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Original Article

Cost efficiency and profitability analysis of rice (*Oryza sativa*) production among smallholder farmers in Federal Capital Territory, Nigeria

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ABSTRACT

This study evaluated cost efficiency and profitability analysis of rice (*Oryza sativa)* production among smallholder farmers in Federal Capital Territory, Nigeria. Multi-stage sampling technique was adopted and used for this study. Data were collected through the use of well-designed and structured questionnaire from 150 sampled rice producers. The following tools of analysis were used to achieve the specific objectives: Descriptive statistics, budgetary technique, stochastic cost frontier model, and principal component analysis. The results show that the average age of the sampled rice producers was 44 years. The average farm size under cultivation by the rice farmers in the study area was 3 hectares indicating that the rice producers are smallholder farmers operating on the small scale basis, the gross margin obtained was N 109.608.47/ha with the gross margin ratio of 0.46, operating ratio of 0.54 and the rate of return on investment of 0.85. This study revealed that rice production is a profitable enterprise in the study area. The statistical and significant factors influencing total cost of rice production in the study area were: cost of fertilizer ($P < 0.01$), cost of labor ($P < 0.05$), cost of chemical ($P < 0.05$), and total output ($P < 0.05$), while the statistical and significant factors influencing cost inefficiency were: age of the farmer ($P < 0.01$), marital status ($P < 0.05$), years schooling ($P < 0.05$), farming experience ($P < 0.01$), non-farm income ($P < 0.10$), household size ($P < 0.01$), cooperative memberships ($P < 0.05$), and extension contact ($P < 0.01$). Rice farmers were faced with the following production constraints: Lack of improved seed varieties, transportation problem, poor storage facilities and inadequate capital. Therefore, the study recommends that farmers should be provided with farm inputs such as fertilizers, improved seeds varieties, and chemicals at a subsidized price to improve productivity and cost efficiency, Credit facilities should also be provided to rice farmers at lower interest rate to enable them to purchase farm inputs in time, farm tractors, equipment, implements, and irrigation facilities should be provided by government to rice farmers, good roads and infrastructural facilities such as milling machines, storage facilities and destoning machine should be provided to farmers to add more value and make more profit.

Keywords: Cost efficiency, profitability, rice, smallholder farmers, stochastic cost frontier model

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INTRODUCTION

Rice (*Oryza sativa)* is one of the common staple food crop consumed by almost more than 50% of the world's total population, it provides about 19% and 13% of global per capita requirements for energy and protein intake, respectively, which makes it critical to global food security.[1] Rice is one of the Nigeria's most popular and consumed food crop in all the geopolitical zones, it has now remained the major important part of the diet of most households' across various parts of the country.[2,3] An average Nigerian consumes about 24.8 kg per annum,[1] this is a clear indication that rice has a higher percentage of total calorie intake per person. This has now made the crop to be a topical mater in the political discussions about food security in the country.[1] However, the national rice production level has fallen short of its demand leading to increased importation of the commodity through the porous land boarders. Nigeria has great capacity and potential to produce enough rice in both the dry and rainy

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seasons production systems. It is well known that the estimated cultivable land size in Nigeria is about 82 million hectares, with estimated size of 4.6 million hectares that is being utilized for paddy rice cultivation. Similarly, only 50,000 hectares were being for irrigation out of the 3.14 million hectares of irrigable land suitable for rice irrigation.[4] Rice production is mostly dominated by smallholder farmers in Nigeria who are cultivating small hectares of farm land using rudimentary and the traditional systems and methods of farming techniques; crop yields are very low per hectare and hence creating a wider gap of demand and supply.[1] The production and consumption of rice globally, over the last decade, has grown at an average rate of 1% and 1.2% per annum, respectively, approaching up to 486.7 million tonnes and 481.64 million tonnes, respectively, in 2017.[5] In comparison with Africa the consumption growth rate on averaged is 4.8% annually within the last past decade, it has now overtaken the joint global consumption of rice growth rate, Nigeria with Egypt taking the lead which accounts for about 30% of the growth.[5] The quantity of rice demand has been on increase at a high rate in Nigeria more than any other member of African countries due to increase in population growth.[6] The level of growth recorded in rice production over the years in Nigeria has been achieved due to an increase in the area of land under cultivation for rice. The size of land area which is under rice production has expand from 2.4 million hectares that was harvested in 2010–3.2 million hectares harvested in 2017.[5] In spite of all this improvement in agriculture, the crop yield remained at the same level of 2 tonnes per hectare, which is just half of the average output obtained in Asia.[1] The total quantity of rice consumption in Nigeria is about 6.9 million MT, there is a decline of 5% due to high prices amid the dwindling purchasing power of the consumers.[7]

