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# PRODUCTION EFFICIENCIES OF ARABLE CROP FARMERS IN OGUN STATE: A COMPARATIVE ANALYSIS OF BANK OF AGRICULTURE LOAN BENEFICIARIES AND NON-BENEFICIARIES

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## ABSTRACT

This study compared the production efficiencies of Bank of Agriculture loan beneficiary and non-beneficiary arable crop farmers in Ogun State. Two hundred and forty arable crop farmers were sampled using multistage sampling technique. The data collected were analyzed using descriptive statistics and stochastic frontier analysis. The finding revealed that the farmers are in their active age. The significant determinants of farm output include farm size, labour, planting material and fertilizer. The production inefficiency model revealed that education, extension contact and loan significantly determined the technical efficiency of the farmers. The determinants of cost of production include farm output, labour wage rate, price of planting material and price of herbicide. The cost inefficiency model showed that age, household size, extension contact and loan have significant effect on the cost efficiency of the arable crop farmers. The mean technical efficiency of 86 percent and 79 percent shows that there is potential to increase the technical efficiency by 14 percent and 21 percent by the loan beneficiaries and non-beneficiaries, respectively. The mean allocative efficiency of 0.81 and 0.67 for the loan beneficiary and non-beneficiary respectively implies there is room for improvement in the allocative efficiency by 19 percent and 33 percent respectively. The mean economic efficiency of 0.78 and 0.60 for the loan beneficiary and non-beneficiary respectively implies the farmers can improve their economic efficiency by 22 percent and 40 percent respectively. The z-test revealed that the loan beneficiary arable crop farmers are more technically, allocatively and economically efficient ($P<0.01$) than their non-beneficiaries' counterpart. Policy option requires the arable crop farmers to expand their farm land to ensure efficient utilization of other resources. Extension and adult literacy education should be encouraged among arable crop farmers to afford the farmers the benefit of agricultural loan. Access to agricultural loan should be strengthened among the non-beneficiary arable crop farmers for increased production efficiency.

**Keywords:** agricultural loan, production efficiencies, stochastic frontier, arable crop farmers

## INTRODUCTION

The measurement of production efficiency of economic units is important in economics. Jema (2008) emphasized that the scarcity of resources is the major factor that makes the improvement in efficiency so important to an economic agent or to a society. Three types of production efficiency are identified in literature: the economic efficiency which combines the technical efficiency and allocative efficiency, is defined as the capacity of a firm to produce a predetermined quantity of output at a minimum cost for a given level of technology; technical efficiency is the ability of a firm to produce maximum output from a given level of inputs while allocative efficiency measures the ability of a firm to use inputs in optimal proportions, given input prices (Bravo-Ureta and Pinheiro, 1997). Access to agricultural loan has been advocated by stakeholders to enhance high production efficiency through the use of technological innovations. According to Rahji (2000), loan is a basic tool of production which provides the farmers with capital to mobilize resources and appropriately combine same to achieve high efficiency.

The Central Bank of Nigeria (2005) asserted that in Nigeria, like in most developing countries, the formal financial system provides services to only 35 percent of the economically active population while the remaining 65 percent are excluded from access to the financial services. According to this source, these 65 percent are often served by the informal sectors through Non-governmental Organization Microfinance Institutions (NGO-MFIs), money lenders, friends, relatives and credit unions. To enhance the flow of financial services to Nigeria's rural areas, government has, in the past initiated a series of public-financial micro/rural credit programmes and policies targeted at the poor. In 2000, government merged the Nigerian Agricultural and Co-operative Bank (NACB), Family Economic Advancement Programme (FEAP) and Peoples' Bank of Nigeria (PBN) to form the Nigerian Agricultural Cooperative and Rural Development Bank Limited (NACRDB) to enhance the provision of finance to the agricultural sector. In 2010, government changed the nomenclature of the NACRDB to Bank of Agriculture (BOA). An important policy question to ask is whether these instituted public micro/rural credit programmes and policies achieved the set goals. No doubt that the short fall in the provision of financial services to the poor, who are mostly small-holder arable crop farmers, has affected the agricultural production in Nigeria. Little progress has been recorded in agricultural production due to Government's efforts geared towards ensuring food security.

An efficient agricultural sector would enable a country to feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. The agricultural sector has a multiplier effect on any nation's socio-economic and industrial fabric because of the multifunctional nature of agriculture. This is obvious, since this sector still employs the larger percentage of the population and remains the most viable sector among the oil and non-oil sectors. It was estimated that the annual food supply in Nigeria would have to increase at an average annual rate of 5.9 percent to meet the food demand and reduce food importation significantly (Amaza *et al.*, 2006). It has also been reported that the production of food in Nigeria has not increased at the rate that can meet the ever-increasing population. While food production increases at the rate of 2.5 percent, food demand increases at the rate of more than 3.5 percent due to the high rate of population growth of 2.83 percent (CBN, 2004). The reality is that Nigeria has not been able to attain self-sufficiency in food production, despite increasing land area put into food production annually. The constraints to the rapid growth of food production seem to mainly be that of low crop yields, and resource-use inefficiency attributable to inefficient farm management and inadequate finance.

Jhingan (2007) observed that an economy can grow but it may not develop because poverty, unemployment and inequalities may continue to persist due to low production efficiency, absence of technological and structural changes. The efficiency with which farmers use available resources and improved technology is important in agricultural production (Rahji, 2005). High production efficiency is associated with the quality of resources used, as well as their quantity and increased resource mobilization and efficient use help to account for productivity increase. Given the low income of the small-scale food crop farmers, only little can be expected from their savings. Similarly, most financial institutions are reluctant to grant loans to the farmers who form the bulk of rural inhabitants because of the nature of agriculture in Nigeria.

