TECHNICAL EFFICIENCY OF RAIN-FED RICE PRODUCTION IN KEBBI STATE, NIGERIA: A STOCHASTIC FRONTIERPRODUCTION FUNCTION APPROACH

Gona[1], A. and R. Ishaya[2]

1 Department of Agricultural Economics and Extension,

Kebbi State University of Science andTechnology, Aliero,Nigeria

Corresponding authors-mail address: (ayubagona@gmail.com 08137206544)

2 Department of Agricultural Economics and Extension,

Usmanu Danfodio University, Sokoto, Nigeria

IJSER

Abstract

This study examined the technical efficiency of Rain fed rice production in Kebbi State, Nigeria. Data were generated from a sample of 120 rain fed rice farmers between June and November 2018 using the multi-stage random sampling technique. Net Farm Income and the Tran slog stochastic frontier production function model were employed for the analysis. The results revealed that Rain fed rice production in the study was found to be profitable, realizing ₦41, 330.0 as net income per hectare. Stochastic frontier production analysis results revealed that the mean technical efficiency of rain fed rice production is 69% suggesting that the farmers were not technically efficient in the utilization of existing resources. The results also showed that for rain fed rice production 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 and 1% level of probability, respectively. Based on these results it is recommended that rain fed 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 output.

Keywords: Rain fed, Efficiency, Rice, Kebbi State, Nigeria

Introduction

In Africa, rice is fast becoming a preferred dish, particularly in the urban communities, hotels and institutions. This preference is due to relative ease of preparation of rice food in catering for a large number of people. The preference together with the rapid population increase has greatly increased the demand for rice in the Continent. Increasing effort therefore, has been devoted to increase rice production in Africa (Maobe and Chweya, 1992).Demand particularly for rice has been on increase in Nigeria at faster rate than in other West African Countries since the mid-seventies (FAO, 2000).Akanji (1998) opined that the rising demand for rice in Nigeria was partly due to increasing population growth, increase in income levels following the discovery of crude oil, rapid urbanization and the commodities' convenience in terms of its ease of preparation. Though the country is the largest producer of rice in West Africa, yet it accounted for up to 20% of sub-Sahara Africa's rice imports for domestic consumptions (Omotola and Ikechukwu, 2006).

IJSER

Therefore, to bridge the gap between domestic rice production and consumption, increased production can be a good alternative because rice is one of the staple crops on Nigeria's import list (Shehu*et al*., 2007). In addition, increase in rice production is necessary, because it has a great potential to play a crucial role in contributing to food and nutritional security, income generation, poverty alleviation and socio-economic growth of Nigeria (Ibrahim *et al.*, 2008). Increased production can easily be achieved in the country since one of the most original features of rice is the fact that it can be grown under different environmental conditions particularly from the point of view of water supply. 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). Inspite of Government's effort aimed at making Nigeria selfsufficient in terms of rice production, Food and Agriculture Organization Statistics (FAOSTAT, 2003), indicated that the annual demand for rice in the country is estimated at five million tons. Out of this quantity, domestic production is three million tons. If growth in the production of rice is to be achieved, there is need to determine the technological progress in the irrigated and favorable rainfed ecosystems.

The presidential task force on rice production was established in 2002; it aimed to achieve self-sufficiency and to generate surplus for export. Achievement of this objective requires a clear understanding of the current level of agricultural productivity level and how it could be enhanced. Productivity level can be enhanced through the use of improved technology and improvement in the technical efficiency of resources. However, given the slow rate that farmers adopt new technology for rice production, improvement in efficiency remains the most cost effective way to enhance productivity in the short term. It is in this regard that this study intends to examine the profitability,technical efficiency of rain-fed rice production and its determinants in Kebbi State, Nigeria.

IJSER

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; β) exp (Vi – Ui) (i = 1, 2………...n)……..…………… (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,δ^2V). 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, δ^2 U), i.e. the distribution of V is half-normal. Thus, the

IJSER

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*………………………………………………………. (2)

= f(Xi; β) exp (Vi – Ui)/f(Xi; β) exp Vi………………………… (3)

= exp (-Ui)……………………………………………………….. (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

IJSER

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.

