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DETERMINANTS OF LEVEL OF ECONOMIC EFFICIENCY OF RICE PRODUCERS IN ANAMBRA STATE, NIGERIA

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Abstract

This study examined determinants and level of economic efficiency of rice production in Anambra State, Nigeria. The specific objectives were to: estimate the level of economic efficiency attained by rice farmers in the area; ascertain the determinants of level of economic efficiency attained by the farmers and assess the nature of returns to scale of rice production in the study area. Two hypotheses tested were: there is no significant difference between the levels of economic efficiency attained by farmers in the selected agricultural zones and socio-economic characteristics of the rice farmers do not significantly influence their economic efficiency level. Primary data were used for the study and Multistage, purposive and random sampling methods were used select 378 respondents. The collated data were analyzed by means of descriptive and inferential statistical tools such as Ordinary Least Squares (OLS) regression, Cobb Douglas Stochastic Frontier Production function and Scheffe's Multiple Comparison test. Findings indicated a minimum economic efficiency score of 0.86, maximum of 0.99 and mean of 0.95 for rice farmers in the study area. Scheffe's Multiple Comparison test indicated significant difference between means of economic efficiency scores and per hectare profits of farmers from paired agricultural zones. Maximun Likelihood Estimation of the Cobb Douglas stochastic frontier production regression showed that the production factors of land, labour and other inputs significantly and positively influenced economic efficiency level of the farmers. Inefficiency effect was significantly and negatively affected by educational level and amount of credit obtained; significantly and positively affected by farming experience while extension visit and farm size were not significant. Returns to scale figures were 1.32, 1.25, 1.15 and 1.12 for Anambra, Aguata and Awka Agricultural zones, and the State (pooled data) respectively. This implies increasing returns to scale across the Agricultural zones and the study area. It is recommended that Government should ensure adequate budgetary allocations to the institutions responsible for making cheap loans available to farmers while the institutions should maintain timely disbursement of the funds.

INTRODUCTION

The term cereal being applied either to the grain or to the plant itself are grasses grown for their edible starchy seeds suitable for food. They belong to the family *Poaceae*. They are rich in carbohydrates but comparatively low in protein and naturally deficient in calcium and vitamin A. The cereals most commonly cultivated are wheat, rice, oats, barley, corn (maize), and sorghum. As human food, cereals are usually marketed in their raw grain form (some are frozen or canned) or as ingredients of various food products. As animal feed, they are consumed mainly by livestock and poultry, which are eventually rendered as meat, dairy, and poultry products for human consumption. Many cereals are used industrially in the production of a wide range of substances, such as glucose, adhesives, oils, and alcohols (Encyclopedia Britannica, 2008)

Rice is the second largest cereal crop in the world after wheat (Wakatsuki, Buri and Fashola, 2003) and is one of the staple foods in Nigeria and could be found in the homes of the higher class, the middle-income earner and the poor (Onya, Okezie, and Ejiba, 2019). It is an essential cash crop produced mainly by small-scale farmers who commonly sell 80 per cent of total production and consume only 20 per cent. Rice generates more income for Nigerian farmers than any other cash crop in the country. The increasing demand for rice may be attributed to its numerous uses and importance. It is a major source of food for about half of the world's population supplying basic energy needs of the people (Nwike and Ugwumba, 2015). An interesting reason for it being so popular, nutritionists suggest is its ease of digestion. Even the sick, elderly and babies can digest this grain very well if cooked. Besides, rice provides 21% of global human per capita energy and it is low in fat and protein, compared with other cereal grains. Rice also provides minerals, vitamins and fiber although; all constituents except carbohydrates are reduced by milling. Rice is used for industrial purposes for beverages, roofing materials, flour and starch, livestock feed, medium for growing tropical mushroom and compost (Effiong, 2005; Idiong, 2005)

