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Evaluation Of Profitability And Technical Efficiency Of Irrigated Rice Production In Kebbi State, Nigeria

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***Abstract:** This study analyzed the technical efficiency of Irrigated rice production in Kebbi State, Nigeria. Data were generated from a sample of 120 Irrigated rice farmers between January and May 2018 using multi-stage random sampling technique. Net Farm Income and Tran slog stochastic frontier production function model were used for the analysis. The results revealed that irrigated rice production in the study was found to be profitable, realizing ₦57, 151.0 as net income per hectare. Stochastic frontier production results revealed that the mean technical efficiency of irrigated rice farmers was 76%, suggesting that the farmers were not technically efficient in the utilization of existing resources. The results also showed that for irrigated rice farmers age, educational level, farming experience, farm size and amount of credit accessed influenced the level of technical efficiency positively and are statistically significant at 1, 10, 5, 1, and 1% level of probability, respectively. Based on the results, it is recommended that irrigated rice farmers should form cooperatives to access Agricultural credit, policies that would ensure timely and adequate supply of fertilizer and other agricultural inputs at subsidized rate to farmers are also advocated to enhance their technical efficiency.*

***Keywords:** Irrigated, Efficiency, Rice, Kebbi State, Nigeria*

I. INTRODUCTION

Rice is one of the important security crops in Nigeria. Nigeria is the leading consumer and the largest producers of rice in Africa and simultaneously one of the largest importers in the World (Oladimeji and Abdulsalam, 2013). Due to the increasing importance of rice as a staple food crop in Nigeria, the government has designed a number of strategies to reduce the importation of rice in order to boost domestic production. This policy was informed by supply not keeping pace with demand (Daramola, 2005).

Globally, rice is an important food crop and increasingly preferred over many traditional foods, such as sorghum, millet and most root and tuber crops such as yam and cassava (Defoer *et al.,* 2004). Rice is consumed by over 4.8 billion people in 176 countries and is the most important food crop for over 2.89 billion people in Asia, 400 million in Africa, 150.3 million people in Nigeria (Daramola, 2005). It is also one of the major cereals to gain the status of a cash crop in Nigeria, especially in those rice-producing areas where it provides employment for more than 80 percent of inhabitants as a result of the commercial activity that takes place along the distribution chain from cultivation to consumption (FAO, 2003).

According to FAS (2002), rice has great potential and can make a crucial contribution, secure supplies of food and nutrition; to the generation of income; alleviation of poverty and the socio-economic growth of Nigeria. Nigeria has potential to become self-sufficient in rice production as virtually all the ecological zones are suitable for rice cultivation either as swamp, upland or under irrigation (FAS, 2002). The declining self-sufficiency ratio in rice production indicates that Nigeria has remained a net importer of rice with well over US $267 million spent annually (Eke, 2008). Rice, a cereal grain, is a staple crop in Nigeria.

Despite the fact that domestic rice production has increased in Nigeria since the 1960s given increases in rice land area, rice production has not been able to keep pace with

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rice consumption (demand). Nigeria's inability to meet her rice consumption needs through local production has resulted in high cash outlays for importation. While progress has been made in increasing the hectares of land under rice cultivation, apparent declines in rice yield within the period has offset the gains in the harvest area. Kebbi State is one of the irrigated rice producing states in Nigeria. Kebbi's role in rice production stems from the presence of the longest river in west Africa (River Niger) in the state and also the establishment of the reservoir in Kanji lake whose water is much in Kebbi state. Furthermore, the state is endowed with so much Fadama land that thrives in rice production. If rice production is to be enhanced without necessarily changing the technology of production, the surest way is to improve on the efficiency of production. Efficiency is the ability to produce a given level of output at lowest cost (Farrell, 1957). Productivity estimates of technological input factors in rice output will provide insight on the relationship of various technological input factor to output and the extent to which output will change if the input factors are changed. Estimates from the technical efficiency level will give an indication of the extent to which the present technology is utilized in the production process and potential improvement. It is against this back drop that this study examined the profitability, technical efficiency and its determinants among irrigated rice farms in Kebbi State, Nigeria.