Efficiency refers to the act of achieving a good result with little waste of effort. Cost efficiency is a ratio of minimum production costs that allows the level of inefficiency to the actual total cost.[8] Certain inefficiencies exist in agriculture but it is not possible to ignore the functions that agriculture plays in alleviating poverty and food security, development that is taking place in agriculture helps in rising farm productivity and it is playing a major role in the battle against rural poverty and hunger.[8] There is a wide gap in yields which indicates that there is need for improvement in rice productivity in Nigeria, currently Nigerian government has failed to make provision to meet the demand of cereals food requirement, this has been linked to the failure of the production systems to meet up and keep pace with the population growth, low rainfall, drought, climate variability, declining soil fertility combined with small farm land holdings, high prices of inputs, and policy inconsistency and summersaults. A very important question that needs to be answered is how cost efficient are farmers in rice production in the study area, it is very important to investigate how cost efficient are farmers in rice production and also identify the factors that affects the level of inefficiency.

Several research studies have been carried out to assess rice farmers' efficiency in Nigeria and outside Nigeria concentrating on measuring only technical efficiency.[1,2,9-12] There is need to fill the gap in literature regarding cost efficiency in rice production which has not been well investigated in the study area. The findings of this research study would provide information to guide policy makers to formulate policies that will improve nations food production as well as food security. Hence, this study was carried out to achieve the following specific objectives.

Objectives of the Study

The objectives are as follows:

1. Determine socio-economic characteristics profiles of rice farmers
2. Analyze costs and returns of rice production
3. Evaluate factors influencing cost efficiency of rice production, and
4. Determine the constraints faced by rice producers in the study area.

MATERIALS AND METHODS

The Study Area

This study was carried out in Federal Capital Territory, Nigeria. The Federal Capital Territory, is the Capital City of Nigeria which came into being with the promulgation of Decree No 6 of 1976. It is located between Latitudes 8.25' and 9.20' North of the equator and Longitudes 6.45' and 7.39' of the Greenwich Meridian. The fast-growing city which falls within the middle-belt region of the country, is surrounded by the following States; Niger to the West and North, Nasarawa to the East and South, Kogi to the West and Kaduna to the North-east. The FCT was created with four Area councils namely: Gwagwalada, Abaji, Kuje, Municipal Area Councils respectively.[13] On October 1, 1996, two more new area Councils Kwali and Bwari, were created to bring the total number of area councils in the Federal Capital Territory to six.[13] The major crops grown in the area are sorghum, cowpea, watermelon, maize, and rice among others. Federal Capital Territory has an estimated population of 3,653,000.[14]

Sampling Techniques and Sample Size

A multistage sampling technique was adopted for this study. In the first stage purposive sampling procedure was used to select Federal Capital Territory based of the numerous number and concentration of rice producers in the area. The second stage involved random selection of three area Councils Kuje, Gwagwalada and Bwari area Councils using ballot box method. In the third stage three villages were selected randomly from each area council based on the intensity of rice farmers. In the fourth stage simple random sampling technique was used in each village to select the desired sample size of 150 farmers.

Methods of Data Collection

The data for this study were collected through the use of well-designed structured questionnaire, the data collected were cross sectional data from primary source, and the data collected from the rice farmers were socio-economic profiles of the farmers, prices of production inputs, quantity of inputs used and constraints faced by farmers in the course of rice production in the study area.

Methods of Data Analysis

This involves the use of the following tools of analysis.

Descriptive Statistics

This involves the use of minimum, maximum, standard deviation, mean, range, percentages, and frequency distributions to summarize the socio-economics characteristics of rice farmers this was used to achieve the specific objective one (i) and pat of specific objective (iv).

