Greener Journal of Agricultural Sciences
Vol. 9(2), pp. 155-162, 2019
ISSN: 2276-7770

DOI Link: http://doi.org/10.15580/GJAS.2019.2.032619050
http://gjournals.org/GJAS

Comparative Analysis of the Technical Efficiency of Beneficiary and Non-Beneficiary Rice Farmers of the Anchor Borrowers' Programme in Benue State, Nigeria

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ARTICLE INFO

Article No.: *03261950*
Type: *Research*
DOI: *10.15580/GJAS.2019.2.032619050*

Submitted: *26/03/2019*
Accepted: *28/03/2019*
Published: *25/04/2019*

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Keywords: *Technical efficiency, Anchor Borrowers' Programme, Rice farmers, Benue State, Nigeria.*

ABSTRACT

Comparative analysis of the technical efficiency of beneficiary and non-beneficiary rice farmers of the Anchor Borrowers' Programme in Benue State, Nigeria was investigated. Data for the study were collected with the aid of well-structured questionnaire from 768 rice farmers consisting of 388 beneficiaries and 380 non-beneficiaries from 18 communities and 18 Local Government Areas using multi-stage sampling technique. The collected data were analysed using descriptive statistics, multiple regression analysis, and stochastic frontier production function. The findings revealed that the beneficiary rice farmers achieved lower levels of technical efficiency compared to the non-beneficiary rice farmers and that seed (0.483) and agrochemical (1.60) used, increased technical efficiency more among beneficiary rice farmers than the non-beneficiary rice farmers while fertilizer (-1.285) used, decreased technical efficiency of beneficiary rice farmers more compared to the non-beneficiary rice farmers. The results also showed that rice production among the beneficiaries was in stage I of the production curve and that gender (1.249), educational level (-0.045), age (0.058), membership of cooperative (-0.250), extension visit (0.126), marital status (-2.633), and household size (0.059) significantly influenced their technical inefficiency. The study recommended policies and programmes targeted at reallocation and redistribution of farm production inputs and taking cognizance the incorporation of farmers' socio-economic characteristics in their formulation.

INTRODUCTION

Rice has continued to play a significant role in the socio-cultural and economic lives of the Nigerian population. Its demand in Nigeria has been increasing at a much faster rate than other West African countries since the mid-1970s. As a core staple food among the Nigerian population, it has been subjected to a combination of measures in an effort to boost local production and reduce the country's large dependence on imports (FEWS NET, 2017). In spite of efforts by successive governments to make Nigeria self-sufficient in rice production, this objective seems not to have been met.

PwC Analysis (2017) revealed that domestic production of rice in Nigeria has never been able to meet domestic demand thereby leading to considerable imports which as at the year 2017 stood at 3.7 million tons with domestic consumption estimated to be 6.4 million tons leaving a huge gap of 2.7 million tons. This situation has continued to encourage dependence on importation. Since this rice import is paid in foreign currency, this has led to the precarious balance of payment position of the country.

Among the several explanations for the poor performance of the Nigerian rice sub-sector are low level of improved farm inputs usage among the small scale rice farmers in the country, high cost of inputs, diversion of subsidized farm inputs, soil degradation, annual bush burning which destroys the soil organic matter, land issues, lack of capital, neglect of the agricultural sector, inadequate extension agents, market failures, insufficient technical know-how in the area of fertilizer application and improved seeds, and inadequate essential inputs for rice farmers (Osanyinlusi and Adenegan, 2016; Ahmed, Xu, Yu and Wang, 2017). These have resulted in inefficiency in the allocation of production resources and hence, low productivity.

Thus, every effort aimed at improving the productivity of rice farmers cannot overlook identifying and addressing these key factors. It is also important to note that knowledge of the technical efficiency status and its determinants, in addition to the key drivers of productivity of rice farms are relevant from policy perspective in a country where new technologies are scarce and productive resources are inadequate. This is because, gains in the efficiency and productivity of rice farms are essential for increasing the farm income of small scale producers of rice in the country.