According to FAO (2017), Nigeria is Africa's leading producer of rice, consumer of rice, and incidentally one of the largest rice importers in the world. Due to its increasing contribution to the per capita calorie consumption, the demand for rice has been increasing at a much faster rate than domestic production in Nigeria and more than in any other African country since mid-1970s (FAO, 2004). Nigeria produced approximately 2 million Metric tonnes (MT) of milled rice in 2008. The Nation's annual production level has increased from 5.5 million tonnes in 2015 to 5.8 million tonnes in 2017 and imported roughly 3 million metric tonnes, including the estimated 800,000 metric tonnes that is suspected to enter the country illegally on an annual basis (USDA, 2017; Udemezue, 2018).The consumption of rice in Nigeria has grown rapidly over the past decade and is currently at an all-time high of 7 million MT (USDA, 2017). The rice importation bill rose from ₦22 Billion in 1999 to ₦96 Billion in 2002 (NCRI, 2004). Report has it that between 2005 and 2015, Nigeria's monthly import bill rose from ₦148 billion to ₦917 billion (Onya, et. al., 2019). In 2016, about 58,260MT of rice was imported into Nigeria from Thailand, according to the Thai Rice Exporters Association. This represents a huge reduction when compared to about 805,765 MT recorded in 2015. By November 2017, the figure reduced to 23,192 MT and between January and November 2018, the figure had crashed to 6,277 MT. Within the years, the Thai Exporters statistics show that there had been a 72.9 per cent reduction in quantity of export to Nigeria while the export value had also crashed by 72.2 per cent. This, clearly, confirms that there has been reduction in Nigeria's rice import figures.

Over the years, the country has depended so much on imports to fill the local supply gap which arose due to inability of local producers to meet demand. According to Akande (2003) there has been a considerable lag between production and demand level with imports making up the short fall. Given to the high import bills for rice and the relatively low quality and yields for the cereal in Nigeria, the Federal Government of Nigeria, under various regimes came up with programmes and policies to stimulate greater local production and consumption of locallyproduced rice and other staple crops (Cadoni and Angelluci, 2013). Worthy of mention is the Presidential Initiative on increased rice production (2002) aimed specifically at reversing soaring import bill, meeting domestic demand by 2006 and reach export capacity by 2007. Main targets were to increase rice production, improve milling quality, and promote marketing to provide domestic rice for consumption and to ultimately reduce national rice importation. The ambitious goal of the Initiative was to produce 15 million tonnes of rice from 3 million hectares of consolidated farm land by 2007. Although the initiative did not reach its final goal, there was a 31 percent increase in rice production between 2002 and 2007(FAO, 2013). A major setback to attainment of policy objectives was lack of optimal attention to the grassroot farmers' level of resource use and returns to scale (Nwike and Ugwumba, 2015).

In spite of continued government intervention, the nation's productivity has not been able to meet the local demand of rice with the average national yield of rice in 2012 being only 1.8 tons of paddy per hectare which is quite low when compared with national average potential of 3.0 tonnes/ha and 5.0 tons/ha for lowland and upland system of production respectively (FAO, 2013). Chidiebere-Mark, Ohajianya, Obasi and Onyeagocha (2019) posits that domestic demand for rice is still high due to rapid population growth, increased urbanization and people's preference for rice as a convenient food (USAID 2011, IFAD 2009). In addition, continued increase in rice demand is attributed to a consumer shift from traditional staples such as yam and garri, to imported parboiled rice. Though presently in Nigeria most local rice like the Abakilliki rice are polished and destoned, nevertheless, if Nigeria is to become self-sufficient in rice production, productivity must be increased. This implies that resources allocated to rice production must be efficiently utilized (Emodi and Agwu, 2018). Local rice production in Nigeria has not been able to catch up with the increasing demand as a result of inadequate production systems, dearth of vital inputs and poor marketing channels (FAO, 2016). Ayedun and Adeniyi

(2019) asserted that, the difficulties associated with improving rice yield could be attributed to the inefficient farm management techniques. Furthermore, inconsistent government policy on rice importation may have contributed to failure in attaining the national objective of improving and increasing rice yield. For instance, Nigerian farmers reacted positively to the ban on rice imports in 1985 by starting to prepare and use their fields for rice cultivation, but imported rice was soon back on the market because of another government policy that liberalized rice imports in 1997. This led to another drop in local rice production. Furthermore, 90 percent of most rice farmers in Nigeria are smallholders applying a low-input strategy to agriculture, with minimum input requirements and low output (USAID 2011, IFAD 2009).