Farm Budgetary Technique

The farm budgetary techniques adopted to determine the profitability, costs and returns of water melon production in the study area was Gross Margin Analysis (GM) and it is defined as the difference between the gross farm income and the total variable cost incur (TVC). This was used to achieve the specific objective two (ii). The Gross Margin Model is stated thus:

$$GM = TR - TVC \tag{1}$$

$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} P_j X_j \tag{2}$$

Where,
P_i = Price of Rice (N)
Q_i = Quantity of Rice Produced (Kg),
P_j = Price of Variable Inputs (N)
X_j = Quantity of Variable Inputs (Units),
TR = Total Revenue obtained from Sales from Rice (N),
TVC = Total Variable Cost (N).

Financial Analysis

This analytical tool was used to determine the ratios to show the profitability of rice production. The financial analysis was used to achieve part of specific objective two (ii). Gross Margin Ratio according to[15] is defined as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Tevenue} \tag{3}$$

The operating ratio (OR) according to[16] is defined as:

$$Operating\ Ratio = \frac{TVC}{GI} \tag{4}$$

Where,
TVC = Total Variable Cost (Naira),
GI = Gross Income (Naira),

According to Olukosi and Erhabor[16] an operating ratio of <1 implies that the gross income from water melon production enterprise was able to pay for the cost of the variable inputs used in the production enterprise.

The rate of return per naira invested (RORI) in rice production by farmers is defined as:

$$RORI = \frac{NI}{TC} \tag{5}$$

Where,
RORI = Rate of Return per Naira Invested (Unit),
NI = Net Income (Naira),
TC = Total Cost (Naira).

Stochastic Cost Frontier Method

Stochastic cost frontier function is stated thus

$$C_i = f\left(P_i, Y_i; \beta_j\right) + \left(V_i + U_i\right); i = 1,2,\ldots,n \tag{6}$$

$$lnC_i = \beta_0 + \beta_q lnY_i + \sum_{j}^{k} \beta_j ln\left(P_{ij}\right) + V_i + U_i \tag{7}$$

where, Ci is total cost of production Y_i is total output, X_{ij} are input quantities, and the P_{ij} are input prices. V_i assumed to be independently distributed random errors. The Cost efficiency of individual farmers is defined in terms of the ratio of the predicted minimum cost C_i^* to observed cost C_i that is

$$CE = \frac{C^*}{C_i} \tag{8}$$

The explicit form of the stochastic cost frontier function is specified as shown below as used by.[1,8,17,18]

$$L_n C_i = \beta_0 + \beta_1 L_n Y_1 + \beta_2 L_n X_2 + \beta_3 L_n X_3 + \beta_4 L_n X_4 + \beta_5 L_n X_5 + V_i + U_i \tag{9}$$

LnC_i = Total Cost of Rice Production
$L_n Y_1$ = Output of Rice (Kg)

X_2 = Cost of Seed Input (Kg)
X_3 = Cost of Fertilizer (Kg)
X_4 = Cost of Chemical Input (Liters)
X_5 = Cost of Labor Input (Man-days)

The Cost Inefficiency Component of the Stochastic Cost Frontier Model is stated thus:

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + ... + \alpha_{10} Z_{10} \quad (10)$$

Where,
U_i = Cost Inefficiency Component
Z_1 = Age of Farmers (Years)
Z_2 = Marital Status
Z_3 = Farm Size (Hectare)
Z_4 = Education Level of Farmers (Years Spent Schooling)
Z_5 = Farming Experience (Years)
Z_6 = Non-farm Income (N)
Z_7 = Access to Credit (N)
Z_8 = Household Size (Number)
Z_9 = Cooperative Membership (1, Yes: 0, No)
Z_{10} = Extension Contact (Number of Contact per Month)
α_0 = Constant Term
$\alpha_1 - \alpha_6$ = Regression Coefficients
V_i = Random Noise

This was used to achieve specific objective (iii).

Principal Component Analysis

Constraints faced by small-scale rice farmers were subjected to factor analysis, principal component method, using the extraction method. This was used to achieve specific objective (iv).