Ekpebu (2006) reported that the performance of the agricultural sector has been unsatisfying over the years due to insufficient loan facilities, inadequate infrastructural facilities, low technology base, high cost of farm inputs and inadequate extension services. The low agricultural output in Nigeria is revealed by the actual yields of major crops compared to the potential yields, implying that there is scope for additional increase of output from the existing hectares of food crops if resources are properly harnessed and efficiently allocated (Amaza and Olayemi (2002). This source also reported that existing low level of output in food crops production is a reflection of low level of technical efficiency, and that increased output is directly related to high efficiency arising from not only the optimal combination of inputs but also the given state of technology.

As a consequence, demand for agricultural loan to boost production became so high among arable crop farmers in Nigeria in general and Ogun State in particular. The importance of loan is that it removes the financial constraints of farmers thereby increasing the likelihood of adoption of new technologies which often involve additional expenditures on improved farm inputs. Arable crop farmers in Nigeria (and Ogun State in particular) are faced with loan problems from both formal and informal sources. Some of these problems, viewed from the side of the non-institutional sources, loan supply is generally scarce, unreliable and subsequently very expensive. The interest rates charged by local money lenders are excessive. Apart from the high interest rates charged, farmers do lose their crops, farmlands, houses and other valuable assets when they are unable to pay back the loan and high interest rate to the money lenders. In addition, loans from friends and relatives are generally small and of short duration. On the other hand, when viewed from the formal financial institutions, loan terms and loan rationing mechanisms have posed a major constraint to smallholder arable crop farmers.

The consequence of loan constraints on food insecurity necessitated the provision of subsidies and agricultural loan for farmers by the past and present government. The Bank of Agriculture and few commercial banks have occasionally introduced and implemented some kind of loan advancement to needy farmers as a way of promoting greater agricultural production efficiency through empowering farmers to procure essential inputs. Many credit institutions have however complained of their seemingly inability to recover loans disbursed to farmers. On the other hand, most farmers have complained of inadequate loan availability. As a result, most of the small-scale arable crop farmers still operate at a subsistence level. An important policy question is: are the few BOA loan beneficiaries operating at a higher efficient level than their non-beneficiaries counterparts? Are the arable crop farmers utilizing the loan to acquire improved farm inputs for production? As government is more responsive to addressing the welfare issues affecting people at the grass root, efficient loan availability to farmers remain the key to realizing these objectives. This is the motivation for this study to determine the differences in the technical, allocative and economic efficiencies of the loan-beneficiary and non-beneficiary arable crop farmers in Ogun State, Nigeria.

## RESEARCH METHODOLOGY

### *The Study Area*

This study was carried out in Ogun State, Nigeria. The State has 20 local government areas and lies approximately between latitude 3° 30 N and 4° 30N and longitude 6° 30 E and 7° 30E (Ogun State Government website). It falls within the humid tropical lowland region with two distinct seasons. The dry season lasts for four months usually from November to February. Average annual rainfall ranges from 1,200 mm in the Northern part to 1,470mm in the Southern part. The monthly temperature ranges from 23° C in July to 32°C in February. The mean daily sunshine hours ranges between 3.8 and 6.8. Relative humidity ranges between 76 percent and 95 percent coinciding with dry and wet season respectively. The northern part of the state is mainly of derived savannah vegetation while the central part falls in the rainforest belt. The southern part has mangrove swamp vegetation. Ogun State is endowed with fertile soil, making it possible to support the growth of food crops, economic crops and livestock. The state shares boundary with Republic of Benin in the West, Lagos State and Atlantic Ocean in the South, Ondo State in the East and Oyo State in the North. Ogun State covers a land area of 16,762 sq km with a population of 3,728,098 (NPC, 2006). For administrative convenience, the State was divided into four agricultural zones by the Ogun State Agricultural Development Programme (OGADEP). These include Abeokuta, Ijebu-Ode, Ilaro and Ikenne zones. The zones are further divided into blocks while the blocks are made up of cells. Eight (8) branch offices of Bank of Agriculture are spread across the four OGADEP zones in the State.

### *Sampling Procedure*

Multistage sampling technique was employed to select the primary data for the study. The first stage involved the purposive selection of one block known for arable crop production from each of the OGADEP zones and where the Bank of Agriculture branch offices are situated. The second stage involved a purposive selection of two cells, believed to be the food basket of each of the selected blocks. In the third stage, 15 beneficiaries of the Bank of Agriculture small holder loan scheme were randomly selected from each cell selected in stage two. In addition, 15 non -beneficiaries were randomly selected from each cell. These procedures led to a selection of 120 loan beneficiaries and 120 non-beneficiaries giving a total of 240 respondents used for the study. In the study area, cassava is mainly intercropped with maize, and for this reason, cassava and maize farmers were selected as the representatives of arable crop farmers. The quantity of outputs were obtained in their local measures and then converted to kg and the outputs in kg were later converted to Grain Equivalent using the conversion factor by Kormawa

(1999). This was done to allow output aggregation as well as allowing for a technical relationship between inputs and outputs to be estimated for the two crops.