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^{1}N of the equator and between longitudes 3° 35^1 and 6° 03^{1}W of the Greenwich. 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.

IJSER

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.

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.

IJSER

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.

Net Farm IncomeModel

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)

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

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

$\sum$ = 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 wereestimated 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)

IJSER

ISSN 2229-5518

Model for Translog Stochastic Frontier Production function was specified as follows:

$$Ln\ y = \beta_o + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 Ln\ X_3 + \beta_4 Ln\ X_4 + \beta_5 LnX_5 + \beta_6 Ln\ X_6 + \tfrac{1}{2} \beta_{11} Ln\ X_1^2 + \tfrac{1}{2} \beta_{22} LnX_2^2 + \tfrac{1}{2} \beta_{33} LnX_3^2 + \tfrac{1}{2} \beta_{44} Ln\ X_4^2 + \tfrac{1}{2} \beta_{55} Ln\ X_5^2 + \tfrac{1}{2} \beta_{66} Ln\ X_6^2 + \beta_{12} LnX_1 LnX_2 + \beta_{13} LnX_1 InX_3 + B_{14} LnX_1 LnX_4 + \beta_{15} LnX_1 LnX_5 + \beta_{16} LnX_1 LnX_6 + \beta_{23} LnX_2 LnX_3 + \beta_{24} LnX_2 LnX_4 + \beta_{25} LnX_2 LnX_{5+} \beta_{26} LnX_2 LnX_6 + \beta_{34} LnX_3 LnX_4 \beta_{35} LnX_3 LnX_5 + \beta_{36} LnX_3 LnX_6 + \beta_{45} LnX_4 nX_5 + \beta_{46} LnX_4 LnX_6 + \beta_{56} LnX_5 LnX_6 + Vi - Ui \ldots\ldots (10)$$

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.

IJSER

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.

IJSER

ISSN 2229-5518

Results and Discussion

Costs and Returns

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

Variable (N)	Amount per farmer (N)	Percentage
A. Revenue	101,754.00	
Variable costs (VC)		
Hired labour	18,065.00	25.65
Rice seed	4,300.00	6.11
Fertilizer	7,950.00	11.29
Herbicides	2,700.00	3.83
Transportation	1,900.00	2.70
B. Total Variable Cost (TVC)	34,915.00	49.58
Fixed Cost (FC)		
Cost of land	1,800.00	2.56
Permanent labour	12,450.00	17.68
Interest on borrowed capital	3,940.00	5.60
Hoe	221.00	0.31
Cutlass	193.00	0.27
Sickle	105.00	0.15
Oxen	4,200.00	5.96
Tractor	12,600.00	17.89
C. Total Fixed Cost (TFC)	**35,509.00**	50.42
D. Total Cost (TC) (B+C)	**70,424.00**	100.00
E. Net Farm Income (NFI) (A-D)	**41,330.00**	

Source: Field survey data, 2018

Results in Table 5 showed that the total revenue for rain fed rice farming is N101, 754.0 while the total cost of production is N70, 424.0 The results reveal that Total Variable Cost is N34,

IJSER © 2019

915.0 and Total Fixed Cost is N35, 509.0 This suggests that Total Variable Cost accounted for 49.58% while Total Fixed Cost accounted for 50.42%. 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 43.33% of the total Cost of production. This could be explained by the fact that rice production is highly labour intensive. Table 6 further revealed that the average Net Farm Income (NFI) per hectare earned by the rain fed rice farmers was N41, 330.0 suggesting that rain fed rice production is profitable. This is in consonance with Studies by Yusuf (2013) and Idowu*et al.*, (2009) in their various studies on profitability of rain fed and upland rice production system in Sokoto and Ogun States, Nigeria.

Financial Analysis

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

Table 2: Profitability analysis of rain fed and irrigated rice production in Kebbi State.