RESULTS AND DISCUSSION

Socio-Economic Characteristics or Profiles of Rice Farmers in the Study Area

Table 1 presents the results of the analysis of the socioeconomic profiles of the sampled rice producers, the results show that majority 88.7% of the sample rice producers were male while 11.3% were female rice farmers this indicates that rice production is dominated by male farmers in the study area, the study also show that the average age of the sampled rice producers is 44 years, about 40.7% of the farmers fall within the age range of 41–50 years which revealed that the sampled rice producers were young farmers and energetic and still in their productive age, young farmers have the ability to avert risk and adopt new innovation and technology which may lead to increase in production level, this finding is consistent with[8] who reported that younger farmers embraces new technology more rapidly than older farmers. Furthermore, the study shows that about 72.7% of the sampled respondents were married

Table 1: Results of the socio-economic profiles of rice farmers in the study area

Variables	Frequency (%)	Mean value
Gender		
Male	133 (88.7)	
Female	17 (11.3)	
Age (years)		43.72
>20	5 (3.3)	
21–30	14 (9.3)	
31–40	38 (25.3)	
41–50	61 (40.7)	
51 and above	32 (21.3)	
Marital status		
Married	109 (72.7)	
Single	28 (18.7)	
Widowed	5 (3.3)	
Widower	5 (3.3)	
Divorced	3 (2.0)	
Education level		
Primary school	35 (23.3)	
Secondary school	20 (13.3)	
Tertiary institution	20 (13.3)	
No formal education	75 (50.0)	
Household size (units)		6.03
1–5	78 (52.0)	
6–10	59 (39.3)	
11–15	8 (5.3)	
16 and above	5 (3.3)	
Farming experience (years)		7.05
1–5	87 (58.0)	
6–10	34 (22.7)	
11–15	15 (10.0)	
16–20	10 (6.7)	
21 and above	4 (2.7)	
Cooperative memberships		
No	131 (87.3)	
Yes	19 (12.7)	
Access to capital		
Yes	13 (8.7)	
No	137 (91.3)	
Nonfarm income (naira)		
None	80 (53.3)	
50,000	13 (8.7)	
51–100,000	32 (21.3)	

(*Contd...*)

Table 1: (*Continued*)

Variables	Frequency (%)	Mean value
101–150,000	16 (10.7)	
151,000–200,000	5 (3.3)	
201,000 and above	4 (2.7)	
Extension contact (number)		
No	51 (34.0)	
Yes	99 (66.0)	
Farm size (hectares)		2.58
1–2	101 (67.3)	
3–4	31 (20.7)	
5–6	10 (6.7)	
7 and above	8 (5.3)	
Method of land acquisition		
Inheritance	85 (56.7)	
Purchase	11 (7.3)	
Gift	40 (26.7)	
Hired	14 (9.3)	
Total	150 (100)	

Field survey data, (2022)

indicating that the sampled respondents had labor supply for the rice production. Also the revealed that 23.3% of the sampled rice producers attained primary school level of education while 13.3% had attained secondary and tertiary level of education. About 50% of the sampled farmers had no formal education, the study indicated the farmers some of the farmers were literate, education level of farmer could help them to access information and also will make them to acquire the knowledge of how to use production inputs accurately and also adopt new technology easily this is in line[2] who reported that education level of a farmer has an implication on the performance of the respondents in terms of rice production. The average household size of the sampled rice producers were 6 persons per household implying that the farmers had supply for rice production in the study area, about 52% of the farmers had 1–5 members per household while 39% had had 6–10 members per household. Majority 58% of the sampled rice producers had 1–5 years farming experience with an average age of 7 years of rice farming experience in the study area, farming experience makes farmers to acquire more knowledge about the farming system as a result of constant practice which was accumulated over time. This study also depicts that majority 87.3% of the sampled rice producers were not members of any cooperative organization, being a member of cooperative organization can enable the farmers to pool their resources together and sale their product in bulk which could earn them more money than selling as an individual farmer. Majority (91.3%) of the sampled rice producers does not have access to credit facilities, only 85 of the sampled farmers could access credit facilities indicating that most of the farmers could not access credit facilities to expand their farm size and acquire more inputs. Most of the rice producers had no other sources of income, about 53.3% of the farmers had no any form of non-farm income. About 66% of the rice farmers had access to extension services, contact with extension officers enables the farmers to benefit from the training they offer to farmers and it could also make them to have access to improved seed varieties, learn more about the application of fertilizer and the usage of other chemicals like herbicides and insecticides properly, it can also make them to access to price information. The average farm size under cultivation by the rice farmers in the study area is 3 ha indicating that the rice producers are small holder farmers operating on the small scale basis in the study area. This is in line with.[19] Majority (56.7%) of the rice producers acquired their farm land through inheritance while 26.7% were through gift.