***Analytical Technique***

The data collected were analyzed using descriptive statistics such as table, frequency, mean and percentage and econometric analyses which include:

***The Stochastic Frontier Production and Cost Functions***

The stochastic frontier modeling has been increasingly popular in recent times because of its flexibility and ability to closely link economic concepts with modeling reality. The modeling, estimation and application of stochastic frontier production function to economic analysis assumed prominence in econometrics and applied economic analysis following Farrell's (1957) seminar paper where he introduced a methodology to measure technical, allocative and economic efficiency of a firm. Farrell noted that the efficiency of a firm consists of three components: the technical efficiency (TE) which measures the ability of a firm to get maximum output from a given set of inputs; and allocative efficiency (AE) which measures the ability of a firm to use inputs in optimal proportion given their respective prices and the third component, economic efficiency (EE) is the product of technical and allocative efficiency and is defined as the capacity of a firm to produce a predetermined quantity of output at a minimum cost for a given level of technology (Bravo-Uretra and Pinheiro, 1997).

Farrell's methodology has been applied widely over decades, while undergoing many refinement and improvements. One of such improvements is the development of stochastic frontier model which enables one to measure farm level technical, allocative and economic efficiency using maximum likelihood estimate. Aigner, Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977) simultaneously introduced the stochastic frontier production function and since then many modifications had been made to stochastic frontier analysis. Aigner *et al*. (1977) applied the stochastic frontier production function in the analysis of the U.S agricultural data. Battese and Corra (1977) applied the technique to the pastoral zone of eastern Australia. On the other hand, Meeusen and Van den Broeck (1977) applied the technique to the analysis of ten French manufacturing industries. In recent times, empirical analyses have been reported by Battese, Malik and Gil (1996), Ajibefun and Abdulkadri (1999), Ojo (2004), Coelli *et al*. (1998), Umoh (2006) and Ogundari and Ojo (2007). The model adopted in this study is based on the one proposed by Battese and Coelli (1995) and Battese *et al.,* (1996) in which the stochastic frontier specification incorporates models for the technical inefficiency effects and simultaneously estimate all the parameters.

The Stochastic frontier production function model was employed to estimate the farm level technical efficiency of the loan beneficiary and non- beneficiary arable crop farmers. The Cobb-Douglas functional form was used because the functional form meets the requirement of being self-dual and it has been applied in most empirical studies. The explicit form of the Cobb-Douglas production function is expressed in equation 1.

$$Y_i = f(X_i : \beta) \exp V_i - \mu_i \qquad \ldots\ldots\ldots.1$$

where $Y_i$ represents the total output of the ith farms, f is the suitable function, $X_i$ represents inputs employable by the ith farm in production, $\beta$ is the parameter to be estimated. $V_i$ and $\mu_i$ are defined below. The technical efficiency of individual farmers is defined in terms of the ratio of observed output ($Y_i$) to the corresponding frontier output ($Y_i$*), conditioned on the level of input used by the farmers (Battese and Coelli, 1988).

Hence the technical efficiency of the farmer is given as:

$$TE_i = Y_i / Y_i^* = f(X_i : \beta)\exp(V_i - \mu_i) / f(X_i : \beta)\exp V_i = \exp(-\mu_i) \quad \ldots 2$$

Thus technical efficiency ranges between 0 and 1

The corresponding cost frontier of Cobb-Douglas functional form which is the basis for estimating the cost efficiency of the food crop farmers is specified as:

$$C_i = g(Y_i P_i : \alpha)\exp(V_i + \mu_i) \quad \ldots..3$$

Where $C_i$ represents the total input cost of the ith farms, g is the suitable function, $Y_i$ is the output of the ith farm, $P_i$ represents input prices employable by the ith farm in production measured in naira, a is the parameter to be estimated. $V_i$ and $m_i$ are defined below.

The cost efficiency ($CE_i$) of individual farmers is defined in terms of the ratio of the predicted minimum cost ($C_i$*) to observed cost ($C_i$).

$$CE_i = C_i^* / C_i = g(Y_i P_i : \alpha)\exp(\mu_i) / g(Y_i P_i : \alpha)\exp(V_i + \mu_i) = \exp(V_i) \quad \ldots(4)$$

The farm specific economic efficiency ($EE_i$) is defined as the ratio of minimum observed total production cost ($C_i$) to actual total production cost ($C_i$*). Thus farmers' economic efficiency ($EE_i$) was estimated as the inverse of cost efficiency.

$$EE_i = 1 / CE_i \quad \ldots\ldots\ldots\ldots\ldots(5)$$

The allocative efficiency ($AE_i$) of the arable crop farmers is estimated from the relationship below following Akinbode (2010).

$$AE_i = EE_i / TE_i \quad \ldots\ldots\ldots(6)$$

The same production technology assumed for the two categories of farmers was specified by the Cobb-Douglas frontier production defined as:

$$\ln Y_i = \beta_o + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + V_i - \mu_i \quad ..7$$

where:

$Y_i$ = Farm Output (Grain Equivalent) from ith farm.

$X_{1i}$ = Farm Size (Hectare)

$X_{2i}$ = Labour (Man days)

$X_{3i}$ = Planting materials (N)

$X_{4i}$ = Fertilizer (kg)

$X_{5i}$ = Herbicides (Litre)

$V_i$ = Random variability in the production that cannot be influenced by the farmer. $V_i$ are assumed to be independent and identically distributed random errors having normal $N \sim (0, \delta_v^2)$ distribution and independent of $\mu_i$

$\mu_i$ = deviation from maximum potential output attributed to technical inefficiency. The $\mu_i$ are assumed to be non-negative truncation of the half-normal distri- $N \sim (\mu, \delta_\mu^2)$ bution

$\beta_0$ = Intercept, $\beta_1 - \beta_6$ = Production function parameters to be estimated

i = 1,2,3,--- n farms.