Although plethora of technical efficiency studies on Nigeria's agricultural production exist in the literature, no study has been done using additive multiplicative dummy approach to compare the technical efficiency of beneficiary and non-beneficiary rice farmers of the Anchor Borrowers' programme. Thus, the broad objective of this study was to compare the technical efficiency of beneficiary and non-beneficiary rice farmers of the Anchor Borrowers' Programme (ABP) in Benue State, Nigeria. The specific objectives were to:

i. Compare the technical efficiency level of beneficiary and non-beneficiary rice farmers of the ABP in the study area;
ii. Estimate the determinants of technical inefficiency among beneficiary rice farmers of the ABP in the study area; and
iii. Describe the technical efficiency level of beneficiary rice farmers of the ABP in the study area.

METHODOLOGY

The Study Area: The study was conducted in Benue State, Nigeria. The State is situated between latitudes $6^0 25^/$N and $8^0 8^/$N and longitudes $7^0 47^/$E and 10^0E. Benue State is the nation's acclaimed food basket of the nation because of the abundance of its agricultural resources. The State is a major producer of food and cash crops (BNARDA, 2004). Smallholder farmers who are involved in arable crop production like rice, yam, cassava, sweet potato, maize, vegetables, soya bean, as well as livestock like poultry, goat, sheep, piggery, cattle, and fish abound in the State.

Sampling Technique and Data Collection: Multi-stage sampling technique was employed to select a sample size of 768 rice farmers consisting of 388 beneficiary and 380 non-beneficiary rice farmers of the Anchor Borrowers' Programme selected from 18 communities and 18 Local Government Areas.

The data for the study were collected using a well-structured questionnaire. Data were collected on the socio-economic characteristics of the respondents; costs and returns of rice production in the study area; farm output, income and productive assets acquired by the respondents; credit demanded and level of utilization of such credit among the respondents; and challenge to credit demand and utilization among respondents.

Analytical Techniques: The data collected were subjected to descriptive and econometric analyses.

The Additive Multiplicative Dummy Variable Approach: The additive multiplicative dummy variable approach was employed to compare the technical efficiency among beneficiary and non-beneficiary rice farmers.

This approach was used rather than the traditional method of fitting separate models and testing the equality of coefficients between them.

This approach was suggested by Gujarati (1970) and Maddala (1988) and has been used widely by researchers (Nwaru, 2003; Nwaru and Iheke, 2010).

The Cobb-Douglas functional form was adopted in this comparison as in most cases, it satisfies statistical, economic and econometric conditions better (Sankhayan, 1998).

Furthermore, Nwaru and Iheke (2010) revealed that the Cobb-Douglas functional form has been found by economists to be most suitable in analyzing production problems of industries and agriculture.

The Cobb-Douglas functional form using the additive multiplicative dummy variable approach is given as:

$$\ln Y = \ln A_0 + \beta_0 D + A_1 \ln X_1 + \beta_1 D \ln X_1 + A_2 \ln X_2 + \beta_2 D \ln X_2 + \ldots + A_n \ln X_n + \beta_n D \ln X_n + \mu_i \; \ldots\ldots(1)$$

Where:

Y= dependent variable
Ln = natural logarithm
A_0 = intercept or constant term
β_0 = coefficient of the intercept shift dummy
D = dummy variable which takes the value of unity for beneficiary rice farmers and zero for non-beneficiary rice farmers.
X_1D, X_2D, … , X_nD = slope shift dummies for the independent variables
X_1- X_n = independent variables
β_1- β_n = coefficients of the slope shift dummies
A_1-A_n = coefficients of the independent variables
μ_i = stochastic error term assumed to satisfy all the assumptions of the classical linear regression model.

If the coefficient of the dummy variable, D (in the additive) is significant, it means that there is a difference in the technical efficiency of the farmer groups. If it is positive, it implies that the specified function for the rice farmer groups denoted as unity has a higher technical efficiency than the group denoted as zero and vice versa.

