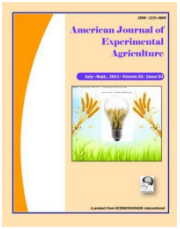

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Productivity and Technical Efficiency among Beneficiary Farmers of Second National Fadama Project in Kaduna State, Nigeria

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ABSTRACT

The study evaluates the productivity and technical efficiency among beneficiary farmers of Second National Fadama project in Kaduna State, Nigeria. Data for analysis were obtained from two hundred and six project beneficiary and non beneficiary farmers respectively. Descriptive statistic, pie chart and stochastic frontier production function were used for the data analysis. The study revealed that fertilizer and pumping machine rated high among the Fadama II project facilities used by the beneficiary farmers. Evidence from the stochastic production analysis shows that Farm size, fertilizer and hired labour were highly significant (1%) in determining the output of project beneficiaries, while chemical, farm size and fertilizer were significant at 1% respectively in determining the output of the non-beneficiary farmers in the study area. The mean technical efficiency of the project beneficiary was higher (92%) than the mean technical efficiency (48%) of the non-beneficiaries. Age, educational level, Fadama farming experience and access to credit were positively related to technical efficiency of project beneficiary at 1% respectively. The study recommends policies that aimed at improving beneficiaries' access to credit, timely distribution of productive inputs. This in turn would help the country to ensure all year round food production and reduction in poverty level among its populace.

Keywords: Productivity; technical efficiency; fadama; farmer beneficiary.

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1. INTRODUCTION

Agriculture as the main stay of Nigerian economy contributes about 41.5% to GDP and a source of food nutrition for Nigerian households (World Bank, 1996). It is a key factor that can affect majority of Nigerians since over 60% of its population is involved in farming (Aturamu and Daramola, 2005).

An essential feature of agricultural production scene in Nigeria is that small farm with land holdings of less than 2.0 hectares per farmer collectively produce over ninety percent of the total agricultural production in the country (Aturamu and Daramola, 2005). Also, majority of these farmers still produce at subsistence level using old management practices that are not economically viable with an overall effect of low productivity and technically inefficient production process (Ogunsumi, 2005). Productivity according to Coelli et al., (1998) is a measure of farm performance which indicates whether a farm uses the best available technology to obtain maximum output from a given set of inputs. On the other hand, technical efficiency is the ratio of total output to total inputs; the larger the amount of inputs per unit of output the smaller the size this ratio becomes (Ohajianya and Onyenweaku, 2001). A production process may be technically inefficient if it fails to produce maximum output from a given bundle of inputs and is therefore operating beneath its stochastic production frontier (Hazarika and Subramanian, 1999).

The analysis of allocative efficiency usually assumes that the farm firm seeks to optimize a profit maximization objective function subject to resource constraint. Resources are said to be efficiently allocated when the value of marginal product of each resource equals its price (Ogunsumi, 2005).

In Nigeria, the problem of attaining food sufficiency and poverty reduction among the rural dwellers that are the bed rock of agricultural production may be due to poor implementation of most programs geared towards improving agricultural sector in the past. However, of recent the National Fadama Development Project is a major instrument for achieving the government's poverty reduction objective in the rural areas of Nigeria (FDP, 2003).

The word "Fadama" is a local Hausa word for low–lying flood plains usually with easily accessible shallow groundwater (FDP, 2003). The use of Fadama resource will ensure all year round farming of some staple food and vegetables especially where Fadama resources are more pronounce.

The National Fadama Development Project was structured into developmental stages for efficiency in implementation strategy. The first stage of the program was called Fadama I project which according to ARDD (2003) appraisal report recorded a huge success as more than 300 percent of the farmers in some participating states in the country increased their production capacity. Nevertheless, the full realization of the project benefits was hampered by certain shortcomings in project design and implementation. Other problems identified during Fadama I are lack of involvement of project clients in project planning, limitation of the project to crop production ignoring downstream value addition activities of marketing and processing, and ignoring other Fadama resource users which led to a lot of conflict among Fadama resource users. In order to resolve some of the shortcomings of Fadama I project, the second stage of the project called Second National Fadama (Fadama II) was introduced in twelve states of Nigeria.

