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Original Research Article

Profit Efficiency of Rice Production in Onicha Local Government Area, Ebonyi State, Nigeria

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Abstract

The study examined the profit efficiency of rice production in Onicha Local Government Area, Ebonyi State, Nigeria. Primary data were collected from a cross section of 120 farmers using a well-structured questionnaire. The objectives of the study were to describe the socioeconomic characteristics of respondents in the study area, estimate the profitability of rice production, determine the profit efficiency of rice production, analyze the factors affecting the profit efficiency and identify the constraints facing rice farmers in the study area. Descriptive statistics, Gross margin analysis and stochastic profit frontier technique were used to analyze the data collected. Majority of the respondents were female (41.8%), within the active age of 41-50 years, and married (75.5%). The budgetary analysis showed that the rate of return on investment was 0.28 and the benefit-cost ratio was 1.28 indicating that the enterprise was profitable. The result of the stochastic frontier analysis revealed that cost of purchase ($p<0.01$), fertilizer ($p<0.01$) and labour ($p<0.05$) were the significant factors influencing rice output in the study area. Inefficiency in rice production was found to increase with age ($p<0.10$), education ($p<0.05$), and farm size ($p<0.01$). The mean technical efficiency of 0.76 (76%) is an indication that available resources were not utilized optimally by the rice farmers in the study area. The study recommended that government at the state and local levels should engage the services of extension officers, and provide credit facilities to the rice farmers.

Keywords: Rice production, profit, efficiency, benefit-cost ratio

Introduction

Rice (*Oryza sativa*) is one of the major staple foods cultivated and consumed in the world, especially in Asia and Africa (Akerele *et al.*, 2018). It is one of the most consumed cereals in Nigeria, after wheat and it is widely consumed in one form or the other (Omoare, 2016). Rice belongs to the tribe *Oryzae*, sub family *Poacoideae* in the grass family *Poaceae* (Syn. Gramineae) and it is the largest single grain consumed in the whole wide world; 75% of it is

cultivated from countries of the Asian continent such as China, India and Indonesia (Mashal *et al.,* 2023). The genus consists of six species, while commercially, *Oryza sativa* Linn is the most important in world rice cultivation, followed by *Oryza glaberina* Steud which is the red-skinned species which is indigenous to West Africa (Akinwunmi *et al.,* 2013). According to Mba *et al.* (2021), in Africa, there is increase in the demand for rice consumption than in other places in the world.

Nigeria is one the largest producers of rice in Africa, and was the second largest producer of rice in West Africa as of 2017, producing 3.7million tonnes of milled rice annually behind Egypt and also of the largest importer of rice in the world (Seuh-Usman *et al*., 2023). Rice is produced in the middle belt, south east and in some far northern states of Nigeria (Audu, 2018). According to Mohammed *et al.* (2019), rice is very important based on the different ways it can be used. In terms of rice production in Nigeria, Ondo, Ekiti, Ogun, Ebonyi and Edo are prominent in the production of rice in the country. However, it is commercially cultivated in only about 11 States, namely: Ebonyi, Kaduna, Niger, Kano, Lagos, Kebbi, Cross-River, Enugu, Taraba, Borno, and Benue with small-holder farmers accounting for about 80% of the country's annual harvest (Aiyedun *et al.,* 2021). Data on the profit efficiency of the rice farmers in Ebonyi State are scanty. This study therefore aimed at analyzing the various indices of profit efficiency of rice production in Ebonyi State, Nigeria

The specific objectives of the study were to;

1. describe the socio-economic characteristics of the respondents in the study area;

2. estimate the profitability of rice production in the study area;

3. determine the profit efficiency of rice production in the study area;

4. analyze the factors affecting the profit efficiency of rice production in the study area;

5. identify the constraints facing rice farmers in the study area.

Methodology

The study area

The study was carried out in Onicha Local Government Area (LGA) of Ebonyi State of Nigeria. The LGA is made up of 5 autonomous communities, namely: Onicha Igboeze/Igboeze Onicha, Ukawu, Isuokoma, Abaomage and Oshiri. The local government is bounded in the east by Cross River State and Ikwo local government areas, in the north by Ezza North and in the west by Ohaozara and Afikpo North local government areas. It has a landmass of approximately 559.62 sq. km, and lies within latitude $6^0$10'N and longitude $7^0$46'E and $8^0$15'W (Ebonyi State Ministry of Land, Survey and Urban Planning, 2006). It has a population of 117,832 males and 118,777 females making a total of 236,609 (NPC, 2006). Residents of Onicha local government area are Igbo-speaking people with farming as their major occupation. The food crops produced in the area include yam, rice, vegetable, cocoyam, and cassava.

Sampling procedure and sampling size

A Multi-stage sampling technique was used to select towns, villages, and respondents. The first stage involved the purposive selection of Onicha Local Government Area (LGA) due to the

presence of a large number of rice farmers in the LGA. The second stage involved the random selection of three communities out of five autonomous communities in the state. The selected towns were Isu, Oshiri and Onicha. The third stage involves the random selection of four villages from each of the towns, which gave a total of twelve villages. Finally, a simple random technique was used to select 10 rice farmers from each of the four villages selected for the study making a total of 120 respondents for the study

Sources and method of data collection

Primary data were used for the study; a well-structured questionnaire and oral interview were used to obtain information from the selected rice farmers in the study areas. Data on the socio-economic characteristics of the respondents, cost and returns of rice farming and the constraints associated with rice farming in the study area were collected.