Ratio per farmer	**Rain fed**
Profitability Index (PT)	0.41
Rate of Return on Investment (RRI)	58.69%
Operating Ratio (OR)	0.34
Benefit/Cost Ratio	1.44

Source: Field survey data, 2015

Result from Table 2 shows that profitability index (PI) was 041for rain fed rice farms. This indicated that out of every ₦100.00 earned ₦41.00 is returned to the farmers as net income for rain fed rice farms. The rate of return on investment (RRI) is shown to be 58.69percent, indicating that the farmer's earn ₦58.69profit in every ₦100.00 invested. An operating ratio (OR) of less than 1 for the rice farms suggests a successful and profitable business, hence operating ratios of 0.34 showed a higher revenue over variable costs.

Estimated Stochastic Frontier Production Function

Table 3: Maximum likelihood estimates of inefficiency factors obtained from the stochastic frontier output for rain fed rice farmers

Variable Production factors	Parameter	Co-efficient	t-ratio
Intercept	β_0	0.653	2.006**
Farm size	β_1	1.483	0.860
Labour	β_2	0.720	2.055**
Quantity of rice seed	β_3	-1.043	-0.730
Quantity of fertilizer	β_4	0.632	2.611***
Quantity of herbicides	β_5	0.341	2.010**
Capital	β_6	0.155	1.123
Squared terms			
Farm s size x Farm size	β_7	-1.031	-2.013**
Labour x labour	β_8	0.814	1.116
Quantity of rice seed x Quantity of rice seed	β_9	0.087	2.001**
Quantity of fertilizer x Quantity of fertilizer	β_{10}	0.265	1.033
Quantity of herbicides x Quantity of herbicides	β_{11}	0.863	0.457
Capital x Capital	β_{12}	0.775	1.852*
Interaction among inputs			
Farm size x Labour	β_{13}	-0.446	0.934
Farm size x Quantity of rice	β_{14}	0.780	0.101
Farm size x Quantity of fertilizer	β_{15}	0.334	2.212**
Farm size x Herbicides	β_{16}	0.463	0.929
Farm size x Capital	β_{17}	-0.356	-2.813***
Labour x Quantity of rice seed	β_{18}	0.936	0.771
Labour x Fertilizer	β_{19}	0.315	1.320
Labour x Herbicides	β_{20}	0.386	2.331**
Labour x Capital	β_{21}	-0.884	-1.235

IJSER

Quantity of seed x fertilizer	β_{22}	0.316	0.990
Quantity of seed x Herbicides	β_{23}	1.389	3.133***
Quantity of seed x Capital	β_{24}	0.257	1.088
Fertilizer x Herbicides	β_{25}	-0.448	-0.913
Fertilizer x Capital	β_{26}	0.816	2.711***
Herbicides x Capital	β_{27}	0.772	0.169
Diagnostic statistics			
Log likelihood ratio		56.17	
LR test		38.10	
Sigma squared	δ°	0.322	(3.616)***
Gamma		0.684	(5.200)***

Source: Field Survey data, 2018

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

The Maximum Likelihood Estimates (MLE) of the stochastic production parameters for the rain fed farmers is presented in Table 3. Result from Table 8 shows the sigma squared value of 0.322, 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 0.684 indicating that 68.4% of the disturbance in the system is due to inefficiency, one sided error and therefore 31.2% is due to stochastic disturbance with two–sided error, supported by the high t-value. Erhabor and Ahmadu (2013) and Onojaand Achike, (2010) in their various investigations obtained similar results.