In order to achieve optimum production level, resources must be available and whatever quantities of available resources must be used efficiently. Nigeria has the potential to be self-sufficient in rice production, both for food and industrial raw material needs and for export. Ogundele and Okoruwa (2006) opined that the fundamental explanation to the recorded low yield is the issue of inefficiency of the rice farmers in the use of resources. One way to increase the productivity of these small holder farmers who constitute the major farming population is through enhancing their farm management skill and improving their efficiency in the use of input resources. FAO, 2003 also noted that chiefly among factors that limit productivity of these small holder farmers is the inefficiency in resource use and of which several studies have attested to its roles in undermining households' food security status and income. Efficiency is a concept which is concerned with how well productive inputs are utilized and exerts a consequential effect on productivity (Puozaa, 2015). In the pioneering study of Farrel (1957), efficiency was defined as the ability to produce a given level of output at the lowest cost. In theory, the concept of efficiency refers to two key concepts which are technical and allocative efficiency. Technical efficiency refers to productive input mix while allocative efficiency is known as price efficiency. A producer who is both technically and allocatively efficient is said to be economically efficient. Economic efficiency is the ability of a firm to attain maximum output from an optimal set of inputs given their respective prices. It entails the ease of transforming given inputs into outputs in a production process (Ume, Ezeano, Eluwa and Ebe, 2016) and very vital for enhancing productivity growth. The underlying premise of Farrell's work is that the removal of inefficienciesis a means of achieving efficient production. As a result, if the farmers pursue attainment of economic efficiency, productivity, increased income and food security are guaranteed.

Based on the above backdrop, the study assesses the economic efficiency of rice production with a view to establishing the extent productive resources are utilized for maximization of profit.
The specific objectives were to:
i.) estimate the level of economic efficiency of rice production in the study area;
ii.) ascertain the determinants of economic efficiency of rice production;
iii.)estimate the returns to scale of rice production;

The Study Hypotheses
The following null hypotheses were tested in the study:
i. There is no significant difference between the levels of economic efficiency attained and the Profits realized by farmers in the selected agricultural zones
ii. Socio-economic characteristics of the rice farmers do not significantly influence their economic efficiency level

METHODOLOGY

The Study Area

The study was carried out in Anambra State. The State is made up of 21 Local Government Areas(LGAs)and four Agricultural Zones (AZs). It is located between latitudes $6^0\ 45^1$ and $5^0\ 44^1$ N and longitudes $6^0\ 36^1$ and $7^0\ 20^1$ E of the area within the Greenwich meridian. The temperature of the state during the dry season (especially in January), ranges from 25.5 to 30.5^{0}C while during the raining season (especially in July) ranges from 25 to 27.5^{0}C.

Population and Sampling Procedure

The study population comprised all the rice farmers in the four agricultural zones (AZs) of the state namely Onitsha, Aguata, Awka and Anambra. Multistage, purposive and random sampling techniques were used to select respondents for the study. The first stage involved purposive selection of three (Anambra, Awka and Aguata) most active rice producing zones (Anambra State Ministry of Agriculture) out of the four (4) agricultural zones in the State. Second stage involved purposive selection of three (3) LGAs from Anambra and Aguata zones and one (1) LGA from Awka zone. These LGAs are known majorly for rice production in the State. A total of seven (7) LGAs were sampled. Stage three involved the purposive selection of three most active rice producing communities in each of the selected seven (7) LGAs, making it a total number of 21communities. The fourth and final stage was the random sampling of 18 farmers from each of the 21selected communities giving a sample size of 378 respondents. Primary data used for the study were collected by means of well-structured and pre-tested questionnaire. Three hundred and seventy eight copies of questionnaire were administered to the farmers with the help of trained enumerators for data collection.

Method of Data Analysis

Objectives of the study were accomplished by means of the following analytical tools**:** Objectives i, ii and iii; to estimate the level of economic efficiency, determinants of efficiency and nature of returns to scale were achieved by means of Cobb-Douglas stochastic frontier production function and Maximum Likelihood Estimation method. Results were based on standard statistical and econometric criteria such as the values of coefficient of determination (R^2), t-values and *a priori* expectations of signs and magnitudes of the regression coefficients.)