If $\beta_0 = 0$ and all β_i ($i = 1,2,\ldots n$) = 0, then the two farmer groups are represented by the same function. If $\beta_0 = 0$ and $\beta_i \neq 0$, then the two groups of farmers face neutral function. If at least one of the $\beta_i \neq 0$, then the two groups of farmers are facing factor biased or non-neutral function (Nwaru and Iheke, 2010).

The Stochastic Frontier Production Function: The stochastic frontier production function model of Cobb-Douglas functional form was employed to estimate the farm level technical efficiency of beneficiary rice farmers of the ABP. The Cobb-Douglas functional form was used because the functional form meets the requirement of being self-dual, it allows the examination of economic efficiency and it has been applied in many empirical studies (Battese and Coelli, 1988; Bivan *et al.*, 2015).

The Cobb-Douglas production functional form is specified as:

$$Y_i = f(X_i \,;\, \beta) \exp V_i\text{-}\mu_i \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(2)$$

The technical efficiency of individual rice farmers is defined in terms of the ratio of observed output to the corresponding frontier output conditioned on the level of input used by the farmers. Hence, the technical efficiency (TE) of the farmer is expressed as:

$$TEi = \frac{Yi}{Yi^*} = \frac{f(Xi\,;\,\beta)\exp(Vi-\mu i)}{f(Xi\,;\,\beta)\exp Vi} = \exp(-\mu_i) \; \ldots\ldots\ldots (3)$$

Where:

Y_i = the observed output
Y_i^* = the frontier output

The production technology of the beneficiary rice farmers was specified by the Cobb-Douglas frontier production function defined as follows:

$$LnY_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + V_i - U_i \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where:

Y_i = output of rice (Kg)
β_0 = constant or intercept of the model
$\beta_1 - \beta_5$ = regression coefficients
X_1 = quantity of seeds (Kg)
X_2 = quantity of fertilizer used (Kg)
X_3 = quantity of agrochemicals used (Litres)
X_4 = quantity of labour used (man-days)
X_5 = farm size (ha)
V_i = random variability in the production that cannot be influenced by the farmer. V_i is assumed to be independent and identically distributed random errors having normal distribution and independent of μi.
μ_i = deviation from maximum potential output attributed to technical inefficiency. The μ is assumed to be non-negative truncation of the half-normal distribution.
i = 1, 2, 3 . . . n farms

The technical inefficiency effect, μ_i is defined as:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\; (5)$$

Where:
U_i = technical inefficiency effect
Z_1 = age of the farmer (years)
Z_2 = farming experience (years)
Z_3 = educational level of the farmer (years)
Z_4 = household size (number)
Z_5 = sex of the farmer (dummy; 1 = male and 0 = female)
Z_6 = extension visit (number of visit in 2016/2017 farming season)
Z_7 = membership of cooperative society (years of participation for members and 0 for non-membership)
Z_8 = marital status (dummy; married =1 and single =0)

δ_0 and δ_i coefficients are unknown parameters to be estimated along with the variance parameters δ^2 and γ. The δ^2 indicates the goodness of fit and the correctness of the distributional form assumed for the composite error term. The γ indicates the total variation of output from the frontier which can be attributed to technical inefficiency.

The *a priori* expectation was that the coefficients of age of the farmer, and household size will be positive while those of farming experience, educational level of the farmer, sex of the farmer, extension visit, membership of cooperative society, and marital status will be negative.

The estimates of all the parameters of the stochastic frontier production function and the inefficiency model were simultaneously obtained using the programme, frontier 4.1 developed by Coelli (1994).

Generalized Likelihood-Ratio Tests: The generalized likelihood-ratio test was employed to test the null hypotheses pertaining to the appropriateness of the specified frontier function, the presence of inefficiency effects, and the relevance of farm-specific and socio-economic factors in explaining the inefficiency of the rice farms studied.

The generalized likelihood-ratio test statistic was specified as:

$$\lambda = -2 [\ln L (H_0) - \ln L (H_1)] \ldots\ldots\ldots\ldots\ldots\ldots \ldots (6)$$

Where L (H_0) and L (H_1) denote the values of the likelihood functions under the specification of the null (H_0) and the alternative (H_1) respectively. The test statistic (λ) has a chi-square (χ2) distribution with degrees of freedom equal to the difference between the parameters involved in H_0 and H_1.