Result from Table 3 indicates that the coefficients of the variables labour (0.720), Quantity of fertilizer (0.632) and Quantity of herbicides (0.341) carried positive signs. They were statistically significant at 5% level except for Quantity of fertilizer that was significant at 1% level of probability. Output elasticity for labour, Quantity of fertilizer and Quantity of herbicides indicated that an increase by 1% of these variables will lead to 0.720, 0.632 and 0.341% increase in the output of rain fed rice, respectively. The result depicts that Quantity of fertilizer is the dominant production variable that influenced the technical efficiency in rain fed rice production. The sum of output elasticity indicates that increasing returns to scale prevailed. Increasing

ISSN 2229-5518

returns indicates that an additional unit of input results in a larger increase in production than the preceding unit. In this scenario, resource use efficiency had not been attained and resources are misallocated. This finding agrees with that of Erhabor and Ahmadu (2013) who found that both family and hired labour and Quantity of herbicides significantly and positively influenced the yield of rice, while Quantity of fertilizer had significant but negative effect on output.

A large number of the interaction terms (2nd order coefficients) were statistically significant at the conventional significance level (1, 5 and 10%), implying the suitability of the Translog function (Okoye and Onyenweaku, 2007). Among the squared terms, the coefficients of Farm size is negative and significant at 5% level while Quantity of rice seed and capital are positive and significant at 5 and 10% level of probability, showing a direct relationship with rice output. Coefficient of interaction between Farm size and capital, Quantity of seed and herbicides and fertilizer and capital are significant at 1% level of probability and have a direct relationship with rice output while interaction between farm size and Quantity of fertilizer, labour and herbicides shows direct relationship with rice output and are highly significant at 5% level of probability.

The negative signs recorded against the slope coefficients of the variables for the interaction terms such as Farm size and capital indicate that as more inputs were incurred on the farm, after reaching its thresh hold, the contribution of these variables reduce the level of output of rice. This is a sign that these resources were not being efficiently allocated or the farm is experiencing diminishing returns with respect to the variables.

Table 4: Technical efficiency of rain fed rice farmers

Technical Efficiency	Frequency	Percentage
0.01-0.20	5	4.17
0.21-0.40	12	10.00
0.41-0.60	38	31.67
0.61-0.80	46	38.33

IJSER © 2019
http://www.ijser.org

0.81 and above	19	15.83
Total	120	100.00
Mean	0.69	
Minimum	0.20	
Maximum	0.91	
Mean of best 10	0.84	
Mean of worst 10	0.23	

Source: Field survey data, 2018

The results of technical efficiency estimates of rain fed rice farmers in Table 4 indicates that the technical efficiencies range from 0.20 to 0.91. The mean technical efficiency was 0.69, 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 farmer. 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 24.18 percent that is (1-0.69/0.91%). The least technically efficient farmer would however, experience efficiency gain of about 78.02 percent that is (1-0.20/0.91%) to be able to attain the level of the most technically efficient farmer. This result is in agreement with that of Erhabor and Ahmadu (2013) who found a mean technical efficiency of 0.605 among small scale farmers in Nigeria. 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.

Inefficiency in Production

This explains the relationship between farmer specific factors and their effects on efficiency.

Table 5: Likelihood estimates of inefficiency factors obtained from the stochastic frontier output for rain fed rice farmers

Variables	Parameter	Co-efficient	t-ratio
Intercept	β_0	2.108	3.401***
Age	β_1	0.234	1.102

Educational level	β_2	1.045	2.640***
Farming Experience	β_3	0.531	1.835*
Farm Size	β_4	0.443	2.102**
Amount of Credit accessed	β_5	0.137	3.480***
Membership of association	β_6	-1.068	-0.511
Access to Extension	β_7	0.710	1.306
Household size	β_8	0.339	0.468
Gender	β_9	0.186	1.004

Source: Field Survey data, 2018
*= significant at 10%, ** = significant at 5%, *** = significant at 1%.