Fadama II project was a comprehensive six-year (2004-2009) action programme developed by the Federal Ministry of Agriculture and Rural Development (FMARD) in close collaboration with the Federal Ministry of Environment (FME) and other Federal and State government ministries, local government and key stakeholders (donor, private operators and NGOs). The objective of Fadama II project in Nigeria is to sustainably increase the incomes and productivity of Fadama users, those who depend directly on Fadama resources (farmers, pastoralists, fishers, hunter, gatherers and service providers) through empowering communities to take charge of their own development agenda, and by reducing conflict between Fadama users. The project has the following components: a) to build the capacity of Fadama users and other key stakeholders; b) to address the technical, social and location-specific activities to improve the management of critical watersheds that ensure Fadama productivity and sustainability in a few (pilot) areas with high potential for up scaling replicability; c) supports a range of advisory services, training, information sharing, awareness programs, and adoption of land use practices that will enable Fadama users to adopt productivity enhancing techniques and more profitable marketing, and at the same time ensure the sustainability of Fadama resource base; d) focus on project management mechanisms, including monitoring and evaluation plans to implement Fadama II.

Therefore the research was carried out in the study area to ascertain the level of productivity and technical efficiency of Fadama II project beneficiary farmers compared with those of non beneficiary farmers.

2. METHODOLOGY

The study was carried out in Kaduna State Nigeria. Ten (10) Local Government Areas (LGAS) participated in Fadama II project in the state, these LGAS fell within the three senatorial districts (Northern, Central and Southern) in the state. Multistage sampling technique involving three stages was employed in the selection of the respondents used for this study. The first stage involved random selection of one local government each from the three senatorial districts. The next stage was purposive selection of two communities each from the three selected local government areas based on the intensity of Fadama activities in those villages. The final stage involved the random selection of farmers “with” and “without” (who participated in Fadama II and those that did not participate respectively). The selection of these respondents was assisted by the list of both participants and non participant farmers given by the Kaduna State Agricultural Development Officers in Kaduna and also through the assistance of the facilitators in each of the Local Government area. About 412 farmers comprising 206 beneficiaries of Fadama II project and 206 non-beneficiaries were used for the study. Farm input-output and socio-economic data of respondents were collected between the months of February and June, 2008.

2.1 Analytical Framework

Descriptive statistics such as mean, frequency and percentage and pie chart were used to discuss the socio-economic characteristics of the farmers. The Stochastic Frontier production function was used to capture and compare the production frontier and technical efficiency in production process of the Fadama II project beneficiary and non-beneficiary farmers**.** The Stochastic Frontier Production technique is preferred for accessing efficiency in Agriculture because of the inherent stochasticity (Ezeh, 2004). It is capable of capturing technical inefficiency in production process, measurement error as well as other statistical noise influencing the shape and position of production frontier (Ogundari et al. 2006). The

use of stochastic frontier production function makes it possible to find out whether the deviation in technical efficiencies from the frontier output is due to farm specific factors or due to external random factors. The stochastic frontier production model developed by Aigner et al. (1977) was employed in this study separately for both project beneficiary and non beneficiary farmers to determine if there is difference between the respondents in terms of productivity and technical efficiency. The parameters of the models were obtained by the use of maximum likelihood estimation method using the computer software Frontier version 4.1 (Coelli, 1994). The model is specified as:

$Yi = F(Xi;ß) \exp(Vi - Ui)$ ---------- (1)

Specifically, the production technology (Technical efficiency) of Fadama II beneficiary and non-beneficiary farmers was estimated using the Cobb Douglas functional form of the stochastic frontier production function model which is defined as follows:-

$$\text{Ln } Yi = \beta_o + \beta_1 \text{LnX}_1 + \beta_2 \text{LnX}_2 + \beta_3 \text{LnX}_3 + \beta_4 \text{LnX}_4 + \beta_5 \text{LnX}_5 + \beta_6 \text{LnX}_6 + V_1\text{-}U_1\text{-----} \quad (2)$$

Where Yi = Farm output ith farmer (in grain equivalent) during the project
Xi = Vector of actual farm input quantities used by the ith farmer ($Xi=X_1\text{-}X_6$).
X_1 = Farm size (in hectares); X_2 = Planting materials (in grain equivalent);
X_3 = Fertilizer (Kg); X_4 = Chemical (li); X_5 = Family labour (in man-day);
X_6 = Hired labour (in man-day); ß = vector of production function parameters to be estimated;
Vi-Ui = is composite error term
Vi = random variability in the production that cannot be influenced by the farmers
Ui= is a non-negative random variable associated with technical inefficiency in production
The technical efficiency of farmer (i) in the contest of the stochastic production function in equation (1) is:

$TE = Yi/Yi^*$ ---------- (3)

$= F(Xi;ß)\exp(Vi - U_i) \backslash F(Xi;ß) \exp(Vi)$ ---------- (4)

$= \exp(-U_i)$ ---------- (5)

The determinants of technical efficiency were modelled in terms of socioeconomic variable of the farmers as:

$$\exp(-U_i) = \varpi_0 + \varpi_1 Z_1 + \varpi_2 Z_2 + \varpi_3 Z_3 + \varpi_4 Z_4 + \varpi_5 Z_5 + \varpi_6 Z_6 + \varpi_7 Z_7 + \varpi_8 Z_8 + \varpi_9 Z_9 + \varepsilon_i \text{ ----------} \quad (6)$$