The same Cobb-Douglas cost frontier function assumed for the two categories of arable crop farmers is specified as follows:

$$\ln C_i = \alpha_o + \alpha_1 \ln Y_i^* + \alpha_2 \ln P_{1i} + \alpha_3 \ln P_{2i} + \alpha_4 \ln P_{3i} + \alpha_5 \ln P_{4i} + \alpha_6 \ln P_{5i} + V_i + \mu_i \quad ..(8)$$

Where:

Ci = Total production cost of the ith farms (naira)

$Y_i$ *= Frontier Output of the ith farms (Grain Equivalent)

$P_{1i}$ = Rent on land per hectare (naira)
$P_{2i}$ = Wage rate of labour per man day (naira)
$P_{3i}$ = Average price of planting materials (naira)
$P_{4i}$ = Price of fertilizer per Kg (naira)
$P_{5i}$ = Average price of herbicides per litre (naira)

$$Y_i^* == Y_i / TE_i \qquad \text{.......... (9)}$$

The variables are as defined above.
The technical and cost inefficiency effect $m_i$ is defined as:

$$\mu_i = \delta_o + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 \qquad \text{.....(10)}$$

Where:

$\mu_i$ = Inefficiency effect
$Z_1$ = Age of the farmer (years)
$Z_2$ = Educational level of farmer (years)
$Z_3$ = Years of farming experience (years)
$Z_4$ = Household size (number)
$Z_5$ =Gender of farmer(male=1,female= 0)
$Z_6$= Number of contact with the extension agent within the last cropping season (number)
$Z_7$ = Loan Status (Beneficiary =1, Non-beneficiary =0)

The $\delta_o$ and $\delta_i$ coefficients are un-known parameters to be estimated along with the variance parameters $\delta^2$ and $\gamma$ .
The variances of the random errors, $\delta_v^2$ and that of the technical and cost inefficiency effects dm2 and overall variance of the model $\delta_\mu^2$ are related. Thus $\delta_\mu^2$ = $\delta^2 = \delta_v^2 + \delta_\mu^2$

The $\delta^2$ indicates the goodness of fit and the correctness of the distributional form assumed for the composite error term. The ratio $\gamma = \delta_\mu^2 / \delta^2$ , measures the total variation of output from the frontier which can be attributed to technical or cost inefficiency. The sigma square $(\delta^2)$ and the gamma $(\gamma)$ coefficients are the diagnostic statistics that indicate the relevance of the use of the stochastic production frontier function and the correctness of the assumption made on the distribution form of the error term. The estimates of all the parameters of the stochastic frontier production function and the inefficiency model were simultaneously obtained using the program FRONTIER version 4.1 (Coelli, 1996). Z-test of difference of mean was used to determine the variation in the mean technical, allocative and economic efficiency of the loan beneficiary and non-beneficiary food crop farmers.

## RESULTS AND DISCUSSION

### *Socio-economic Characteristics of Loan Beneficiary and Non-beneficiary Arable Crop Farmers*

The distribution of dominant analysis of the socio-economic characteristics of loan beneficiary and non-beneficiary arable crop farmers is presented in Table 1. The dominant indicator shows that majority (72.5% of loan beneficiary and 71.7% of non-beneficiary) of the arable crop farmers are aged between 30 and 55years, with the mean ages of 50 years and 49years respectively. This implies that majority of the farmers are still in their economically active age and thus expected to be productive with available resources. In terms of gender, majority (91.7% of loan beneficiary and 87.5% of non-beneficiary) of the arable crop farmers are males. This shows active involvement of men in farming in the study area. The findings also revealed that majority (87.5 % of the beneficiary and 85.9% of the non-beneficiary) of the arable crop farmers were married. This implies that the farmers have additional responsibility. The result further revealed that the mean household size for the arable crop farmers was 7 persons with majority (79.1% of loan beneficiaries and 75% of non-beneficiaries) having between 6 and 10 members. This may be an indication that more members of household are available for farming at the expense of formal education. Majority (81.7% of loan beneficiaries and 68.3% of non-beneficiaries) of the arable crop farmers had formal education with low educational level (mean years of education was 10 years and 9 years for loan beneficiaries and non-beneficiaries respectively). The mean farming experience was 25 years and 23 years with majority (70% and 60%, respectively having between 16 and 35 years of experience in farming). This implies that the two categories of farmers are relatively experienced in farming. Extension service to farmers is an important incentive in farm production as it aids information dissemination and adoption of innovation. The finding also revealed that majority (63.3%) of the loan beneficiaries met with extension personnel quarterly while majority (53.3%) of the non-beneficiaries met with extension officers once in six months. The proportion above shows low extension services to farmers especially among the non-beneficiaries.

**Table1: Dominant Analysis of Socio-economic Characteristics of Arable Crop Farmers**

| | **Beneficiary** | | **Non-beneficiary** | |
|---|---|---|---|---|
| **Variables** | **Dominant Indicator** | **Mean** | **Dominant Indicator** | **Mean** |
| Age | 72.5% between 30 and 55 years | 50 years | 71.7% between 30 and 55 years | 49 years |
| Gender | 91.7% males | | 87.5% males | |
| Marital Status | 87.5% married | | 85.9% married | |
| Household size | 79.1% had between 6 and 10 members | 7 members | 75.0% had between 6 and 10 members | 7 members |
| Education | 81.7% had formal education | 11 years | 63.3% had formal education | 9 years |
| Farming Experience | 70.0% had between 16 and 35 years | 25 years | 60.0% had between 16 and 35 years | 23 years |
| Extension visit | 63.3% were visited quarterly | | 53.3% were visited once in six months | |

Source: Field Survey, 2011.