Table 5 shows the results of the factors influencing technical efficiency of rain fed rice production in Kebbi State, Nigeria. The coefficients of educational level and amount of credit accessed were positive as expected and are statistically significant at 1.0% and 10% level of probability. This finding is in consonance with previous findings by Tanko and Jirgi (2008) and Yusuf (2012). 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. Farmers with more experience are likely to be more efficient in organizing their production and executing farm operations. This supports the view of Abdullahi*et al*., (2012) who affirmed that gaining more years of experience through learning by doing enhances their level of efficiency. The coefficients of farm size and amount of credit accessed were positive as expected and are statistically significant at 5% and 1% level of probability, respectively. Results from Table 5 reveals that increasing farm size by 1% will increase the level of efficiency by 0.443 Access to credit provides the farmers with the means of expanding and improving their farm. Hence, lack of credit facility will have negative effect on technical efficiency. This corroborates the findings of Sunday *et al*., (2013) and disagrees with studies by Abdullahi*et al*., (2012) who found that

IJSER

access to credit had no significant effect on efficiency from their study on Economics of resource use in small-scale rice production: A case study of Niger State.

Conclusion

Results of the study revealed that an average Net Farm Income (NFI) per hectare earned by the rain fed rice farmers was N41, 330.0 The study concluded that rain fed rice production in the study area is profitable. The Stochastic frontier production analysis results revealed that the mean technical efficiency of rain fed rice production was 69%. This means that rain fed rice farmers were technically inefficient in the utilization of existing resources. The implication of the result is that in spite of the fact that rain fed 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.

IJSER

References

Abdullahi, A., Baba, K. M. and Ala, A. L. (2012) "Economics of Resource Use in Small-Scale Rice Production: A case Study of Niger State, Nigeria". *International Journal of AgricScience.*2 (5): 429-443,

Aigner, D., Lovell, C.A.K. and Schmidt, P. (1977)."Formulation and Estimation of Stochastic Frontier Production Models"*Journal of Economics* 6: 21-37.

Akanji, B.O. (1998). Hedomic Price Analysis of the Demand for Grain Crops in Nigeria.The Case Study of Rice and Cowpea. An Unpublished PhD Thesis submitted to the University of Ibadan, Nigeria Pp 97.

Amaza, P.S. and Olayemi, J. K. (2001) "The Influence of Education and Extension Contact onFood Crop Production in Gombe State Nigeria", *Journal of Agribusiness and Rural Development*, 1(1): 80-90.

Bagi F.S. (1982). "Economic Efficiency of Share Cropping: Reply and Some Further Results." Malayan Economic Review, 27(1); 86-95.

Bagi, F.S. and Huang C. J.(1983). "Estimating Production Technical Efficiency for Individual Farms in Tennesse" *CanadianJournal of Agricultural Economics*, 31(1): 249-256.

Battesse, G.E. and Coelli, T. J. (1995).“A Model of Technical Inefficiency Effect in Stochastic Frontier production Function for Panel Data”, *Journal of Empirical Economics,* 20:325-332.

Coelli, T.J. (1995). “Recent Developments in Frontier Modeling and Efficiency Measurement” *AustralianJournal of Agricultural Economics*, 34(3): 219-245.

Daramola, B.(2005) Government Policies and Competitiveness of Nigeria’s Rice Economy. Paper presented at the Workshop on Rice Policy and Food Security in Sub-Saharan Africa, Organized by WARDA, Cotonou, Republic of Benin. 7th-9th Nov. P5.

Erhabor,P. O. and Ahmadu, J. (2013).Technical Efficiency of Small- Scale Rice Farmers in Nigeria. *Journal of Agriculture and Allied Sciences* 2(3)14-22

Farrell, M. J. (1957).The Measurement of Productive Efficiency. *Journal of Royal Statistics Society Series A*. 21 (10 253-281.

Food and Agriculture Organization (FAO)(2000). *Agricultural and Food Marketing Managementin the Developing Countries*. Rome. Pp366

Food and Agriculture Organization Statistics (FAOSTAT) (2003).*Production Year Book*, Rome.

Idowu, A. O., Akerela, I. and O. Ezekiel (2009). Profitability Level of Upland Rice Production in Ilaro Agricultural Zone of Ogun State, Nigeria. Proceedings of the 23rd Annual Conference of the Farm Management Association of Nigeria, Sokoto. Pp317-322.