Model Specifications

Stochastic Frontier

The Cobb-Douglas stochastic frontier production function model adopted by Awuniyi and Omonona (2006), Adetunji and Adeyemo (2012) and Nwike, *et. al*.(2017) were used to determine the level and determinants of economic efficiency of rice production. The model is specified as:

$lnYij = \beta_0 + \beta_1 InX_1ij + \beta_2 X_3ij + \beta_3 X_3ij + \beta_4 X_4ij + \beta_5 X_5ij + Vij - Uij$

Where subscripts ij refer to the jth observation of the ith farmer:

ln= Logarithm to base 10

Y=Revenue from rice production ~~(N)~~

X_1=Rental value of farm land ~~(N)~~

X_2=Labour used in rice production ~~(N)~~

X_3= Other inputs such as fertilizers, rice seeds, agro-chemicals ~~(N)~~

It is assumed that the inefficiency effects are independently distributed and Uij arises by truncation (at zero) of the normal distribution with mean Uij and variance σ. Where Uij is defined by the equation:

Uij=Ϛ0+ Ϛ1Zij+ Ϛ2z2ij+ Ϛ3Z3ij+ Ϛ4Z4ij+ Ϛ5Z5ij

Where:

Uij= economic inefficiency of the ith farmer and jth observation of the farmer

Z1= Years of experience of the ith farmer in rice production

Z2=Years of formal education of the ith farmer

Z3=Amount of credit available to farmers (N)

Z4= Extension agents' visits

Z5=Farming status (dummy: 1 if the farmer is a full time farmer and 0, if otherwise.

The β and Ϛ coefficients are unknown parameters to be estimated by the method of maximum likelihood using the computer programme frontier version 4.1 (Coelli, 1996).

Elasticity of production and Returns to scale

Elasticity of production measures the degree of responsiveness between inputs and output while return to scale (RTS) describes the response of an output towards its proportional change from input (Hidayah and Susanto, 2013).

The returns to scale adopted by Nwike, et. al., (2017) is used for this study and expressed as: $RTS= \Sigma x_1 + \Sigma x_2 + \Sigma x_3$

Where: Σx_1, Σx_2, Σx_3 are individual elasticities of output with respect to land, labour and material inputs.

If $\Sigma x_1 > 1.0$, there is increasing returns to scale

lf $\Sigma x_1 < 1.0$, decreasing returns to scale and

lf $\Sigma x_1 = 1.0$, It implies constant returns to scale.

Analysis of Variance (ANOVA)

Analysis of Variance (ANOVA) was used to determine whether there is significant difference in the level of economic efficiency attained and the profits realized by farmers from the selected agricultural zones.

The ANOVA denoted by F is therefore a ratio computed as

$$\mathbf{F} = \frac{S^2_B}{S^2_W}$$

Where:

F = ANOVA

S^2_B = Between groups variance

S^2_W = Within groups variance

Scheffe's test (Fs)

Scheffe's test offers statistical comparison of the groups within the phenomenon while ANOVA (F) is used to determine significant difference between groups. ANOVA test (F) indicates whether a significant difference exists between groups while Scheffe test (Fs) provides information with respect to effectiveness or ineffectiveness of each group in the phenomenon being investigated. Scheffe's test can customarily be used with both equal and unequal sample sizes (Uzoagulu, 1998).

To get the Scheffe's test groups from the three groups:

- Compare group A with group B*
- Compare group A with group C
- Compare group B with group A
- Compare group B with group C*
- Compare group C with group A*
- Compare group C with group B

The Scheffe's test (Fs) formula is given as

$$Fs = \frac{(X_i - X_2)^2}{(V_w / n_i) + V_w / n_2)}$$

Where:

X_i = Mean of the first group

X_2 = Mean of the second group

V_w = Variance within groups

n_i = Sample size of the first group

n_2 = Sample size of the second group (Uzoagulu, 1998).