RESULTS AND DISCUSSION

Comparative Analysis of the Technical Efficiency of Beneficiary and Non-Beneficiary Rice Farmers

The estimated production function for beneficiary and non-beneficiary rice farmers are summarized and presented in Table 1.

Table 1: Estimated production function for the beneficiary and non-beneficiary rice farmers

Variable	Parameter	Coefficient	t-ratio
Intercept	A_0	2.522	6.716***
Seeds	A_1	-0.107	-0.985^{NS}
Hired labour	A_2	-0.014	-0.763^{NS}
Fertilizer	A_3	0.904	7.027***
Agrochemical	A_4	-0.485	-2.357**
Farm size	A_5	-0.063	-0.531^{NS}
(Intercept dummy)D	β_0	-2.930	-4.210***
(Seed)D	β_1	0.483	3.089***
(Hired labour)D	β_2	0.107	1.188^{NS}
(Fertilizer)D	β_3	-1.285	-4.787***
(Agrochemical)D	β_4	1.603	4.558***
(Farm size)D	β_5	-0.067	-0.409^{NS}
	R^2		0.283
	$\bar{R}^2$		0.273
	F-ratio		27.188***

Source: Field survey data, 2018. *, **, = statistically significant at 1 and 5 percent respectively. NS = Not significant**

The coefficient of multiple (R^2) was 0.283 which implies that 28.3 percent of the variation in rice output is accounted for by the independent variables. The F-ratio was significant at 1% which attests to the overall significance of this estimated function.

The coefficient of fertilizer was positive and significant at 1%. The implication is that increase in fertilizer utilization would lead to increase in rice output. The coefficient of agrochemical was negative and significant at 5%. The implication is that increase in agrochemical utilization would lead to a decrease in rice output.

The intercept dummy was statistically significant implying that a shift in technology existed between the beneficiary and non-beneficiary rice farmers. In other words, both groups of farmers had unequal technical efficiency and production function.

The coefficient of the intercept dummy was negative. The implication is that there was a shift in neutral technical efficiency parameter to a lower level for the beneficiary rice farmers. The beneficiary rice farmers therefore had lower technical efficiency than the non-beneficiary rice farmers and hence, achieved a lower level of output per unit of input.

The slope dummies for seed and agrochemical used were significant and positively related to technical efficiency. This implies that seed and agrochemical used have stronger positive relationship to technical efficiency among beneficiary rice farmers as compared to the non-beneficiary rice farmers. Specifically, a 1% increase in seed and agrochemical used would lead to 0.48% and 1.60% respectively more technical efficiency among beneficiary rice farmers than among the non-beneficiary rice farmers.

The slope dummy for fertilizer was significant and negatively related to technical efficiency. This implies that fertilizer used have stronger negative relationship to technical efficiency among beneficiary rice farmers as compared to the non-beneficiary rice farmers. Specifically, a 1% increase in fertilizer used would lead to 1.29% less technical efficiency among beneficiary rice farmers than among the non-beneficiary rice farmers.

Hypotheses Test for Beneficiary Rice Farmers

The result of the generalized-likelihood ratio tests of hypotheses involving the parameters of the stochastic frontier and inefficiency model for beneficiary rice farmers in Benue State is presented in Table 2**.**

Table 2 presents the results of the null hypotheses of interest. The first null hypothesis which states that production function is not Cobb-Douglas was rejected as the computed test statistic (λ) is greater than the tabulated χ2. Hence, Cobb-Douglas frontier model was an adequate representation of the data.

The second hypothesis which states that technical inefficiency effects are absent from the model was rejected indicating that there is presence of technical inefficiency effects in the production of rice among beneficiaries. Confirming this result further is the value of gamma (γ) which is 99.92% and very close to one and significantly different from zero, thereby establishing the fact that high level of inefficiencies exist among the sampled farmers.