Kaka, Y. (2007). Efficiency of Resource Use in Hungary Rice Production in Arewa Local Government area, Kebbi State. An M. Sc Dissertation Submitted to the Department of Agricultural Economics and Extension, UsmanuDanfodio University, Sokoto.

Kalirajan, K. P and Flinn, J. C. (1983).“The Measurement of Farm Specific Efficiency”.*Pakistan Journal of Applied Economics* 2 (2): 167-180.

Khumbhakar, S.C. (1990). “Production Frontiers, Panel Data and Time Varying Technical Inefficiency” *Journal of Econometrics*, 46: 201-211

Maobe, S.N., and Chweya, J.A. (1992) Influence of Seedling Age and Nitrogen Application Method on Dry Matter Production and Nitrogen Uptake of Lowland Rice Cultivated on anAlfisol. *East African Agricultural and Forestry Journal*, 57(3), 163-171.

National Population Commission (NPC) (2006) Census 2006. Retrieved 24th December 2013 from U R L: http://www.nigeriannews.com/letters/letters.htm

Nwachukwu, I. N. and Onyenweaku, C. E. (2007). Economic Efficiency of Fadama Telfairia Production in Imo State, Nigeria. A Translog Profit Function Approach. http:/mpra.ub.uni-muenchen.de.13469/I/eeo. Efficiency pdf.Retrieved4/9/14

IJSER

Okoye, B. C. and Onyenweaku, C. E. (2007). "Economic Efficiency of Small-holder Cocoyam Farmers in Anambra State", A Translog Stochastic Frontier Cost Function Approach, *Agricultural Journal* 2: 535-542.

Oladimeji, Y. U. and Abdulsalam, Z. (2013).Analysis of Technical Efficiency and its Determinants among Small Scale Rice Farmers in Patigi Local Government Area of Kwara State, Nigeria.IOSR*Journal of Agriculture and Veterinary Science (IOSR-JAVS),3(3),34-39.*

Omotola, K. A. and AIkechukwu, (2006). Rice Milling inNigeria.Internet.http://www.ricenigeria.com as retrieved on November 2013

Onoja, A. O. and A. I. Achike (2010). Comparative Analysis of Farm Resource Efficiencies in Rice Production under Small-scale Farmer Managed Irrigation Schemes and Rainfed Systems in Kogi State, Nigeria. *Research Journal of Agriculture and Biological Sciences*, 6(6): 1047-1054.

Shehu, J.F., Tashikalma, A. K. and Gabdo, B.H. (2007). Efficiency of Resource Use in Small Scale Rainfed Upland Rice Production in North West Agricultural Zone of Adamawa State. In Haruna, U., Jibril, S.A., Mancha, Y.P. and Nasiru, M. (Eds).Consolidation of Growth and Development of Agricultural Sector.Proceeding of the 9th Annual National Conference ofNigeria Association of AgriculturalEconomists.AbubakarTafawaBalewaUniversity, Bauchi, Nigeria. 5th-8th November. Pp 552-560.

Tanko, L. (2004). Optimum Combination of Farm Enterprises in Kebbi State, Nigeria: A linear programming Approach. Unpublished Ph.D Dissertation, Department of Agricultural Economics, Michael Okpara University of Agriculture, Umedike, Nigeria.

Tanko, L. and Jirgi, A. J. (2008). Economic Efficiency Among Smallholder Arable Crop farmers, Kebbi State, *Nigeria. Continental Journal of Agricultural Economics* 2: 14-22.

Tsoho, B. A. (2005). Economics of Tomato-Based Cropping System Under Small-scale Irrigation in Sokoto State, Nigeria. An M. Sc Dissertation Submitted to the Department of Agricultural Economics and Farm Management, University of Ilorin, Nigeria. Pp 112

Yusuf, M. (2013) Resource Productivity, Profitability and Determinants of Technical Efficiency in Rain fed Lowland Rice Production System in Sokoto State, Nigeria. A PhD Pre defense Seminar Paper Presented to the Department of Agricultural Economics and Extension, UsmanuDanfodio University, Sokoto. 83pp.

IJSER

IJSER