II. THEORETICAL FRAMEWORK

Efficiency is the ability to produce a given level of output at lowest cost (Farrell, 1957). Economic efficiency is the ability of an enterprise to achieve the highest possible profit, given the prices and levels of resources of the enterprise (Bagi, 1982). The economic theory of production provides the analytical framework for most empirical research on productivity and efficiency. As a result of the pioneering, but independent, works by Aigner *et al.* (1977), Bagi and Huang (1983), Kalirajan and Flinn (1983) as well as Amaza and Olayemi (2001), consideration has been given to the possibility of estimating the stochastic frontier production function. In most of the studies, it was found that the Cobb–Douglas stochastic frontier does not provide an adequate representation for describing the data given the specification of a Translog model (Tanko, 2004).

Considering a farmer using inputs X_1, $X_{2,}$….Xn to produce output Y, efficient transformation of inputs into output is characterized by the production function f(X), which shows the maximum output obtainable from various input vectors. The stochastic frontier production function is defined as:

$$Yi = f(Xi; \beta) \exp(Vi - Ui) \quad (i = 1, 2 \ldots n) \quad (1)$$

Where:

Yi = Production of the i^{th} farm

Xi = Vector of input quantities of the i^{th} farm

β = Vector of unknown parameters of the i^{th} farm

Vi = random error associated with random factors not under the control of the farm e.g. weather and diseases

Ui = inefficiency effects (one –sided error with U≥0) i.e. Ui's are non – negative with technical inefficiency in production.

(Vi - Ui) = composite error term.

The symmetric component, V, accounts for factors outside the farmer's control such as weather and diseases. It is assumed to be independent and identically distributed as N~ $(0,\delta^2 V)$. A one-sided component U >0 reflects technical inefficiency relative to the stochastic frontier, f(Xi; β) exp (Vi – Ui). Thus U = 0 for a farm output which lies on the frontier and U<0 for one whose output is below the frontier as N~ $(0, \delta^2 U)$, i.e. the distribution of V is half-normal. Thus, the stochastic production frontier model can be used to analyze cross- sectional data. The model simultaneously estimates the individual technical efficiency of the respondents as well as determinants of technical efficiency (Battesse and Coelli, 1995).

The estimation of stochastic frontier production makes it possible to find out whether the deviation in technical efficiencies from the frontier output is due to firm specific factors or due to external random factors. It provides estimates for the technical efficiency by specifying composite error formulations to the conventional production functions (Khumbakar, 1990; Coelli, 1995; Battesse and Coelli, 1995).

Technical efficiency of an individual farmer is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the farmer. The technical efficiency of farmer (i) in the context of the stochastic production function in equation (1) is

$$TE = Yi/Yi^* \quad (2)$$

$$= f(Xi; \beta) \exp(Vi - Ui) / f(Xi; \beta) \exp Vi \quad (3)$$

$$= \exp(-Ui) \quad (4)$$

Where:

Yi = Observed value of output

Yi* = frontier output (or potential output)

Given the density function Ui and Vi, the frontier production function can be estimated by the maximum likelihood technique. The value of the technical efficiency lies between zero and one. The most efficient farmer will have value of one, whereas the least efficient farmer will have value lying between zero and one. The stochastic frontier of the Tran slog type was specified for this study. The maximum likelihood technique was used to estimate the parameters of the stochastic frontier and the predicted technical efficiency/inefficiency of the farmers.

III. MATERIALS AND METHODS

STUDY AREA AND LOCATION

The study was carried out in Kebbi State, Nigeria. The choice of Kebbi State was based on the fact that it is one of the major states involved in rice production. Kebbi State is located in the north-western part of Nigeria and occupies a land area of about 36,229 square kilometers with a population of about 3,351,831 (NPC, 2006). Projecting this population to 2018, the State has a population of about 4,387,096. The State lies between latitudes 10° 05^1 and 13° 27^1N of the equator and between longitudes 3° 35^1 and 6° 03^1W of the Greenwich.

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This area is characteristic of Sudan savanna sub-ecological zone with distinct wet and dry seasons. Soils are ferruginous on sandy parent materials evolving from sedentary weathering of sandstones.

Over two- third of the population are engaged in agricultural production, mainly arable crop alongside cash crops with animal husbandry. The major crops cultivated include sorghum, millet, maize, cowpea, sweet potato, rice, vegetables and fruits. Cash crops grown here include soybeans, wheat, ginger, sugarcane, tobacco and gum-arabic.