Hypotheses Testing

The testing of stated null hypotheses for the study were done as follows:

i. Test for significant difference in the means of economic efficiency levels and profits attained by farmers from selected agricultural zones, was achieved using Analysis of Variance (ANOVA) and Scheffe's Multiple Comparison Test.

ii. Determinants of economic efficiency level was tested for individual significance of the regression parameters using t-statistic and for the overall significance of the estimates of the regression parameters using F –Statistic.

RESULTS AND DISCUSSION

The economic efficiency of an enterprise explains the ability of a firm to produce the maximum output given the level of inputs employed (be technically efficient), use the right mix of inputs in the light of relative price of each input (be input allocative efficient) and produce the right mix of outputs given to the set of prices (be output allocative efficient) kumbhakar and Lovell, 2000; Omojola et al. 20). The economic efficiency scores as well as the determinants of efficiency and inefficiency effects were analyzed by means of a one-step Cobb-Douglas stochastic frontier production function.

Economic efficiency scores of the farmers

The distribution of economic efficiency scores of the rice farmers according to agricultural zones and the study area (pooled data) is shown in Table 4.1. It could be seen from the table that the same majority (72.67%, 70.66% and 71.66%) of the farmers fell within the economic efficiency range of 0.91-0.98 in Anambra, Aguata and, Awka zones respectively. Only 4%, 2.67% and 3.33% of the farmers attained economic efficiency score of above 0.98in the three respective zones (Table 1). Comparatively, rice farmers in Anambra Agricultural zone were more economically efficient than the farmers in Awka zone, who incidentally were more economically efficient than their counterparts in Aguata zone. This implies that rice farmers in Aguata Agricultural zone are the least economically efficient in the study area. For the State (pooled data), 214 accounting for 71.34% of the rice farmers fell within the economic efficiency score range of 0.91-0.98. Only 11 farmers accounting for 3.66% of them reached economic efficiency score of above 0.90. In all, a minimum of 0.80, maximum of 0.95 and mean of 0.95 economic efficiency scores were recorded for rice farmers in the study area. These results implied that most rice farmers in Anambra State were able to technically and allocatively manage their resources, hence were economically efficient. Further improvement in the ability of the farmers to manage productive resources better will close the existing economic efficiency gap of 5% among farmers in the State and ensure the attainment of maximum economic efficiency by the farmers. Magreta *et. al.,* (2013) and Ogunniyi, *et. al.* (2012) attested to high economic efficiency levels recorded by rice farmers in Southern Malawi and Osun State of Nigeria respectively.

Table 1: Estimated economic efficiency scores of the farmers

Score	Anambra Freq	Zone %	Aguata Freq	Zone %	Awka Freq	Zone %	Anambra Freq	State (Pooled) %
≥ 0.90	70	23.33	80	26.67	75	25.00	75	25.00
0.91 – 0.94	110	36.67	106	35.33	115	38.33	110	36.67
0.95 – 0.98	108	36.00	106	35.33	100	33.33	104	34.67
Above 0.98	12	4.00	8	2.67	10	3.33	11	3.66
Mean		0.97		0.92		0.94		0.95
Minimum		0.89	0.88			0.86		0.86
Minimum		0.99	0.99			0.98		0.99

Source: Field survey, 2022. Note: Freq = Frequency. % = Percentage.

Test of Hypothesis i: There is no significant difference between the levels of economic efficiency attained by farmers in the selected agricultural zones. This test was conducted by means of a One-way ANOVA test and ratified using Scheffe's Multiple Comparison test. The results are presented in Tables 2 and 3. It could be seen from Table 2 that there is significant difference in the technical efficiency scores attained by rice farmers in the selected agricultural zones of the study area at 5% alpha level (F=12.156). That is, the null hypothesis of existence of no significant difference is rejected and the alternative accepted that there exists significant difference among zonal means. Furthermore, the Scheffe's Multiple Comparison test result (Table 3) Shows that there is significant difference between the means of economic efficiency levels attained by rice farmers in Anambra and Aguata agricultural zones, and Anambra and Awka zones, but not Aguata and Awka.