The third hypothesis which states that farmers' socio-economic characteristics considered in the inefficiency model do not have significant influence on their level of technical inefficiency was rejected. This means that the determinants of the technical inefficiency significantly contribute to the differences in the farmers' technical efficiencies.

The null hypothesis which specifies that technical inefficiency effects are not stochastic was rejected. This implies that the traditional mean response function is not an adequate representation for farm production among the respondents given the specification of the stochastic frontier and inefficiency models defined by equations 4 and 5 respectively.

Table 2: Generalized-likelihood ratio tests of hypotheses involving the parameters of the stochastic frontier and inefficiency model for beneficiary rice farmers in Benue State

S/N	Null hypotheses	L(Ho)	L(Ha)	λ	Degree of freedom	χ2 Critical	Decision
	Stochastic frontier						
1	Production function is not Cobb-Douglas (Ho: $\beta i = 0$)	-7.52	407.23	829.5*	5	15.09	Reject Ho
	Inefficiency model						
2	Absence of inefficiency (Ho: $\gamma = \delta 0 = \delta 1 = \delta 2 = \delta 3 = \delta 4 = \delta 5 = \delta 6 = \delta 7 = \delta 8 = 0$	31.28	407.23	751.9*	10	23.21	Reject Ho
3	No technical effect (Ho: $\delta 1 = \delta 2 = \delta 3 = \delta 4 = \delta 5 = \delta 6 = \delta 7 = \delta 8 = 0$	94.46	407.23	625.54*	8	20.09	Reject Ho
4	Technical inefficiency not stochastic (Ho: $\gamma = 0$)	188.19	407.23	438.08*	2	9.21	Reject Ho

Source: Field survey data, 2018. * = Test statistic exceeds the 99th percentile for the corresponding χ2 distribution: so the null hypothesis is rejected.

Maximum Likelihood Estimates of the Production Function of Beneficiary Rice Farmers

The maximum likelihood estimates (MLE) for the stochastic production function used in explaining the influence of production inputs on farm output among beneficiaries of ABP, and also in determining the effect of farmer specific characteristics on technical inefficiency is presented in Table 3.

The value of the sigma-squared (δ^2) was 0.71 and was statistically significant at 1% level. This indicates a good fit and correctness of the distributional form assumed for the composite error term in the model.

The gamma value (γ) was 0.9992 and it was statistically significant at 1%, implying that 99.92% of the total deviation from the efficient rice frontier output is due to inefficiencies arising from the production process while the random effects constitute 0.08%. This further means that technical inefficiency effects dominate the noise effect in explaining the total variation in rice output.

Table 3: Stochastic frontier production function results for the beneficiary rice farmers

Variable	Coefficient	Standard error	t-ratio
Production function			
Constant	-0.7459	0.0692	-10.78***
Seeds (X_1)	0.5068	0.00846	59.94***
Labour (X_2)	0.00167	0.0101	1.65^{NS}
Fertilizer (X_3)	-1.4964	0.0341	-43.88***
Agrochemical (X_4)	2.3002	0.0305	75.30***
Farm size (X_5)	-0.0083	0.0139	-0.5999^{NS}
Inefficiency model			
Constant	-2.7563	0.4967	-5.55***
Gender (Z_1)	1.2485	0.1624	7.69***
Educational level (Z_2)	-0.0453	0.00995	-4.56***
Age (Z_3)	0.0579	0.007599	7.63***
Membership of cooperative (Z_4)	-0.2500	0.0333	-7.50***
Extension visit (Z_5)	0.1260	0.0332	3.79***
Marital status (Z_6)	-2.6327	0.2212	-11.90***
Household size (Z_7)	0.05851	0.01856	3.15***
Experience (Z_8)	0.00396	0.008861	0.45^{NS}
Diagnostic statistics			
Sigma-squared (δ^2)	0.70696	0.06702	10.55***
Gamma (γ)	0.9992	0.0001931	5175.21***

Source: Field survey data, 2018. * = Significant at 1%; NS = Not significant**

The estimated elasticity parameters of seed (0.5068) and agrochemical (2.3002) were positive and significantly influenced output of farmers ($p < 0.01$). This implies that increasing these factors will increase the output of rice among the beneficiaries in the study area. It also means that a 10% increment in these inputs will increase rice output by 5.068 and 23.002 percent respectively.

