Economic Efficiency of Rice Production in Jigawa State

Fatima Muhammad Adam, Usman Saad, Dr. Murtala Abdu, & Hanifatu Adamu Sambo
Department of Economics and Development Studies,
Federal University Dutse.

Abstract: *The study analysed economic efficiency of Rice production in Jigawa state, Nigeria. A two-stage sampling procedure was used to select a total number of 399 respondents from the three local governments area. Data were collected through interview schedule and structured questionnaire administered to the sampled Rice farmers. Data analysis was done using descriptive statistics, and stochastic production frontier approach. The findings of the analysis show that there is high level of efficiency in rice production in the study area. Furthermore, Farm size, cost of seed, cost of fertilizer, cost of herbicides and cost of labour are found to be significant determinants of rice production in the area. However, the study recommends that the relevant government authorities should guarantee timely and appropriate application of fertilizer at a discounted cost that is within the means of farmers and extension professionals must make an effort to motivate rice farmers to organize into cooperative groups. As a result, they might be able to take advantage of the economies of scale in purchasing inputs to lower production costs and obtain official credit. Moreover, subsidies or loans for rice growing should be given by governmental and nonprofit organizations to unemployed youngsters in the area*

Keyword: Efficiency. Stochastic frontier approach. Profitability. Economic efficiency

Introduction

Rice is the third most staple food after maize and cassava in Nigeria and has become most important food security crop due to its increased significance in the Country [International Rice Research Institute (IRRI), 2019]. The two types of rice that are commonly produced in Nigeria are the African Rice (Oryza glaberrima) and the Asian rice (Oryza sativa). In recent times however, new hybrid varieties have been introduced such as new rice for Africa (NERICA). Rice is cultivated in almost all Nigeria's agro-ecological zones, from the mangrove swamps of the Niger Delta to the dry zones of the Sahel in the North. The Northern part accounts for 72% of total rice production [Growth and Employment in States Wholesale and Retail Sector report, 2019]. A total of 3.2 million hectares of land was harvested by 1.43 million farmers in the 2019. production environment is Rainfed lowland which is covered 47% of cultivated area and accounting for over 50% of the few total rice produced in Nigeria, while rainfed upland rice production covered (30% cultivated area, 17% domestic production), irrigated systems (17% cultivated area, 27% domestic production), deep water and mangrove swamp environments (6% cultivated area, 4% domestic production) are the other rice production environments in Nigeria (KPMG Research, 2018).

Nigeria is the leading producer of rice in Africa, consumer of rice, and incidentally one of the largest rice importer in the world. This increase in rice demand is attributed to the consumer shift from traditional staples such as yam, maize, millet and garri, to imported parboiled rice. Though presently in Nigeria most local 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. 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. Thus, 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 (Obiekwe, *et al.,* 2023). However, the ability of rice farmers in Jigawa state to adopt new agricultural technologies is affected by farmers and farm characteristics. Examples of such characteristics include age, household size, level of education, total land area used for rice production, and farmer's managerial ability or experience in rice farming. However, over 70% of the rice farmers in Jigawa state are illiterate. High illiteracy rates affect farmers' ability to adopt new agricultural practices and to effectively mobilize and apply production inputs. Rice farmers also face high input costs (fertilizer, pesticides and machine power) and they lack incentives because of the removal of input subsidies in the country. About 80% of rice farmers are smallholders cultivating an average farm size of 2 hectares. The ability of rice farmers in the study area to adopt new technology and achieve sustainable small-scale production depends on their level of technical efficiency. Efficiency measurement is very important because it is a factor for productivity growth.

This paper aims to measure the economic efficiency of Rice production is Auyo, Kafin Hausa and Jahun local government. Hence suggesting how the efficiency of rice farmers will improve the production Level of rice output in the region.

Methodology

Efficiency measures are important because of its vital role in the production. The efficiency of rice production has been of longstanding interest to the economists and policymakers in Nigeria. Technical efficiency in production is defined as the ability of the farmer to produce at the maximum output (frontier production), given the quantities of inputs and production technology (Aigner et al., 1977). Production efficiency is concerned with the relative performance of the process used in transforming inputs into output. The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or certain level of output at least-cost. The greater the ratio of production output to the factor input, the greater the magnitude of technical efficiency and vice versa. This definition of technical efficiency implies that differences in technical efficiency between farms exist. Variation in technical efficiency of producers might arise from managerial decisions and specific-farm characteristics that affect the ability of the producer to adequately use the existing technology.