IV. SAMPLING DESIGN AND DATA COLLECTION

The study was conducted in Kebbi State which was purposively selected due to its importance in rice production. The sampling method used was the multi-stage random sampling technique. The State was divided in to four according to Kebbi State Agricultural Development Project (ADP) zones, namely Argungu, Bunza, Yauri and Zuru Zones. In the first stage, three (ADP) zones were purposively selected where rain fed rice production operates mainly in the state. These include Argungu, Bunza and Yauri zones. Secondly, from each of the ADPs two Local Government Areas (LGAs) were purposively selected in each zone, giving a total of six LGAs in the study. These include Argungu and Dandi LGAs in Argungu zone, Yauri and Ngaski LGAs in Yauri zone, Bunza and Jega LGAs in Bunza zone. Thirdly, from each of the LGAs, two leading villages noted for rain fed rice production were purposively selected giving a total of twelve villages and from each village tenrain fed rice farmers were randomly selected through snow ball technique, giving a total of 120 rice farmers interviewed for the study.

Both Primary and secondary data were used for the study. The primary data was collected from the rural households through the use of pre- tested and well trained ADP enumerators under the supervision of the researchers. The household socioeconomic characteristics and input- output data constituted the bulk of the data collected.

V. NET FARM INCOME MODEL

Net farm income (NFI) is the difference between gross income and total costs of production. This was used to determine the profitability. Notationally, NFI is specified as follows:

NFI = GFI – TVC – TFC…………………………….. (5)

$$= \sum_{j=1}^{m} P_j Q_j - \sum_{k=1}^{m} -P_k Q_k - \sum_{1=1}^{1} FL \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where:

P_j = Price of a unit of j^{th} output

Q_j = Quantity of j^{th} output

P_k = Price of a unit of k^{th} input

Q_k = Quantity of k^{th} input

FL = Cost of fixed inputs

∑ = Summation sign

NFI = Net Farm Income (₦)

GFI = Gross Farm Income (₦), it is the total monetary value of rice output (₦)

TVC = Total variable cost (₦); this include, expenses on farm size, labour, rice seeds, quantity of fertilizer used, quantity of herbicides used, Factors of production were valued at the prevailing market prices at the period of survey in the study area. Cost items identified were classified into fixed and variable costs. The fixed cost items include depreciation on tools and equipment such as hoe, cutlass, sickle, and interest on borrowed capital etc. The variable cost items include labour (both family and hired), cost of seeds, cost of fertilizer, cost of herbicides. The straight-line-method of depreciation was used in the study, and it was assumed that the salvage value of the fixed cost items used in production was zero.

Other profitability ratios were estimated to measure the economic performance. The models are specified below.

Profitability Index (PI) = NFI/GI ………………….. (7)

Rate of Return on Investment (RRI) (%) = NFI/TC x 100…(8)

Operating Ratio (OR) = TVC/TR …………….. (9)

Model for Tran slog Stochastic Frontier Production function was specified as follows:

$$Ln\ y = \beta_o + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 Ln\ X_3 + \beta_4 Ln\ X_4 + \beta_5 LnX_5 + \beta_6 Ln\ X_6 + ½\ \beta_{11} Ln\ X_1^2 + ½\ \beta_{22} LnX_2^2 + ½\ \beta_{33} LnX_3^2 + ½\ \beta_{44} Ln\ X_4^2 + ½\ \beta_{55} Ln\ X_5^2 + ½\ \beta_{66} Ln\ X_6^2 + \beta_{12} LnX_1 LnX_2 + \beta_{13} LnX_1 InX_3 + B_{14} LnX_1 LnX_4 + \beta_{15} LnX_1 LnX_5 + \beta_{16} LnX_1 LnX_6 + \beta_{23} LnX_2 LnX_3 + \beta_{24} LnX_2 LnX_4 + \beta_{25} LnX_2 LnX_{5+} \beta_{26} LnX_2 LnX_6 + \beta_{34} LnX_3 LnX_4 \beta_{35} LnX_3 LnX_5 + \beta_{36} LnX_3 LnX_6 + \beta_{45} LnX_4 nX_5 + \beta_{46} LnX_4 LnX_6 + \beta_{56} LnX_5 LnX_6 + Vi - Ui \ldots\ldots (10)$$

Where:

β_o = Constant term

β_1- β_{56} = Parameters to be estimated

Ln = Logarithm to base e.