***Maximum Likelihood Estimates of the Production Function of Loan Beneficiary and Non-beneficiary Arable Crop Farmers***

The results of the Maximum Likelihood Estimates (MLE) of the production function of Bank of Agriculture loan beneficiary and non-beneficiary arable crop farmers are presented in Table 2. The variance parameters for sigma- square ($\delta^2$) and gamma ($\gamma$) were 0.20 and 0.97 and are significant at 1 percent in each case. The sigma-square attests to the goodness of fit and correctness of the distributional form assumed for the composite error term while the gamma indicates the systematic influences that are unexplained by the production function and the dominant sources of random errors. This implies that about 97 percent of the variation in output of the farmers is due to the differences in their technical inefficiency.

All the coefficients of production function have the expected signs except labour input and fertilizer. The results showed that farm size ($X_1$), planting material ($X_3$) and herbicide ($X_5$) have positive effect on farm output while labour and fertilizer have negative effect on farm output. While the parameters of farm size, labour and planting material were significant at 1 percent, that of fertilizer was significant at 5 percent. The findings showed that herbicide do not exert any significant influence on farm output of the farmers. However, the negative sign of the coefficients of labour and fertilizer is an indication that these inputs are over-utilized among the farmers.

The contribution of farmers' socio-economic characteristics including age, years of formal education, farming experience, household size, sex, extension contact and loan to farm inefficiency was also examined. The signs of the coefficients of these variables have important policy implications as positive sign implies negative effect on farm efficiency while negative sign signifies a positive effect on farm efficiency. The inefficiency model revealed that education ($p<0.01$), extension contact ($p<0.01$) and loan ($p<0.01$) have positive significant effect on the technical efficiency of the farmers. This result supports the findings of Ogundari and Ojo (2007) who reported that education and loan increased the technical efficiency of food crop farmers. Thus inefficiency effects exist and have significant influence on farmers' technical efficiency.

**Table 2: Maximum Likelihood Estimates of the Stochastic Frontier Production Function for the Loan beneficiary and non-beneficiary Arable Crop Farmers**

| Variable | Coefficient | Standard Error | T-value |
|---|---|---|---|
| Production Function | | | |
| Constant | 6.1761*** | 0.4399 | 14.03 |
| Farm Size (X1) | 0.6395*** | 0.0499 | 12.81 |
| Labour (X2) | -0.0117*** | 0.0024 | -4.72 |
| Planting material (X3) | 0.3252*** | 0.0485 | 6.71 |
| Fertilizer (X4) | -0.0034** | 0.0017 | -2.01 |
| Herbicide (X5) | 0.0009 | 0.0017 | 0.51 |
| Inefficiency Model | | | |
| Constant | -0.6021*** | 0.1172 | -5.10 |
| Age (Z1) | 0.0191 | 0.0208 | 0.93 |
| Education (Z2) | -0.0116*** | 0.0021 | -5.54 |
| Farming Experience (Z3) | -0.0314 | 0.0337 | -0.93 |
| Household Size (Z4) | -0.0610 | 0.0601 | -1.01 |
| Gender (Z5) | 0.0007 | 0.0137 | 0.05 |
| Extension Contact (Z6) | -0.0433*** | 0.0044 | -9.73 |
| Loan (Z7) | -0.3080*** | 0.0321 | -9.58 |
| Diagnostic Statistics | | | |
| Sigma square ($\delta 2$) | 0.2064*** | 0.0221 | 9.35 |
| Gamma ($\gamma$) | 0.97*** | 0.0229 | 42.63 |

*** implies significant at 1 percent, ** implies significant at 5 percent, * implies significant at 10 percent.
Source: Field survey, 2011

### *Maximum Likelihood Estimates of the Stochastic Frontier Cost Function*

The result of the maximum likelihood estimates of the stochastic frontier cost function is as presented in Table 3. The sigma square was estimated as 0.058 and significant at 1 percent, attesting to the goodness of fit of the model. Also, the variance ratio (gamma) estimated at 0.47 and significant at 1 percent revealed that inefficiency effects exist among the cassava farmers. This signifies that about 47 percent of the variation in total production cost is due to differences in cost inefficiency of the farmers.

All the coefficients of the variables examined in the cost function have positive signs with the exception of rental value of land. The result showed that frontier output (Y*), labour wage rate ($P_1$), price of planting material ($P_4$) and price of herbicide ($P_6$) have significant positive effect on the total cost of production. These variables are significant at 1 percent, 1 percent, 10 percent and 5 percent respectively. This implies that cost of production increases with increase in output, labour wage rate, price of planting material and price of herbicide, *ceteris paribus.* The implication of the negative sign on the co-efficient of rental value of land is that land is underutilized among the farmers.

The inefficiency model showed that age, household size, extension contact and loan have significant effect on the cost efficiency of the arable crop farmers as these variables were significant at 5 percent, 1 percent, 10 percent and 1 percent respectively. While the age, extension contact and loan have negative effect on cost efficiency the household size has positive effect on cost efficiency of the farmers. This implies that the cost efficiency of the farmers decreases with increase in farmer's age and extension contact while the economic efficiency of the farmers increases with increase in age and extension contact. Also, while loan decreases the cost efficiency of the farmers it increases the economic efficiency of the loan beneficiary arable crop farmers. Lastly, the more the household size the more the farmers are cost efficient but the lesser they are economically efficient.