Where,
Yi = is observed value of output, Yi* = is frontier output (potential output)
$\varpi_1\text{-}\varpi_9$ = coefficients of the technical efficiency determinants to be estimated
Z_1 = age of farmer in years; Z_2 = sex of farmer (dummy; 1= male, 0 female); Z_3 = household size (numeric); Z_4 = educational level of farmer in years; Z_5 = Farming experience (years); Z_6 = Fadama farming experience (years); Z_7 = access to credit (dummy; 1,0); Z_8 = extension contact (nos of contact); Z_9 = farm size (ha).

Given the density function of Ui and Vi the frontier production function can be estimated by maximum likelihood techniques. The value of the technical efficiency lies between zero and one. The most efficient farmer will have value one, while farmer having value lying between zero and one is described as inefficient.

3. RESULTS AND DISCUSSION

3.1 Distribution of Project Beneficiaries According to the Use of Fadama II Facilities

Productive asset acquisition is the second largest project invested in by Fadama II program to improve the productivity of the beneficiaries (World Bank, 2003). As shown in figure 1, about 27% and 23% of project beneficiaries respectively indicated that fertilizer and pumping machine were the project facilities mostly used by respondent. Other facilities include planting material, advisory services and credit facility. The order of usage of these facilities indicates the relative importance and availability of the facilities in the study area.

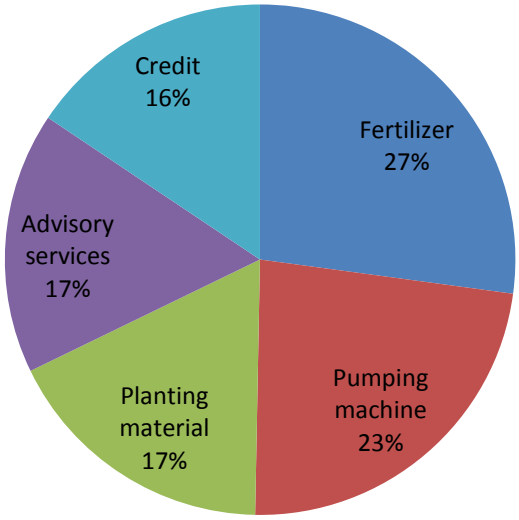

Figure 1. A chart showing distribution of beneficiary farmers according to the use of Fadama II facilities

3.2 Estimated Production Function

Table 1 indicates the maximum likelihood estimates of the Stochastic Frontier for Fadama II project for beneficiary and non-beneficiary farmers in the study area. The estimated variance (σ^2) was statistically significant at1% level for both respondents indicating goodness of fit and correctness of the specified distribution assumption of the composite error terms.

Table 1. Maximum likelihood estimate of production efficiency of Fadama II project beneficiary and non-beneficiary farmers

Variable	Parameters	Estimates Beneficiaries	Estimates Non-beneficiaries
Constant term	β_o	9.3296(18.4993)***	8.3669(61.8246)***
Farm size	β_1	0.4062(5.9168)***	1.3378(7.5419)***
Planting material	β_2	0.0882(1.7941)*	0-0.0075(-0.1311)ns
Fertilizer	β_3	0.0659(8.5753)***	0.1501(13.7479)***
Chemical	β_4	-0.0766(-1.4439)ns	-0.1921(-7.0182)***
Family labour	β_5	-0.0707(-2.1369)**	-0.0295(-0.9575)ns
Hired labour	β_6	-0.1263(-3.4056)***	0.0585(0.6702)ns
Technical efficiency factors			
Constant	ϖ_0	-1.0252(-1.9064)*	-1.0045(-1.0994)ns
Age	ϖ_1	0.0305(3.8207)***	0.0134(1.2595)ns
Sex	ϖ_2	-0.1476(-1.0519)ns	0.6534(0.9906)ns
Household size	ϖ_3	0.0038(0.2372)ns	-0.0012(-0.0654)ns
Education	ϖ_4	0.2037(2.6389)***	0.1088(1.5847)*
Farming experience	ϖ_5	-0.0086(-1.0747)ns	-0.0009(-0.1029)ns
Fadama experience	ϖ_6	0.3616(3.2510)***	0.0039(0.1644)ns
Credit access	ϖ_7	0.0404(4.0760)***	0.0249(0.1351)ns
Extension contact	ϖ_8	0.1581(0.2537)ns	0.2299(1.1829)ns
Farm size	ϖ_9	-0.2378(-2.3741)**	0.0347(0.1728)ns
Sigma squared	σ^2	0.1053(4.7623)***	0.5878(4.7095)***
Gamma	γ	0.1699(8.8889)***	0.9999(346816.31)
LR		36.94	50.85