Y = Output of rice (Kg)

X_1 = Farm size of rice (hectare)

X_2 = Labour (man days)

X_3 = Quantity of rice seed used (kg)

X_4 = Quantity of fertilizer used (kg)

X_5 = Quantity of herbicides used (liters)

X_6 = Capital (#)

Vi = Normal random errors which are assumed to be independently and identically distributed having zero mean and constant variance.

Ui = Non – negative random variables associated with the technical inefficiency of irrigated rice.

$$Ui = \delta_o + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3 + \delta_4 z_4 + \delta_5 z_5 + \delta_6 z_6 + \delta_7 z_7 + \delta_8 z_8 + \delta_9 z_9 \ldots.\ (11)$$

Where:

Ui = Technical inefficiency

Z_1 = Age of the farmers in (years)

Z_2 = Level of education (number of years spent in school)

Z_3 = Farming experience in (years)

Z_4 = Farm size (hectare)

Z_5 = Amount of credit accessed (#)

Z_6 = Membership of association (1 for membership, 2 otherwise)

Z_7 = Access to extension (1 for access, 2 otherwise)

Z_8 = Farm household size

Z_9 = Dummy variable for gender (1 for male, 2 for female) δ - δ_9 = Unknown parameters to be estimated.

VI. RESULTS AND DISCUSSION

Variable (N)	Amount per farmer (N)	Percentage
A. Revenue	158,906.00	
Variable costs (VC)		
Hire labour	28,315.00	27.83
Rice seed	5,700.00	5.60
Fertilizer	10,500.00	10.32
Herbicides	3,600.00	3.54
Charges on water	2,340.00	2.30
Transportation	2,215.00	2.17
B. Total Variable Cost (TVC)	52,670.00	51.76
Fixed Cost (FC)		
Cost of land	2,150.00	2.11
Permanent labour	16,845.00	16.55
Interest on borrowed capital	6,980.00	6.86
Hoe	233.00	0.23
Cutlass	186.00	0.18
Sickle	91.00	0.09
Oxen	6,100.00	5.99
Tractor	16,500.00	16.23
C. Total Fixed Cost (TFC)	**49,085.00**	48.24
D. Total Cost (TC) (B+C)	**101,755.00**	100.00
E. Net Farm Income (NFI) (A-D)	**57,151.00**	

Source: Field survey data, 2018

Table 1: Average costs and returns for irrigated rice farms in Kebbi State

Results in Table 1 showed that the total revenue for irrigated rice farming is N158, 906.0 while the total cost of production is N101, 755.0 The results reveal that Total Variable Cost is N52, 670.0 and Total Fixed Cost is N49, 085.0 This suggests that Total Variable Cost accounted for 51.76% while Total Fixed Cost accounted for 48.24%. This finding is in disagreement with studies by Tsoho (2005) and Kaka (2007) who found that Total Variable Cost accounted for up to 90% of the total Cost of production. This could be attributed to the fact that majority of the farmers had access to credit which assisted them in the utilization of tractor hiring services, Oxen and permanent labour for their production activities.

With regards to the total costs, labour cost alone accounted for 44.38% of the total Cost of production. This could be explained by the fact that rice production is highly labour intensive. Table 1 further revealed that the average Net Farm Income (NFI) per hectare earned by the irrigated rice farmers was N57, 151.0 indicating that irrigated rice production is profitable. This is in consonance with Studies by Yusuf (2013) and Idowu and Achike (2009) in their various studies on profitability of irrigated and upland rice production system in Sokoto and Ogun States, Nigeria.

VII. FINANCIAL ANALYSIS

Financial analysis was done to assess the economic performance of both rain fed and irrigated rice farms in the study area. Table 2 shows the farm financial ratios of irrigated rice farms in the study area.

Ratio per farmer	Irrigated
Profitability Index (PT)	0.36
Rate of Return on Investment (RRI)	56.17%
Operating Ratio (OR)	0.33
Benefit/Cost Ratio	1.56

Source: Field survey data, 2018

Table 2: Profitability analysis of irrigated rice production in Kebbi State

Result from Table 2 shows that profitability index (PI) was 0.36. This indicated that out of every ₦100.00 earned ₦36.00 is returned to the farmers as net income. The rate of return on investment (RRI) is shown to be 56.17 percent, indicating that the farmer's earn ₦56.17 profit in every ₦100.00 invested. An operating ratio (OR) of less than 1 suggests a successful and profitable business, hence operating ratio of 0.33 showed a higher revenue over variable costs.