The estimated elasticity parameter of fertilizer (-1.4964) was negative and significantly influenced output of farmers ($p < 0.01$). This implies that increasing this factor will decrease the output of rice in the study area. It also means that a 10% increment in this input will decrease rice output by 14.964 percent.

However, the coefficients of labour (0.0167) and farm size (-0.0083) were not significant at all conventional levels. Furthermore, the sum of coefficients (b_i) in Cobb-Douglas production model gives the return to scale. The return to scale (RTS) was 1.319, indicating an increasing return to scale and that rice production among beneficiary farmers was in stage I of the production curve. Therefore, farmers are encouraged to continue increasing their inputs especially seeds and agrochemical for a better output.

The inefficiency parameters were specified as those relating to farmers' specific socio-economic characteristics. A positive coefficient indicates that the variable increases technical inefficiency in rice production while a negative coefficient indicates that the variable decreases technical inefficiency in rice production.

Analysis of Table 3 shows that the estimated coefficient of gender was significant at 1% and positively related to technical inefficiency. The positive sign of the coefficient is at variance with the *a priori* expectation, implying that if a farmer is male, the farmer's level of technical inefficiency in rice production increases. Female farmers owing to the challenges they face compared to the male farmers in terms of access to information and resources and also due to their responsibilities in the home, are less likely to be technically efficient compared to male farmers. However, male farmers who are technically inefficient are those that are older and had no contact with extension agents. According to Sibiko_*et al*. (2012), older farmers are risk averse making them late adopters of better agricultural technologies. The study by Sibiko_*et al*. (2012) also revealed that access to extension agent services enable farmers to obtain information on crop diseases or pests and their control methods as well as insights on innovative farming techniques that guarantee higher productivity. This finding is at variance with Ojehomon_*et al*. (2013) who revealed that female farmers are technically inefficient compared to the male farmers.

The coefficient of educational level was significant at 1% and negatively related to technical inefficiency. The negative sign of the coefficient agrees with the *a priori* expectation, implying that as years of formal education increases, technical inefficiency decreases. Farmers with formal schooling tend to be more efficient in food crop production due to their enhanced ability to acquire technical knowledge which makes them closer to the frontier output. This finding agrees with Girei_*et al*. (2013) who revealed education increases efficiency in food crop production.

The coefficient of age was significant at 1% and positively related to technical inefficiency. The positive sign of the coefficient conforms to the *a priori* expectation, implying that as age increases, technical inefficiency increases. Older farmers are risk averse making them late adopters of better agricultural technologies. This finding is consistent with Itam_*et al*. (2015) who revealed that older farmers because of their conservative attitudes will be less willing to adopt improved technology and hence, have low levels of technical efficiency.

The coefficient of membership of cooperative was significant at 1% and negatively related to technical inefficiency. The negative sign of the coefficient is consistent with the *a priori* expectation, implying that if a farmer is a member of cooperative, the farmer's level of technical inefficiency decreases. Group membership helps farmers to mitigate problems associated with market imperfections and reduces transaction costs, hence increasing technical efficiency. The finding agrees with Sibiko_*et al*. (2012) who revealed that farmers who are members of producer organizations tend to benefit shared knowledge with respect to modern farming methods, economies of scale in accessing input markets as a group and hence, more technically efficient in production.

The coefficient of extension visit was significant at 1% and positively related to technical inefficiency. The positive sign of the coefficient is at variance with the *a priori* expectation, implying that if a farmer had contact with extension agents, the farmer's level of technical inefficiency increases. Access to extension services enable farmers to obtain information on crop diseases or pests and their control methods, as well as insights on innovative farming techniques that guarantee higher productivity. However, farmers who had contact with extension agents and are technically inefficient are older farmers. Older farmers due to their conservative attitudes will be less willing to adopt improved technology and hence, less efficient compared to younger farmers. This is consistent with Sibiko_*et al*. (2012) who observed that older farmers are relatively more reluctant to take up better technologies, as they prefer to hold on to the traditional farming methods and thus, more technically inefficient compared to their younger counterpart.