### *Efficiency Analysis of the Arable Crop Farmers' Technical Efficiency Estimates of Loan Beneficiary and Non-beneficiary Arable Crop Farmers*

The distribution of the technical efficiency estimates of the Bank of Agriculture loan beneficiary and non-beneficiary arable crop farmers is presented in Table 4. The results revealed that majority (50 percent) of the loan beneficiaries have their technical efficiency above 0.90 while the remaining 50 percent have their technical efficiency falling below 0.90 but above 0.50. This gives a mean technical efficiency of 0.86 which implies that the loan beneficiaries have potential to increase their output by 14 percent. On the other hand, 33.33 percent of the non -beneficiaries have their technical efficiency above 0.90 while the remaining 66.67 percent have their technical efficiency below 0.90 but above 0.47. This gives a mean technical efficiency of 0.79 implying the non-beneficiaries have potential to increase their technical efficiency level by 21 percent. The mean output oriented efficiency of 86 percent for beneficiaries and 79 percent for non -beneficiaries showed that the non-beneficiaries have more potential for technical efficiency increase while the beneficiaries are more technically efficient as the farmers operate on the same frontier.

**Table 3: Maximum Likelihood Estimates of the Cost Function for the Loan beneficiary and non-beneficiary Arable Crop Farmers**

| Variable | Coefficient | Standard Error | T-value |
|---|---|---|---|
| Cost Function | | | |
| Constant | 4.7446*** | 0.7209 | 6.58 |
| Frontier Output (Y*) | 0.6148*** | 0.0304 | 20.19 |
| Rental Value on Land (P1) | -0.03974 | 0.0673 | -0.59 |
| Labour Wage Rate (P2) | 0.1762*** | 0.0279 | 6.30 |
| Price of Planting Materials (P3) | 0.0162* | 0.0084 | 1.92 |
| Price of Fertilizer (P4) | 0.0117 | 0.0073 | 1.61 |
| Price of Herbicide (P5) | 0.0081** | 0.0035 | 2.27 |
| Inefficiency Model | | | |
| Constant | 0.3569 | 0.1849 | 1.93 |
| Age (Z1) | -0.0101** | 0.0046 | -2.01 |
| Education (Z2) | 0.0005 | 0.0047 | 0.95 |
| Farming Experience ((Z3) | 0.0064 | 0.0039 | 1.62 |
| Household Size (Z4) | 0.0295*** | 0.0097 | 3.04 |
| Gender (Z5) | -0.0275 | 0.0683 | -0.40 |
| Extension Contact (Z6) | -0.0069* | 0.0041 | -1.67 |
| Loan (Z7) | -0.2909*** | 0.0606 | 4.79 |
| Diagnostic Statistics | | | |
| Sigma Square ($\delta 2$) | 0.0586*** | 0.0087 | 6.73 |
| Gamma ($\gamma$) | 0.4705*** | 0.0396 | 11.87 |

*** implies significant at 1 percent, ** implies significant at 5 percent, * implies significant at 10 percent.
Source: Field survey, 2011.

**Table 4: Distribution of Technical Efficiency (TE) Estimates of Loan Beneficiary and Non-beneficiary Arable Crop Farmers**

| | Beneficiary | | Non-beneficiary | |
|---|---|---|---|---|
| **Class** | **Frequency** | **Percentage** | **Frequency** | **Percentage** |
| < 0.50 | - | - | 3 | 2.50 |
| 0.51-0.60 | 05 | 4.16 | 13 | 10.83 |
| 0.61-0.70 | 06 | 5.00 | 15 | 12.50 |
| 0.71-0.80 | 18 | 15.00 | 18 | 15.00 |
| 0.81-0.90 | 31 | 25.83 | 31 | 25.83 |
| >0.90 | 60 | 50.00 | 40 | 33.33 |
| Total | 120 | 100 | 120 | 100 |
| Mean TE | 0.86 | | 0.79 | |
| Minimum TE | 0.52 | | 0.47 | |
| Maximum TE | 0.96 | | 0.95 | |

**Source: Field survey, 2011.**

***Allocative Efficiency Estimates of the Loan Beneficiary and Non-beneficiary Arable Crop Farmers***

The distribution of the allocative efficiency estimates of the Bank of Agriculture loan beneficiary and non-beneficiary arable crop farmers is presented in Table 5. The allocative efficiency ranges between 0.28 and 0.99 for the loan beneficiaries with the mean allocative efficiency of 0.81. Fairly large proportions (35 percent) of the loan beneficiaries have their allocative efficiency between the class of 0.81 and 0.90, 30 percent have their allocative efficiency above 0.90 while the remaining 35 percent have their allocative efficiency below 0.81 but above 0.27. The mean allocative efficiency implies that the loan beneficiaries have the potential to increase their allocative efficiency by 19 percent. On the other hand, 30 percent of the non-beneficiaries have their efficiency range between 0.61 and 0.70. The mean allocative efficiency of 0.67 for the non-beneficiaries implies there is room for improvement in their allocative efficiency by 33 percent with the present production technology.

**Table 5: Distribution of Allocative Efficiency (AE) Estimates of Loan Beneficiary and Non-beneficiary Arable Crop Farmers**

| | Beneficiary | | Non-beneficiary | |
|---|---|---|---|---|
| Class | Frequency | Percentage | Frequency | Percentage |
| < 0.30 | 01 | 0.80 | - | - |
| 0.31-0.40 | 03 | 2.50 | 03 | 2.50 |
| 0.41-0.50 | 01 | 0.80 | 05 | 4.17 |
| 0.51-0.60 | 06 | 5.00 | 32 | 26.67 |
| 0.61-0.70 | 14 | 11.67 | 27 | 22.50 |
| 0.71-0.80 | 17 | 14.17 | 27 | 22.50 |
| 0.81-0.90 | 42 | 35.00 | 08 | 6.67 |
| >0.90 | 36 | 30.00 | 09 | 7.50 |
| Total | 120 | 100 | 120 | 100 |
| Mean AE | 0.81 | | 0.67 | |
| Minimum AE | 0.52 | | 0.47 | |
| Maximum AE | 0.96 | | 0.95 | |

Source: Field survey, 2011.