Costs and Returns of Rice Production in the Study Area

Table 2 shows the analysis of costs and returns of rice production by sampled rice producers in the study area, the results revealed that the average cost of seed per ha was N 15,317 which carries 11.9% proportion the TVC of production, fertilizer costs N 21,414/ha which carries 16.6% proportion while the cost of chemical incur was N 14,308.73, the cost of labor expended by the rice farmers was N 58.663.80, and labor carries the largest proportion of the TVC carrying 45.6%. The TVC incur was N 128,703.53/ha, fixed cost was considered negligible on the short-run while the revenue realized was N 238,372.00/ha, the gross margin obtained was N 109.608.47/ha with the gross margin ratio of 0.46 with operating ratio of 0.54 and the rate of return on investment of 0.85 indicating that everyone naira invested in rice production 85 kobo was obtained which covers profits, taxes, commissions, and cost of production. This study revealed that rice production is a profitable enterprise in the study area.

Factors Influencing Cost Efficiency of Rice Production

Table 3 presents the results of the maximum likelihood estimates of the stochastic cost frontier function of rice produces in the study area using the cobb Douglass production function. The estimated gamma parameter 0.131 is significant at ($P < 0.01$) implying that 13.1% of variation in the total cost of rice production among the sampled rice producers was due to the differences in their cost efficiencies thereby indicating the presence of cost inefficiency. This finding is consistent with Abdul *et al*.[19] who reported similar results. The results further revealed that the cost of seed influences the total cost of rice production positively but it was not statistically significant in the study area. The cost of fertilizer influences the total cost of rice production positively ant it was statistically significant at ($P < 0.01$). The coefficient of fertilizer (0.4156) implies that

Table 2: Financial analysis, costs and returns, profitability of rice production per hectare in the study area

Variable cost items	Average value (n)/ha	Proportion	Percentage
A. Variable cost			
Cost of seed	15,317.00	0.119	11.9
Cost of fertilizer	21,414.00	0.166	16.6
Cost of chemical	14,308.73	0.111	11.1
Cost of labor	58,663.80	0.456	45.6
Transportation	10,000.00	0.078	7.8
Taxes and commission	4,000.00	0.031	3.1
Loading/ offloading	5,000.00	0.039	3.88
B. Total variable cost	128,703.53		
C. Total revenue	238,372.00		
D. GM	109,668.47		
Net farm income	109668.47		
GM ratio	0.46		
Operating ratio	0.54		
Rate of return on investment	0.85	1	100

Field survey data, (2022). GM: Gross margin

percentage change in the quantity of fertilizer applied to the rice farm will result in the increase in the total cost of rice production by 41.56%. Furthermore, the cost labor influences the total cost of production positively, the coefficient of labor (0.22) signifies that a percentage increase in the cost of labor will result in 22% increase in the total cost of rice production in the study area, and it was statistically significant at ($P < 0.05$) probability level, this is in line with Antriyandarti[20] who reported that any increase in the cost of these variables will result in the increase in the total cost of production. The cost of chemical influence the total cost production positively, the coefficient of chemical 0.2396 implies that a percentage change in the chemical as a result of more usage results in 24% increase in the total cost of rice production among farmers in the study area and it was statistically significant at ($P < 0.05$) probability level. This finding is consisting with finding of Sadiq *et al*.[21] which indicated that any increase in the cost of variables results in the increase in the total cost of rice production. Total output of rice influences the total cost of rice production positively and was statistically significant at ($P < 0.05$) probability level. This implies that as the total output increases the total cost of rice production also increases. A percentage change in total output will lead to 35% increase in the total cost of rice production in the study area. This result is in line with.[8,10]