The coefficient of marital status was significant at 1% and negatively related to technical inefficiency. The negative sign of the coefficient concurs with the *a priori* expectation, implying that if a farmer is married, the farmer's level of technical inefficiency decreases. Marriage brings about an increase in family size which makes labour readily available and reduce high cost of hired labour. Since rice farming requires a lot of farm hand and given the fact that farming is still at the subsistent level in the study area, rice farmers who are married are more likely to be technically efficient than unmarried farmers. This finding agrees with Bivan_*et al*. (2015) that revealed a negative relationship between marital status and technical inefficiency.

The coefficient of household size was significant at 1% and positively related to technical inefficiency. The positive sign of the coefficient agrees with the *a priori* expectation, implying that as household size increase, the level of technical inefficiency increases. Increase in family size would decrease the level of technical inefficiency if only the household is constituted of adults who make labour readily available as well as reduce the cost of hired labour. However, rice farmers who had large household size and are technically inefficient are those whose household were made of children which increases the farmer's cost of hired labour and hence, making the farmer more technically inefficient. This finding is at variance with Itam_*et al*. (2015) which revealed that an increase in family size would result in increased levels of technical efficiency.

Efficiency Analysis of Beneficiary Rice Farmers

The frequency distribution of the technical efficiency estimates of beneficiary rice farmers in the Anchor Borrowers' Programme (ABP) are presented in Table 4.

Analysis of Table 4 shows that majority (81.2%) of beneficiary rice farmers had technical efficiency above 0.783 with a mean technical efficiency of 0.854. The mean technical efficiency of beneficiary rice farmers implies there is room for improvement by 14.6%.

Table 4: Distribution of technical efficiency estimates of beneficiary rice farmers

Efficiency class	Frequency	Percentage
≤0.150000	7	1.8
0.150001-0.361000	9	2.3
0.361001-0.572000	36	9.3
0.572001-0.783000	21	5.4
≥0.783001	315	81.2
Total	388	100
Mean	0.854	
Minimum	0.123	
Maximum	0.995	

Source: Field survey data, 2018

CONCLUSION

The findings revealed that the beneficiary rice farmers achieved lower levels of technical efficiency compared to the non-beneficiary rice farmers and also that seed and agrochemical used increased technical efficiency more among beneficiary rice farmers than the non-beneficiary rice farmers while fertilizer used decreased technical efficiency of beneficiary rice farmers more compared to the non-beneficiary rice farmers.

The result also showed that rice production among beneficiaries of the Anchor Borrowers' Programme was in stage I of the production curve. Thus, the beneficiary rice farmers are encouraged to continue increasing their inputs especially seeds and agrochemical for a better output. The findings further revealed that socio-economic characteristics of the beneficiary rice farmers significantly influenced their level of technical inefficiency.

Based on these findings, it was advocated that the Benue State government should come up with policies and programmes targeted at reallocation and redistribution of farm production inputs for increased farm productivity and efficiency. Such policies should include increasing rice farmers' access to farm land that will enable them employ the use of more farm resources since there is increasing return to scale.

Also, policies geared towards increasing the resource use efficiency of rice farmers in the State and hence their farm income should include farmers' specific efficiency factors such as gender, educational level, age, membership of cooperative, extension visit, marital status, household size, and experience in their formulation.

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Cite this Article: Okeke, AM; Mbanasor, JA; Nto, PO (2019). Comparative Analysis of the Technical Efficiency of Beneficiary and Non-Beneficiary Rice Farmers of the Anchor Borrowers' Programme in Benue State, Nigeria. Greener Journal of Agricultural Sciences 9(2): 155-162, http://doi.org/10.15580/GJAS.2019.2.032619050.