Variable Production factors	Parameter	Co-efficient	t-ratio
Intercept	β_0	2.342	0.981
Farm size (x_1)	β_1	1.561	3.402***
Labour (x_2)	β_2	1.223	1.468
Rice seed (x_3)	β_3	0.879	0.175
Quantity of Fertilizer (x_4)	β_4	2.315	2.819***
Quantity of Herbicides (x_5)	β_5	1.320	2.218**
Water charges (x_6)	β_6	1.154	1.900**
Capital (x_7)	β_7	-0.002	-1.108
Squared Terms			
Farm size x Farm size	β_{11}	0.083	-0.912
Labour x Labour	β_{22}	0.008	0.356
Rice seed x Rice seed	β_{10}	-0.037	-1.046
Fertilizer x Fertilizer	β_{11}	1.405	2.651***
Herbicides x Herbicides	β_{12}	0.872	1.803*
Water charges x Water charges	β_{13}	0.751	1.010
Capital x capital	β_{14}	-0.814	-0.800
Interaction among inputs			
Farm size x Labour	β_{15}	0.433	0.314
Farm size x Rice seed	β_{16}	1.052	2.102**
Farm size x Fertilizer	β_{17}	0.633	1.107
Farm size x Herbicides	β_{18}	1.215	1.803*
Farm size x Water charges	β_{19}	-0.621	-0.455
Farm size x Capital	β_{20}	0.008	1.033
Labour x Rice seed	β_{21}	1.101	2.810***
Labour x Fertilizer	β_{22}	0.407	0.813
Labour x Herbicides	β_{23}	1.031	0.445
Labour x Water Charges	β_{24}	-0.060	-0.186
Labour x Capital	β_{25}	0.077	1.014
Rice seed x Fertilizer	β_{26}	1.224	0.813
Rice seed x Herbicides	β_{27}	0.046	0.222
Rice seed x Water charges	β_{28}	0.389	2.816**
Rice seed x Capital	β_{29}	0.495	0.133
Fertilizer x Herbicides	β_{30}	-0.211	-0.813
Fertilizer x Water	β_{31}	0.423	1.850*

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Charges			
Fertilizer x Capital	β_{32}	0.883	0.931
Herbicides x Water charges	β_{33}	0.102	1.224
Herbicides x Capital	β_{34}	-0.087	-0.102
Water charges x Capital	β_{35}	0.452	0.331
Diagnostic statistics			
Log likelihood ratio		-64.08	
LR test		41.01	
Sigma squared	$\delta°$	0.716	(6.321)***
Gamma		0.778	(7.389)***

Source: Field Survey data, 2018

= significant at 10%, ** = significant at 5%, * = significant at 1%.*

Table 3: Maximum likelihood estimates of the determinants of technical efficiency among irrigated rice farmers

The estimates of the stochastic frontier production function for irrigated rice production is presented in Table 3. Result from Table 3 shows the sigma squared value of 0.716, is statistically significant at 1% level. This parameter estimate ascertains the goodness-of-fit and the correctness of the specified distributional assumptions of the composite error term. The estimate of the variance ratio/the gamma was 0.778 indicating that 77.8% of the disturbance in the system is due to inefficiency, one sided error and therefore 22.2% is due to stochastic disturbance with two–sided error, supported by the high t-value. The coefficients of farm size and Quantity of fertilizer had the expected a priori signs and were significant in determining farmer's efficiency in irrigated rice production at 1% level of probability. Their output elasticity's indicated that an increase of 1% in farm size (hectare) and Quantity of fertilizer inputs will lead to 1.561 and 2.315 % increase in output of irrigated rice, respectively. The sum of elasticity's indicated that the farmers were operating in the increasing returns to scale stage of production in the short run. It depicts a situation whereby an increase in a unit of input leads to a larger increase in production than the preceding unit. The coefficients of Quantity of herbicides and water charges were positive and significantly related to output of rice at 5% level. This implies that increasing Quantity of herbicides and water charges will lead to an increase in technical efficiency of irrigated rice output. This finding is in consonance with the findings of Tanko and Jirgi (2008) who found that increasing farm size by 1% will lead to a corresponding increase in output in their study on economic efficiency of small holder arable crop farmers in Kebbi State.