***Economic Efficiency Estimates of the Loan Beneficiary and Non-beneficiary Arable Crop Farmers***

The frequency distribution of the economic efficiency estimates of the Bank of Agriculture loan beneficiary and non-beneficiary arable crop farmers estimated as the inverse of cost efficiency is presented in Table 6. The economic efficiency estimates of the loan beneficiaries range between 0.47 and 0.94. Majority (47.5 percent) of the loan beneficiaries have their economic efficiency between 0.81 and 0.90. The mean economic efficiency estimated at 0.78 is an indication that the loan beneficiaries have the potential to improve their economic efficiency by 22 percent. On the other hand, the economic efficiency estimates of the non-beneficiaries range between 0.43 and 0.88. Large proportion (40.83 %) of the non-beneficiaries has their economic efficiency falling between 0.51 and 0.60. The mean economic efficiency of 0.60 implies that the non-beneficiaries of loan have the potential to improve their economic efficiency by 40%

**Table 6: Distribution of Economic Efficiency (EE) Estimates of Loan Beneficiary and Non-beneficiary Arable Crop Farmers**

| | Beneficiary | | Non-beneficiary | |
|---|---|---|---|---|
| Class | Frequency | Percentage | Frequency | Percentage |
| < 0.40 | - | - | - | - |
| 0.41-0.51 | 02 | 1.67 | 13 | 10.83 |
| 0.51-0.60 | 04 | 3.33 | 49 | 40.83 |
| 0.61-0.70 | 14 | 11.67 | 45 | 37.50 |
| 0.71-0.80 | 40 | 33.33 | 12 | 10.00 |
| 0.81-0.90 | 57 | 47.50 | 01 | 0.80 |
| >0.90 | 03 | 2.50 | - | - |
| Total | 120 | 100 | 120 | 100 |
| Mean EE | 0.78 | | 0.60 | |
| Minimum EE | 0.47 | | 0.43 | |
| Maximum EE | 0.94 | | 0.88 | |

Source: Field survey, 2011.

***Test of Mean Efficiency Difference between the Loan Beneficiary and Non-beneficiary Arable Crop Farmers***

The test of mean efficiency difference between the loan beneficiaries and non-beneficiaries was accomplished using t-test of mean difference and the results are presented in Table 7. The test was based on the hypotheses that there is no significant difference between the efficiencies (technical, allocative and economic) of the loan beneficiary and non-beneficiary arable crop farmers. The results of the t-test showed that there is a significant difference ($p<0.01$) between the technical efficiencies of the two categories of farmers. This signifies that the loan beneficiaries produced more output from a given level of inputs than their non-beneficiary counterparts. Also, the result of the t-test showed that there is a significant difference ($p<0.01$) between the allocative efficiency of loan beneficiaries and non-beneficiaries. This implies that the loan beneficiaries have more capacity to combine inputs in optimum proportion given the input prices than their non-beneficiary counterparts. Above all, the result showed that economic efficiency of the two categories of farmers differed significantly ($p<0.01$). This also implies that the loan beneficiary cassava farmers have the capacity to produce more output at a minimum cost than the non-beneficiaries. Therefore, the null hypotheses were rejected for the technical efficiency, allocative efficiency and economic efficiency. Thus, the loan beneficiaries are more technically, allocatively and economically efficient than the non-beneficiaries.

**Table7: Test of Mean Efficiency Difference between the Loan Beneficiary and Non-beneficiary Arable Crop Farmers**

| Production Efficiency | Mean | Standard Deviation | N | DF | T-cal | T-tab @ $\alpha 0.01$ | Decision |
|---|---|---|---|---|---|---|---|
| Technical Efficiency | | | | | | | |
| Beneficiaries | 0.86 | 0.1064 | 120 | 238 | 3.63 | 2.58 | Reject Ho |
| Non-beneficiaries | 0.79 | 0.1446 | 120 | | | | |
| Allocative Efficiency | | | | | | | |
| Beneficiaries | 0.81 | 0.1537 | 120 | 238 | 7.42 | 2.58 | Reject Ho |
| Non-beneficiaries | 0.67 | 0.1305 | 120 | | | | |
| Economic Efficiency | | | | | | | |
| Beneficiaries | 0.78 | 0.0903 | 120 | 238 | 16.72 | 2.58 | Reject Ho |
| Non-beneficiaries | 0.60 | 0.0767 | 120 | | | | |

Source: Field survey, 2011.

## CONCLUSION AND RECOMMENDATIONS

The study revealed that the two categories of farmers are still in their economically active age. The loan beneficiaries are more educated than their non-beneficiaries' counterpart. The determinants of farm output include farm size, labour, planting material and fertilizer. The finding also showed that herbicide does not exert any significant influence on farm output of the farmers. However, the negative sign of the coefficients of labour and fertilizer is an indication that these inputs are over-utilized among the farmers. Education, extension contact and loan determined the technical efficiency of the arable crop farmers. The determinants of cost of production include farm output, labour wage rate, price of planting material and price of herbicide. Land is however, underutilized among the farmers. The cost inefficiency model showed that age, household size, extension contact and loan have significant effect on the cost efficiency of the arable crop farmers. The loan beneficiary arable crop farmers are more technically, allocatively and economically efficient than their non-beneficiaries' counterpart but the non-beneficiaries have more potentials for production efficiency increase. Adult literacy education and extension education is recommended for the arable crop farmers. Farm expansion is recommended to allow efficient utilization of other resources. Agricultural loan should be extended to non-beneficiaries for increased production efficiency.