The cost inefficiency component revealed that out of ten variables the were included in the specified model 8 variables were statistically significant that has an influence on the cost efficiency among rice producers in the study area the signs of the coefficients indicates either decrease or increase in the cost efficiency level. The negative sign implies decrease in the cost inefficiency while positive sign implies decrease in the cost efficiency level. Age of the farmer influences the cost efficiency positively and it was statistically significant at ($P < 0.01$) probability level. The positive sign implies that a unit change in the age of farmer will result in the increase in the cost inefficiency level by 2.1%, this could be because the older farmer has less possibility of accepting modern approaches and adoption of technologies, young farmers are more cost efficient than old farmers because they are more knowledgeable. This is in in line with.[8] Marital status influences cost efficiency positively implying marital status increases cost inefficiency and it was statistically significant at ($P < 0.05$). Years schooling influences cost efficiency negatively and it was statistically significant at ($P < 0.05$) implying that a unit increase in the number of years spent in school will lead to decrease in the cost inefficiency by 5.5% meaning that the level of education of a farmer helps in allocating cost to farm inputs and as a result it may lead to increase in the cost efficiency level in rice production due to their technical know-how. This in line with Abdul *et al*.[19] who reported that as farmers acquire more education the better the cost allocation in efficiency of crop production. Farming experience influences cost efficiency negatively and it was statistically significant at ($P < 0.01$), the coefficient of farming experience (0.20) implies that a unit increase in the farming experience of a farmer will results in 20% increase in cost efficiency among rice producers as farmers accumulate experience over the years they will be able to purchase their inputs accordingly and avoid waste of resources that could lead to increase in cost of production and decrease profit and efficiency level. Non-farm income influences cost efficiency in rice production negatively and it was statistically significant a ($P < 0.10$) probability level, farmers income will help them to quire inputs at appropriate time and also makes them not to borrow fund at high interest rate which could increase the cost of production thereby increasing cost efficiency in rice production among farmers. Household size influences cost efficiency positively and it was statistically significant at ($P < 0.01$) probability level, the positive sign signifies that a unit increase in the number persons per household will result in the increase in the cost inefficiency this could be as a result of too many members per family that require more attention, payment of student school fees, hospital bills, and other family needs that may divert the fund from been used for rice production, large family members but not providing labor for farm operation this is contrary with[21] who found that a unit increase in the number of person in a household results in the decrease in cost inefficiency. Cooperative membership influences

Table 3: Maximum likelihood estimates of the stochastic cost frontier function of rice farmers in the study area

Variables	Parameter	Coefficient	SE	Z
Stochastic frontier				
Constant	P0	−0.6129849	0.7078342	−0.87
Cost of seed	P1	0.0156258	0.1388485	0.11
Cost of fertilizer	P2	0.4156944*	0.1004259	4.14
Cost of labor	P3	0.2225042**	0.1077518	2.06
Cost of chemical	P4	0.2395997*	0.0998848	2.40
Total output	P5	0.3541996**	0.1458523	2.43
Cost inefficiency model				
Age	Z1	0.0729009*	0.0215354	3.65
Farm size	Z2	−0.2200428	0.1913996	−1.15
Marital status	Z3	0.4135806*	0.1922583	2.15
Years schooling	Z4	−0.0549272**	0.0265527	−2.07
Farming experience	Z5	−0.2023651*	0.0295475	−6.48
Non-income	Z6	−0.2486688*	0.1293165	−1.92
Access to credit	Z7	−0.3849409	0.3194764	−1.20
Household size	Z8	0.3788836*	0.0297602	12.72
Cooperative membership	Z9	−0.5937275**	0.2377541	−2.49
Extension contact	Z10	−1.986563*	0.3794362	−5.24
Sigma^2	σ^2	−2.305711		
Gamma	γ	0.131385		
Log likelihood		−29.804738		
Number of observation	*n*	150		

*Significant $P<0.01$, **Significant $P<0.05$***, Significant $P<0.10$. Field survey data, (2022). SE: Standard error

cost efficiency of rice production negatively implying that cooperative membership decreases cost inefficiency (increases cost efficiency), cooperative membership makes farmers to have access to farm inputs at a low cost because they may purchase the inputs in bulk, a unit change in the coefficient of cooperative membership will results in 59% increase in cost efficiency among rice farmers in the study area. Extension contact also increases cost efficiency negatively and it was statistically significant at ($P < 0.01$) probability level, the coefficient of extension contact (–1.986) implies that a unit increase in the number of contact with the extension officer for extension services will results in 1.99% increase in the cost efficiency, this may occur as a result of advices that the extension officers may offer to the farmers on how to utilize input such as fertilizer, chemical and seed such that they will not over utilize their resources and as a result it may reduce cost of purchasing input among farmers in the study area. This is in agreement with the findings of Rahaman.[8]

Distribution of Cost Efficiency Score Level among Rice Producers

Table 4 depicts the cost efficiency level distribution of rice producers in the study area, about 10% of the sampled

Table 4: Distribution of cost efficiency score among rice farmers in the study area

Cost efficiency score	Frequency (%)
0–0.2	15 (10.00)
0.21–0.4	11 (7.33)
0.41–0.6	11 (7.33)
0.61–0.8	13 (8.67)
0.81–1.0	100 (66.67)
Minimum	0.016865
Maximum	0.998749
Mean CE	0.861582