Technical Efficiency	Frequency	Percentage
0.01-0.20	06	5.00
0.21-0.40	23	19.17
0.41-0.60	24	20.00
0.61-0.80	49	40.83
0.81 and above	18	15.00
Total	120	100.00
Mean	0.76	
Minimum	0.19	
Maximum	0.96	
Mean of best 10	0.91	
Mean of worst 10	0.26	

Source: Field survey data, 2018

Table 4: Technical efficiency of irrigated rice farms

The results of technical efficiency estimates of irrigated rice farmers in Table 4, indicates that technical efficiencies range from 0.19 to 0.96. The mean technical efficiency was 0.76, indicating that technical efficiency is widely distributed across the farmers. There was a wide gap between the efficiency of best technical efficient farmers and that of the average farmers. The estimates reveal that for the average farmer to attain the level of the most technically efficient farmer in the sample, he/she would require a cost savings of 20.83 percent that is (1-0.76/0.96%). The least technically efficient farmer would however, experience efficiency gain of about 80.21 percent that is (1-0.19/0.96%) to be able to attain the level of the most technically efficient farmer. This result is in consonance with that of Yusuf (2013) who found a mean technical efficiency of 0.73 in rain fed rice farming in Sokoto State. The implication of the findings is that even though rice farmers in the study are inefficient in production technically, results revealed that there is more room for improvement to attain the level of the best technical efficiency.

Variables	Parameter	Co-efficient	t-ratio
Intercept	β_0	2.506	2.210***
Age	β_1	0.449	3.132***
Educational level	β_2	0.387	1.910*
Farming Experience	β_3	1.230	2.213**
Farm Size	β_4	0.628	4.501***
Amount of Credit accessed	β_5	0.484	2.634***
Membership of association	β_6	0.105	0.337
Access to Extension	β_7	-1.306	-0.119
Household size	β_8	-0.825	-1.015
Gender	β_9	0.325	0.662

Source: Field Survey data, 2018

= significant at 10%, ** = significant at 5%, * = significant at 1%.*

Table 5: Maximum likelihood estimates of inefficiency factors obtained from the stochastic frontier output for irrigated rice farms

Results in Table 5 reveal that the coefficients of age, farm size and amount of credit accessed were positive as expected and are statistically significant at 1.0% level of probability. While the coefficients of educational level and farming experience were both positive as expected and are statistically significant at 1.0% and 5% level of probability. Aged farmers are relatively more efficient in production because it is possible that such farmers gain more years of experience through learning by doing and thereby becoming more efficient. This is in consonance with the studies by Erhabor and Ahmadu (2013).

For farming experience it implies that a farmer who has a large number of years of experience in fattening will be able to understand the intricacies of rice farming and therefore will always aim to achieve higher level of technical efficiency. Sunday *et al.*, (2013) obtained similar results in their analysis of Economic efficiency of cassava farmers in southern wet land region of Cross River State, Nigeria.

For farm size, it implies that farmers who had more farm size tend to be more technically efficient in rice farming. Since farm size gives an indication of how large or small the farms

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are, it is thus in line with a priori expectation that larger farm size connotes high level of technical efficiency. This corroborates the findings of Nwachuku and Onyenweaku (2007) who noted that larger farm size exhibits the advantages of economies of scale.

Farmers with formal education tend to be more efficient in food crop production, due presumably to their enhanced technical competence, which enable them to produce close to the frontier output. Also, farmers with education respond readily to the use of improved technology and tend to cope with complexities associated with improved technology. Access to credit is expected to increase production by procuring inputs timely. If production credit is invested on the farm, it is expected that this will lead to higher levels of output, but in case the credit is not accessed on time, it may, more often than not, lead to misapplication of funds. Hence, the expected impact of such funds will not be felt on the farm. If the credit is invested for consumption as is common with most farmers, credit will likely not lead to an improvement in the level of technical efficiency.

VIII. CONCLUSION

Results of the study revealed that an average Net Farm Income (NFI) per hectare earned by irrigated rice farmers was N57, 151. The study concluded that irrigated rice production in the study area is profitable. The Stochastic frontier production analysis results revealed that the mean technical efficiency of irrigated rice production was 76%. This means that irrigated rice farmers were technically inefficient in the utilization of existing resources. The implication of the result is that in spite of the fact that irrigated rice production in the study area is profitable, there is more opportunity to improve the technical efficiency through reduced cost of production and resource adjustments.

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