## REFERENCES

**Aigner, D.J, Lovell, C.A.K., Schmidt, P.** 1977. "Formulation and Estimation of Stochastic Frontier Production Models." *Journal of Econometrics,* 6: 21-32.

**Ajibefun, I. A., Abdulkadri, A.** 1999. "An Investigation of Technical Inefficiency of production of farmers under the National Directorate of Employment in Ondo State, Nigeria." *APP Economics Letters*, 6: 111-114.

**Akinbode, S. O.** 2010. "Economic Burden of Diseases and Production Efficiency among Rice Farming Households in Ogun and Niger States, Nigeria". Ph.D. Thesis, Department of Agricultural Economics and Farm Management, University of Agriculture Abeokuta, Nigeria.

**Amaza, P. S., Olayemi, J. K.** 2002. "Analysis of Technical Inefficiency in Food Crop Production in Gombe State, Nigeria". *Applied Economics Letter,* 9: 51-54.

**Amaza, P. S., Bila, Y., Iheanacho, A. C.** 2006. "Identification of Factors Influencing Technical Efficiency of Food Production in West Africa: Emperical Evidence from Borno State, Nigeria". *Journal of Agriculture and Rural Development in the Tropics and Subtropics.*107(2), 139-147.

**Battese, G. E., Corra, G. S.** 1977. "Estimation of a Production Function Model with Applied to the Pastoral Zone of Eastern Australia." *Austarilian Journal of Agricultural Economic.* 21: 169-179.

**Battese, G. E., Malik, S. J., Gill, M. A.** 1996. "An Investigation of Technical Inefficiencies of Production of Wheat Farmers in Four Districts of Pakistan". *Journal of Agricultural Economics.* 47 (1), 37-49.

**Battese, G. E., Coelli, T. J.** 1988. "Production of Fano level Technical Efficiency from a generalized view". *Journal of Econometrics.* 38, 387-399.

**Battese, G. E., Coelli, T. J.** 1995 "A Model for Technical Inefficiency Effect in Stochastic Frontier Production for Panel Data." *Empirical Economic.* 20, 325-345.

**Bravo-Ureta, B. E., Pinheiro, A.** 1997. "Technical, Economic and Allocative Efficiency in Peasant Farming: Evidence from the Dominican Republic." *The Developing Economics*. 35(1), 48-67

**CBN**, 2005. Central Bank of Nigeria Micro Finance Policy, regulatory and Supervisory Framework for Nigeria.

**CBN**, 2004. Central Bank of Nigeria Annual Report and Financial Statements.

**Coelli, T. J., Prasado Rao, D. S., Battese, G. E.** 1998. "An Introduction to Efficiency and Productivity Analysis". Kluwer Academic Publishers, Boston/Dordrecht.

**Coelli, T. J.** 1996. A Guide to Frontier Version 4.1c. A Computer Program for Stochastic Frontier Production and Cost Function Estimation. Department of Econometrics, University of New England, Armidale.

**Ekpedu I. D.** 2006. "Review of The Agricultural Sector in Nigeria (1960-1989)". *African Journal of Economy and Society*. 7 ( 1).

**Farrell, J. M.** 1957. "The measurement of productive efficiency". *Journal of Royal Stats.* 506 (120), Part (III): 253-290.

**Jema, H.** 2008. " Economic Efficiency and Marketing performance of Vegetable Production in Eastern and Central Parts of Ethiopia". Ph.D. Thesis. Department of

Economics. Swedish University of Agricultural Science.

**Jhingan, M. L.** 2007. *The Economics of Development and Planning.* Vrinda Publications (P) Ltd: P5.

**Kormawa, P. M.** 1999. " Food Demand Structures and Market Studies for IITA mandate Crops: an overview" in Kormawa, P.M. and Aiyedun, E. (Eds.), Food Demand and Market Studies in the Drier Savannah of Nigeria. Proceedings of a Methodological and Stakeholders' Workshop, September 7-8, Kaduna, Nigeria.

**Meeusen, W., Van den Broeck, J.** 1977. "Efficiency Estimation from Cobb- Douglas Production Functions with Composed Error." *International Economic Review*, 18: 435-444.

**NPC** 2006. National Population Commission, 2006 Population Figure.

**Ogundari, K., Ojo, S. O.** 2007. " Economic Efficiency of Small Scale Food Crop Production in Nigeria: A Stochastic Frontier Approach" *Journal of Social Sciences*. 14 (2), 123 -130.

**Ojo. S. O.** 2004. "Improving Labour productivity and Technical efficiency in food crop production: A panacea for poverty Reduction in Nigeria." *Food, Agriculture and Environment,* 2(2): 227-231.

**Rahji, M. A. Y.** 2005. "Determinants of Efficiency Differentials in Lowland Rice Production Systems in Niger State, Nigeria". *Ibadan Journal of Agricultural Research,* 1(1):7-17.

**Rahji M. A. Y.** 2000. "An Analysis of the Determinant of the Agricultural Credit Approval/ Loan Size by Commercial Banks in South Western Nigeria". *Journal of Nigerian Development Studies.* 1: 6-25.

**Umoh, G. S.** 2006. "Resource Use Efficiency in Urban Farming: An Application of Stochastic Frontier Production Function". *International Journal of Agriculture and Biology.* 13 (5).233-242.

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