A number of studies have examined the productive efficiency in its domain to agricultural production in Nigeria. Abdulmuminu, et al (2019) determine socio-economic factors affecting adoption of recommended lowland rice production technologies in Jigawa State, the result indicated that household size, land ownership and sources of labour significantly affect adoption of recommended lowland rice production technologies. Farming experience had inverse relationship with the adoption of recommended lowland rice production technologies. Also, Danmaigoro, (2019) used net farm income and trans log stochastic frontier production function model to analyzed the technical efficiency of irrigated rice production in kebbi state. The result of the stochastic frontier production result revealed that the mean technical efficiency of irrigated rice farmers was 76%, suggesting the farmers are not technically efficient in the utilization of existing technology. Also, farmers age, education, faming experience, farm size and amount of credit accessed influenced the technical efficiency positively. However, Adeleke et al (2023) analyzed economic efficiency of small-holder wheat farmers around Hadejia Valley Irrigation scheme in Jigawa State, Nigeria. Both descriptive and inferential statistics were used to analyzed the data. The stochastic frontier analysis results indicated that a unit increase in the use of land, fertilizer, labour and herbicide

contributed to wheat output by 0.577, 0.341, 0.078 and 0.174 respectively. The predicted technical, allocative and economic efficiencies were 0.76, 0.32 and 0.24 respectively. This implies that wheat farmers were not fully efficient and output could have been increased by 24% and about 68% of cost would have been saved. Miebi (2021) examines the productivity and technical efficiency of cassava production in Delta state using SFA, the mean technical efficiency of 67% is recorded. This imply that the average efficiency of cassava production is could be improve by 33% through better use of existing resources and technology. The major factors which influenced the farmers technical efficiency were farm size, planting material and capital while farming experience, level of education, access to credit, gender, age of farmers, household size has a significant effect on their inefficiency level. And Omotoso et al (2021) compared the profitability and the technical efficiency of vegetable production and factors influencing the technical efficiency of vegetable production between organic and inorganic farming system in Imo state. Budgetary analysis and stochastic frontier model were. The result showed that, inorganic system achieved significantly higher returns than organic system. The mean technical efficiencies for organic and inorganic vegetable farmers were 89.5% and 75.64% respectively. Farm size, labor and quantity of seeds were the crucial factors that affected the technical efficiency under both farming systems.

Therefore, this study is necessarily because there are still little empirical studies on economic efficiency of rice production in the study area.

Materials And Methods

The Study Area

The study was conducted in Jigawa State, Nigeria. The State is situated in the North-western part of the country between latitudes 11.00 ° N to 13.00 ° N and longitudes 8.00 ° E to 10.15 ° E. The State has a total land area of approximately 22,410 square kilometers with twenty-seven (27) Local Government Areas (LGAs) (National Population Commission, NPC, 2006). The State has a projected population of 6,549,233 people in 2019 and the population growth of the state is expected at 3.2 % with about 48 % of the population falling under the age of fifteen (NPC, Sq 2006). Out of the estimation about 2.9 million was measured to be productive adults and the majority (80%) of the population was found in the rural areas and is made up of typically Hausa, Fulani and Manga.

Sampling procedure

The Population for the study constitutes 399 Rice farmers from the three local government areas in Jigawa State. Two stages sampling procedure will be used to select sample represented Rice farmers for this Study. First stage involved purposive selection of three local governments area out of twenty-seven local governments, which are Auyo, Kafin Hausa and Jahun. The population are 227400, 459600, 395300 respectively. The second stage involves random selection of 83 rice farmers from Auyo, 170 from Kafin Hausa and 146 from Jahun. Sample size was calculated according to Yemane (1967) this is expressed as: $n = \frac{N}{1+N(e)^2}$

ni = $\frac{Ni}{N}.n$

Where:

ni = Sample size in local government

Ni = Total numbers of farmers in each local government

n = Estimated final sample size

N = No of population

Auyo = ni = $\frac{Ni}{N}.n = \frac{227,400}{1080300}.399 = 82.9$

Kafin Hausa = ni = $\frac{Ni}{N}.n = \frac{459,600}{1080300}.399 = 170$

Jahun ni = $\frac{Ni}{N}.n = \frac{395,300}{1080300}.399 = 146$

$$n = \frac{N}{1 + N(e)^2}$$

: $n = \frac{1,080,300}{1+1,080,300(0.0025)^2} = 399$

Data Analysis: The data ware analyzed using descriptive statistics, and stochastic frontier production function.The stochastic frontier production function will be used for the analysis of technical efficiency. Coelli (1996) specified the SFPF as:

Yi = f (Xi; β) exp (Vi – Ui) (i = 1, 2…...n)……..……

Where:

Yi = Production of the ith farm

Xi = Vector of input quantities of the ith farm

β = Constant

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.

The model is explicitly linearized into log form as follows: $lnYi = \beta 0 + \beta 1 lnX1 + \beta 2 lnX2 + \beta 3 lnX3 + \beta 4 lnX4 + \beta 5 lnX5$ + Vi – Ui.....(1)

where:

In = the natural logarithm

Yi = Output (kg)

X1 = Farm size (ha)

$X2$ = Seed (kg)

$X3$= Fertilizers (kg);

$X4$ = Herbicides (litre);

X5 = labor (Man-hour)

Vi = Error term not under the control of farmers

Ui = Error term under the control of farmers' (technical inefficiency)

$\beta 0$ = Intercept (constant term)

$\beta 1$ – $\beta 2$ = regression coefficients to be estimated.

The model to identify determinants of inefficiency, Ui, is expressed as:

Ui = δo + δ1z1 + δ2z2 + δ3z3 + δ4z4 +.....(2)

Where:

Z1 = age (years)

Z2 = family size (number)

Z3 = farming experience (years)

Z4 = education (years)

δo = Constant

δ1 – δ4 = regression coefficient

Result And Discussion

Socio-economic characteristics of rice farmerns in Auyo, kafin Hausa and Jahun local government.

Variables	Frequency	Percentage
Gender		
Male	245	81.67
Female	55	18.33
Age		
18 to 35 years	31	10.33
36 to 45 years	96	32.00
46 to 60 years	171	57.00
60 years above	2	0.67
Level of education		
Quranic	24	8
Secondary	105	35.33
Primary	56	18.67
Tertiary	114	38

The survey response obtained from the 3 local government in Jigawa state stood as 300 out of the 399 sampled questionnaire issued. The response rate is 75% which shows that more than half of the respondents returned their questionnaire. Among the total number of the respondents, 245 were males and 55 were females representing 81.67% and 18.33% respectively. The age distribution of the respondents shows that 10.33% were within the range of 18-35 years, 32% were within the range of 36-45 years, 57% were within the range of 46-60 years and 0.67% are 61 years and above. Farmers within the range of 36-45 are an active age group for meaningful agricultural production. Therefore, there is likelihood of high productivity in rice production in the study area. While the result of level of education shows that 8% of the farmers are from Quranic education. And about 18.67%, 35.33%, 38% had primary, secondary and tertiary education, respectively. However, Illiteracy is believed to have a negative implication on efficient use of productive resources and adoption of farm innovation. According to Danmaigoro, (2019) level of education is expected to influence farmers' adoption of agricultural innovations and decision on various aspects of farming. They also maintain that education is highly important for sustainable agricultural growth and development

Result of the Stochastic Frontier Function

In order to fulfill the primary goal of the research, which is to determine empirically the economic efficiency/inefficiency of rice production in Auyo, Kafin Hausa and Jahun local government, Jigawa state, stochastic frontier function was analyzed and presented the result in table 4.4

Table 4.4 Stochastic Frontier Approach

Variables	Coefficient	Standard Error	Z	P>Z
Farm size	0.2563	0.0429	5.96	0.000***
Cost of seed	0.2937	0.1689	17.39	0.000***
Cos of fertilizer	0.9774	0.4142	23.59	0.000***
Cost of Herbicid	-0.5918	0.1745	-33.91	0.000***
Cost of labour	0.1897	0.0125	15.16	0.000***
_cons	-7.1098	0.4433	-16.04	0.000***
lnsig2u				
_cons	-33.0176	3.3826	-10.35	0.000***
Age	-1.5918	1.0398	-1.53	0.000***
Family size	-0.9721	0.2877	3.38	0.000***