One-way ANOVA

Table 2: Economic efficiency score (regressand)

Item	Sum of Squares	DF	Mean Square	F	Sign
Between groups	284.286	2	142.143	12.156	0.000
Within groups	398.003	679	199.002		

Table 3: Scheffe multiple comparison test for zonal economic efficiency levels

I (Rank)	J (Rank)	Mean Difference (I-J)	Standard Error	Sign
Anambra	Aguata	0.05	15034.21	0.001
	Awka	0.03	15021.01	0.004
Aguata	Anambra	0.03	15034.21	0.001
	Awka	-0.02	15003.82	0.256
Awka	Anambra	0.03	15021.01	0.004
	Aguata	0.02	15003.82	0.256

Source: Field survey, 2022.

Test of Hypothesis ii

Hypothesis ii which states that socio-economic characteristics of the rice farmers do not significantly influence their economic efficiency level is rejected. The alternative is hereby accepted that socio-economic factor of the farmers jointly and significantly influenced their economic efficiency level.

Determinants of Economic Efficiency and Inefficiency Effects

The Maximum Likelihood Estimation Technique was used to examine the factors affecting economic efficiency scores of the farmers. The production factors involved were land, labour and other inputs while the inefficiency model had farming experience represented by FAE, education (EDU) amount of credit obtained (AMC)., extension visits (EXT) and farm size (FAS). Table 4 presents results of the analysis. The three production factors exerted positive and statistically significant influences on output in the three selected zones as well as in the State (pooled data). This implies that higher the quantities of these inputs engaged in the production, higher the output and profit. This result agrees with Adetunji and Adeyemo (2012) and Mogashoa (2021) who in their separate studies posited significant relationship between increase in quantities of farm inputs and output.

Table 4: Maximum likelihood estimates of parameters of the Cobb Douglas stochastic frontier production function

Variable	ParaAnambra Co-ef	Zone T	Aguata Co-ef	Zone T	Awka Co-ef	Zone T	Anambra Co-ef	State (pooled) T
Production factor:								
Constant β	0.22	1.43	0.43	0.76	0.37	1.55	0.28	0.56
Land β	0.33	2.62**	0.42	2.74**	0.28	1.88*	0.32	2.16**
Labour β	0.48	3.46***	0.54	4.36***	0.56	3.77***	0.47	2.48**
Other inputs β	0.51	6.21***	0.29	3.13**	0.31	2.54**	0.33	3.16***
Inefficiency effect:								
Constant δ	0.70	0.38	0.65	0.71	0.64	0.82	0.66	0.83
FAE δ	0.14	4.22***	0.08	3.47***	0.13	2.26**	0.05	2.47**
EDU δ	- 0.09	- 2.55**	- 0.11	- 1.99**	- 0.07	-2.44**	- 0.12	- 3.11***
AMC δ	- 0.12	- 2.15**	- 0.26	- 2.23**	- 0.16	-3.15***	- 0.08	- 2.36**
EXT δ	- 0.31	- 1.26	- 0.52	- 1.48	- 1.21	- 0.49	- 0.16	- 0.75
FAS δ	- 0.24	- 0.82	- 0.38	- 1.44	- 0.73	- 1.24	- 0.45	- 1.15
Diagnostic statistics:								
Likelihood ratio	96.43		98.36		101.24			102.36
Sigma squared (σ^2)	5.75		6.14		5.36			7.34
Gamma (γ)	0.97		0.95		0.94			0.95

Source: Field survey, 2022. Note: *; **; *** = Significant at 10%, 5% and 1% alpha levels respectively.