Field survey data, (2022). CE: Cost Efficiency

respondents fall within the cost efficiency level of 0–0.2 while 7.33% of the sampled farmers attained 0.21–0.4 and 0.41–0.6 cost efficiency level, respectively, about 8.67% attained 0.61–0.8 cost efficiency, majority 66.67% fall within the ranges of 0.81–1.0 level of cost efficiency with the minimum and maximum cost efficiency level of 0.016865 and 0.998749, respectively, and average cost efficiency of 0.861582 implying that on average rice farmers were able to attain 86% efficiency level of cost saving in rice production, there is an

Table 5: Results of the principal components for constraints faced by rice farmers in the study area

Constraints	Eigen-value	Difference	Proportion	Cumulative
Lack of improve seed	1.93249	0.372621	0.1757	0.1757
Transportation	1.55987	0.279285	0.1418	0.3175
Poor storage facilities	1.28059	0.251408	0.1164	0.4339
Inadequate capital	1.02918	0.042846	0.0936	0.5275
Bartlett test of sphericity	86.885			
KMO	0.5686			
Rho	1.000			

Field Survey Data, (2022). KMO: Keiser-Meyer-Olken

inefficiency gap of 14% that need to be filled with existing technology among the rice producers in the study area. This is in consonance with.[8,11,22]

Principal Component Analysis of the Constraints Faced Rice Producers in the Study Area

Table 5 shows the results of the principal components analysis of constraints faced by rice producers in the study area, PCA is a statistical technique that transform interrelated data with many variables into few number of uncorrelated variables. From the results the number of principal components retained using the Kaiser–Meyer criterion were four (4 based on the Eigen values >1. The retained components explained about 53% of the variation of the components included in the model analyzed. The Kaiser-Meyer-Olkin measures of sampling adequacy (KMO) of 0.57 and Bartlett test of sphericity of 86.885 and was statistically significant at 1% probability level which demonstrated that the variables were feasible for principal component analysis. Lack of improved seed and transportation had an Eigen value of 1.93249 and 1.55987 and it was ranked 1st and 2nd in the order of importance based on perception of the rice farmers. Poor storage facilities and inadequate capital with Eigen values of 1.28059 and 1.02918 and were ranked 3rd and 4th, respectively, in the order of occurrence based on the perception of the farmers. This is in line with.[23] This result is also in line with Kumar *et al*.[24] who reported similar crop production challenges faced by farmers in their study area.

CONCLUSION

The findings from this study show that rice production is profitable in the study area, the rice producers are in their youthful age of productivity and they are still energetic, rice production is dominated by male farmers, the farmers are small-scale farmers with an average farm size of 3 hectares of farm land. The TVC incurred was N 128,703.53/ha, fixed cost was considered negligible on the short-run, while the revenue realized was N 238,372.00/ha, the gross margin obtained was N109,608.47/ha with the gross margin ratio of 0.46, operating ratio of 0.54 and the rate of return on investment of 0.85 indicating that everyone naira invested in rice production 85 kobo was obtained which covers profits, taxes, commissions and cost of production. This study revealed that rice production is a profitable enterprise in the study area. The statistically significant factors influencing total cost of rice production in the study area were: cost of fertilizer, cost of labor, cost of chemical, and total output while the statistically significant factors influencing cost inefficiency were age of the farmer, marital status, years schooling, farming experience, non-farm income, household size, cooperative membership, and extension contact. Rice farmers were faced with the following production constraints lack of improved seed varieties, transportation, poor storage facilities and inadequate capital, the following recommendations were made:

1. Farmers should be provided with farm inputs like fertilizers, improved seeds varieties, and agro chemicals at a subsidized price in order to improve productivity and cost efficiency among rice producers
2. Credit facilities should be provided to rice farmers at lower interest rate to be able to purchase farm inputs in time to enhance their cost efficiency
3. Farm tractors, equipment, implements and irrigation facilities should be provided by government to rice farmers to supplement labor drudgery and encourage mechanized farming
4. Government should construct good roads and infrastructural facilities such as milling machines, storage facilities, and destoning machine should be provided to farmers
5. Extension services should be made available to farmers in the form of programs to teach them about the application of farm inputs appropriately and they should also be encouraged to join cooperative membership to have access to resources easily.

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