Faming exp	0.4864	0.5546	8.77	0.000***
Level of edu	5.3044	0.6174	8.57	0.000***
Sigma squared	0.1134	0.1664		0.000***
Lamda	2.392	0.5044		0.000***
LR	24.77			

Source: Authors computation using stata 17 2024
*** significant at 1%,

The maximum likelihood estimates of the parameters of the stochastic frontier production function and the inefficiency model are presented in Table 4.4 the result shows that the estimated value of the sigma squared (δ2) was 0.11 and statistically significant at 1% probability level. This indicated a good fit and the correctness of the specified model. It shows that 11% of the observed variation in the output of Rice in the study area was explained by the included explanatory variables. Gamma (γ) is also a measure of level of the inefficiency in the variance parameter. For the Cobb-Douglas model used for the study, the lamda estimate was large (γ=2.3) and significant at 1% level indicating the presence of technical inefficiency effects in the operations of the Rice production. It means that technical inefficiency is an important factor in explaining output differences among Rice farmers in the study area.

The coefficient of farm size (0.26) indicates a positive relationship between farm size and rice production in the study area at 1% level of significant. This implies that a 1% increase in farm size will lead to an increase in output of Rice by 2.6kg. This result is in line with Abba (2019) who reported a positive relationship between farm size and output of rice farmers in Pakistan. Also, the coefficient of seed (0.29) are also positive at 1% level of significant, thus increasing quantity of seed used by 1% will result in increased in output by 0.29%. This result agrees with Rezoyana et al (2018). Seed quantity is important because it determines to a large extent the output obtained. If correct seed rates and quality seeds are not used, output will be low even if other inputs are in adequate. The coefficient of fertilizer 0.98 were found to be significant at 1%. This implies that there is positive relationship between fertilizer and output in the study area. This is in line with the study of Tedesse et al (2016). Also, the coefficient of herbicides (-0.59) is statistically insignificant at 1% level. The coefficient is not different from zero which implies that increasing in quantity will not result in increased in output. This is in line with Rezoyana et al (2018) the result found out that herbicides had an insignificant effect on the gross yield of rice production in Bangladesh. The negative sign could be due to over application of herbicide by the respondents. The coefficient of labour (0.19) was positive at 1% level of significant, thus a 1% increase in labour would boost rice production in the study area by 0.19%. This result is in line with Omotoso et al (2021). As cost of production increases, farmers resort to minimise cost by employing more of family and communal labour which are relatively cheaper.

The inefficiency result revealed that the estimated coefficients of age (-1.59), family size (-0.97) at 1% level of probability were negative. This implies that these factors led to a decrease in technical inefficiency meaning that, increasing them will lead to increase in technical efficiency of rice farmers in the study area. When the age of farmers increases their experience in acquiring and handling inputs increases thereby making them more efficient. While in the traditional farming setting, Journal of Agriculture and Sustainability 46 increase in household size increases family labour as members of the family are used on the farm. The coefficient of farming experience (0.49) at statistically significant level of 1%, this means that as years of farming experience of respondents increases, their technical efficiency also increases. The more experience farmers have in rice farming, the more skills they acquire and the more comfortable they become with the production system. The coefficient of education (5.30) at 1% level of significant indicates that education has impact on technical efficiency of Rice

farmers in the study area. This is in line with the study of Miebi et al 2021), Hai Dang et al (2019).

Conclusion

Based on the study's findings, it can be said that rice cultivation is profitable in the local governments of Auyo, Kafin Hausa, and Jahun in Jigawa state because the cost of producing the grain is less than the yield. There is little to no economic inefficiency in the region's rice production, and the main factors influencing its profitability are labor cost, fertilizer cost, and output volume. Given that a sizable profit was made per hectare of land farmed at the lowest possible cost of production, rice growing was clearly a viable endeavor in the study area. The business can provide employment opportunities for the general public.

Recommendations

Furthermore, extension professionals must to make an effort to motivate rice farmers to organize into cooperative groups. As a result, they might be able to take advantage of the economies of scale in purchasing inputs at lower production costs and obtain official credit. Moreover, the government agency should provide rice farmers with sufficient training on new technologies. It is advised that local farmers utilize modern farming techniques and technology resources in the interim.

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