With regards to the inefficiency effect, farming experience, educational level and amount of credit obtained by the rice farmers were the three out of the five factors inputted in the model that had significant influence on economic inefficiency while the rest two (extension visits and farms size) were not significant (Table 4). According to the result in table 4, the coefficient of farming experience was positive and significant. This is at variance with *a priori* expectations that farming experience should have negative effect on inefficiency and positive relationship with economic efficiency. This result is similar to Magreta, *et. al.* (2013) who posited a positive relationship between farming experience and economic efficiency of rice farmers. It however, contradicts the finding of Ogunniyi, *et. al. (2012)* that farming experience has no significant influence on efficiency of rice farmers. The coefficient of education exerted negative and statistically significant influence on inefficiency in the three zones as well as the State. This development is in line with *a priori* expectations that education should have negative effect on inefficiency and positive effect on economic inefficiency. It implied that the rice farmers who obtained higher educational level were expected to produce more and consequently earned higher profit. Omojola, (2014) and Okecho, *et. al.* (2019) emphasized the positive and significant effect of education on farm productivity and profitability. Amount of credit obtained had negative and significant influence on inefficiency according to *a priori* expectations of positive relationship between account of credit obtained and economic efficiency. This implies that higher the amount of credit obtained and adequately invested in an enterprise, higher the quantity of output expected from the enterprise. It could mean that the rice farmers who obtained credit, and invested it properly were able to produce more output and realize more profit than their counterparts who did otherwise. This result compares favourably with Magreta, *et. al.* (2013) who reported that rice farmers performed better as a result of credit they obtained. The gamma coefficient (γ) represented proportion of the error term which is attributed to inefficiency effect. The values of the variance parameter gamma (γ) for the three Agricultural zones and the State (Table 4) are given as Anambra zone (0.97), Aguata zone (0.95), Awka zone (0.94) and Anambra State (0.95). These values imply that about 97%, 95%, 94% and 95% of the proportions of error term across the zones and State (pooled data) are due to farm inefficiency. The estimated value of sigma squared ($ϱ^2$) of 7.34 for the State was large and significant at 5% level, an indication that the variables were a good fit for the model. Based on the foregoing, hypothesis ii which states that socio-economic characteristics of the rice farmers do not significantly influence their economic efficiency level is rejected. The alternative is hereby accepted that socio-economic factor of the farmers jointly and significantly influenced their economic efficiency level.

Nature of Returns to Scale

The response of output to a proportionate change in quantities inputs is referred to as returns to scale or the rate by which output changes if all inputs are changed by the same factor.

Table 5: **Estimated output elasticities and returns to scale of the production factors**

Variable	Anambra Zone	Aguata Zone	Awka Zone	Anambra State (pooled)
Land	0.33	0.42	0.28	0.32
Labour	0.48	0.54	0.56	0.47
Other inputs	0.51	0.29	0.31	0.33
RST	1.32	1.25	1.15	1.12
Remark	Increasing	Increasing	Increasing	Increasing

Source: Field survey, 2022. Note: RST = Returns to scale.

Result of the analysis of returns to scale, done with the Cobb-Douglas stochastic frontier production function, is presented in Table 5. It could be seen from the table that returns to scale was 1.32, 1.25, 1.15 and 1.12 for Anambra, Aguata and Awka Agricultural zones and the State (pooled data) respectively. This implies increasing returns to scale across the Agricultural zones and the State (pooled data).It is advisable at this stage of the production function that rational farmers should increase quantities of inputs used in production so as to produce more output at reasonable cost and therefore realize more profit. For Anambra State (pooled data), holding labour and other inputs constant, a 1% increase in farm size (land) led on the average to about 0.32% increase in output. Furthermore, holding land and other inputs constant, a 1% increase in labour led to a 0.47% increase in output. Finally, holding land and labour constant, a 1% increase in other inputs led to 0.33% increase in output. Then adding the three output elasticity values of land (0.32), labour (0.47) and other inputs (0.33) gave 1.12 as the value of returns to scale parameter for rice farmers in Anambra State. This implied that the farmers were operating at increasing returns to scale, and are likely to produce more and earn more profit if they carefully effect increases in the quantities of inputs engaged in the production process.

CONCLUSION AND RECOMMENDATIONS

Rice production in Anambra State is economically efficient and profitable, though there still exist some economic efficient gaps among the farmers. These gaps could be attributed to the identified problems militating against rice production in the area. Economic efficiency and profitability of rice production by the farmers would improve if adequate policy measures are adopted to mitigate the constraints identified in the study especially insufficient funds, scarcity and high cost of labour, scarcity and high cost of improved seeds, and climate change/irregular rains. Based on the findings, It is recommended that Government should ensure adequate budgetary allocations to the institutions responsible for making cheap loans available to farmers while the institutions should maintain timely disbursement of the funds and government should resuscitate the moribund irrigation facilities and construct new ones to ensure adequate and timely supply of water to the rice fields all year round since poor yield was identified due to climate change.

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