Source: Field survey, 2008

The gamma (γ) were estimated at 0.17 and 0.99 for the project beneficiary and non-beneficiary farmers respectively and were significant at 1% level for both respondents. This implied that 17% and 99% of the total variation in the farm output of the beneficiary and non-beneficiary farmers respectively is due to technical inefficiency. As revealed also in Table 1, five variables (farm size, planting material, fertilizer, family and hired labour) were significant in determining the farm output of beneficiary farmers, while three variables (Farm size, fertilizer and chemical) significantly influenced the farm output of non-beneficiaries in the study area. This result agrees with the finding of Ogundari et al. (2006) in estimating confidence intervals for technical efficiency of rain fed rice farms in Nigeria in which all the variable inputs used by farmers except chemical were significant for their output. Farm size

and fertilizer contributed positively to the output of both respondents at 1 percent level of significance respectively. This conforms to the expected sign of the variables in question. Family and hired labour were negatively related to the output of project beneficiary farmers at 10% and 1% levels respectively. This result contrasts the findings of Okoye et al. (2007), Onyeweaku and Nwaru (2005) and Ezeh (2004).

3.3 Determinants of Technical Efficiency

The estimated values of the determinants of technical efficiency of Fadama II project beneficiary and non-beneficiary farmers is as shown in Table 1. The coefficients of age, education, Fadama farming experience and credit were positively related to project beneficiary farmer's technical efficiency at 1% levels of significant respectively. This implied that the more increase in the quantity of the corresponding variables, the more technically efficient would the farmers. According to Ajibefun and Aderinola (2004) advancement in age is a disincentive to technical efficiency because ageing farmers would be less energetic to work as such may not necessarily be technical efficient. The significant of educational of project beneficiary to their technical efficiency may be due to the fact that some aspect of Fadama II project requires a certain level of education as criteria for participation (Nkonya, et al., 2008). Findings by Simonyan et al. (2010) on socio-economic determinants of farmers participation in Fadama II project also indicates that educational status of farmers was highly significant in determining the level of participation of farmers in Fadama II project. The coefficient of farm size is negatively related to technical efficiency of beneficiary farmers and is significant at 5% level. This implied that the larger the farm sizes the less control would the farmers have on Fadama resource hence the less efficient would the farmers. On the other hand, the coefficient of educational status of the non-beneficiary farmers was the only significant factor that influenced their technical efficiency.

3.4 Distribution of Respondents According to Technical Efficiency Estimates

The results of the frequency distribution of technical efficiency estimates of Fadama II project beneficiary and non-beneficiary farmers are shown in Table 2. The technical efficiency estimates presented in Table 2 indicates that it ranged from 0.37 to 0.99 and the mean technical efficiency was 0.92 for the project beneficiary farmers. On the other hand, the technical efficiency for the non-beneficiary farmers ranged from 0.11 to 0.97 while their mean efficiency was 0.48. This implied that Fadama II project beneficiary farmers were more technically efficient than the non-beneficiary.

Table2. Frequency distribution of technical efficiency estimate of Fadama II beneficiary and non-beneficiary farmers

Efficiency	Beneficiary Frequency	Percentage	Non- beneficiary Frequency	Percentage
<0.20	-		20	9.71
0.21-0.50	01	0.49	101	49.03
0.51-0.90	36	17.48	72	34.95
>0.90	169	82.04	13	6.31
Total	206	100	206	100
Maximum	0.99		0.97	
Minimum	0.37		0.11	
Mean	0.92		0.48	

This result conforms to the finding of Ezeh (2004) who reported that Fadama crop farmers in Abia State, Nigeria were more technically efficient than their non-Fadama crop counterpart. The differences in the level of technical efficiency may be due to advisory services and some productive assets that the beneficiary had through their participation in Fadama II project.

4. CONCLUSION

The study revealed that the project beneficiary farmers were more technically efficient than the non-beneficiaries, however both respondents did not attain their maximum technical efficiency as such there is room for improvement in their level of technical efficiency in Fadama crop production. The coefficients of education, Fadama farming experience and access to credit were highly significant in determining the technical efficiency of beneficiary farmers, whereas educational level of non-beneficiary farmers was the only factor that was significant to their technical efficiency. If the objective of enhancing food productivity and income among rural dwellers will be attain in Nigeria by the year 2020, there is therefore the need for policies that aimed at improving Fadama II beneficiary farmers' access to credit, timely distribution of productive inputs and the number of extension contact.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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