Data analytical technique

Descriptive statistics: descriptive statistics such as frequencies, percentages, means, standard deviation and charts were used to describe information on the socio-economic characteristics of the rice farmers as well as the constraints faced by the farmers in the study area.

Gross margin analysis: This was used to determine the cost and returns of rice farming in the study area. The gross margin (GM) was represented by:

$$GM = TR - TVC \quad (1)$$

Where;

TR = Total revenue
TVC = Total variable cost

$$BCR = (\text{Benefit cost ratio}) = TR/TC \quad (2)$$

Stochastic profit frontier technique: This was used to estimate the profit efficiency and determine the factors influencing the profit efficiency of rice production in the study area. The model was specified as follows:

$$Y = f(xi, \beta)evi - ui \quad (3)$$

Where Y is the dependent variable, f(x) is the functional form, β is the technical coefficient, vi is the random component which assumed to be identically and independently distributed with mean zero, and ui is the inefficiency effect of the firm. The estimated Cobb-Douglas stochastic frontier Production function was assumed to specify the technology of the farmers and is specified in the form:

$$\ln Y_{ij} = \beta 0 + \beta 1 \ln X1_{ij} + \beta 2 \ln X2_{ij} + \beta 3 \ln X\ 3_{ij} + \beta\ 4 \ln X\ 4_{ij} + \beta 5 \ln X5_{ij} + V_{ij} - U_{ij} \quad (4)$$

Where 'ln' represents logarithm to base e; subscripts ij refers to the jth observation of the farmer.

Y = Gross margin (₦)
X1 = price of seed (₦)
X2 = Cost of fertilizer (₦)
X3 = Cost of labour (₦)

X5 = Cost of transportation (₦)
X5 = Cost of pesticide (₦)

$$Uij = \delta 0 + \delta 1 \ln Z 1i + \delta 2 \ln Z2i + \delta 3 \ln Z3i + \delta 4 \ln Z4i \quad (5)$$

Where Uij represents the technical inefficiency of the farmer;

Z1 = Sex (dummy variable: male = 1 and female = 0)
Z2 = Age (years)
Z3 = Marital status
Z4 = Educational level measured in number of years spent in formal school
Z5 = Household size (number of persons)
Z6 = Rice production experience (years)
Z7 = Major occupation
Z8 = Farm size (ha)
z9 = membership of cooperative association
Z10 = Access to credit (dummy)

The maximum–likelihood estimates of the β and δ coefficients in equations (4) and (5) respectively were estimated simultaneously using the computer programmed frontier

Results and Discussion

Socio-economic characteristics of rice production farmers

The finding shows that 59.1% of the respondents were females while 40.9% were males (Table 1). This implies that female farmers were more involved in rice production than their male counterparts in the study area. This result agrees with the finding of Usman and Aliyu (2022) that males are more engaged in various economic and agricultural activities than their female counterparts. The result revealed that a high percentage (41.8%) of the farmers were within the age group of 41-50 years, with the mean of about 47years. This indicates that young adults were more actively involved in rice farming activities. Considering the age range of a majority of the farmers, their productivity is at its peak and hence is of great value to rice production.

The results also show that 74.5% of the farmers had either primary or secondary form of education. The result reveals that all of the respondents have had a form of education, with about 65% of them having western education. The rice farmers were therefore sufficiently educated, and knowledgeable enough to understand and adopt new technologies with minimal or no resistance. This result corroborates the reports of Zelda *et al.* (2022), who asserted in their study that level of education of an individual can enhance the rate of adoption of agricultural innovations, use of modern equipment, improve decision making on various aspects of farming, thus increasing the level of output in rice production and processing. It shows that about 5.5% of the respondents were single, 75.5% were married, 9.1% were divorced and 10% were widowed. The majority of the farmers were married, which agrees with the study carried out by Onumadu and Osahon (2014). The essence of marriage in most farming communities is to engage family members for labour and to carry out other farming activities. Married people have more responsibilities to provide the household needs, hence their active involvement in farming. The study revealed that family size in 72.2% of the respondents ranged from 1-5 persons. This implies that the farmers in the study area might have advantage as regards unpaid family labour

Table 1: Socio-economic Characteristics of Rice production Farmers in the Study Area N =110

Variable	Frequency	Percentage
Sex		
Male	45	40.9
Female	65	59.1
Age		
<30	31	28.2
31-40	46	41.8
41-50	27	24.5
> 50	6	5.5
Mean	**47.01**	
Educational Qualification		
No formal Education	8	7.3
Primary Education	38	34.5
Secondary Education	44	40.0
Adult/Vocational	16	14.5
Tertiary Education	4	3.6
Marital Status		
Single	6	5.5
Married	83	75.5
Divorced	10	9.1
Widowed	11	10.0
Household size		
< 5	80	72.7
6-10	26	23.6
> 10	4	3.0
Mean	**4.32**	
Production Experience		
<5	89	80.9
6-10	14	12.5
11-15	4	3.6
>15	3	2.7
Mean	**4.44**	
Religion		
Christianity	80	72.7
Islamic	3	2.7
Traditional	27	24.5

Source: Data from field survey 2023

availability since majority of the household had members that can participate in farm work. The availability of this unpaid labour reduces the cost of farm labour. The findings also revealed that a majority of the rice farmers (80.9%) had less than 5 years of farming experience. This implies that farmers with more farming experience are likely to be more versatile regarding the proper

timing of land preparation, planting, application of agrochemicals, harvesting and threshing also preservation of good seeds for the next farming season. This is not limited to only following the agronomic practices, but also with the right combination of inputs for a profitable farm venture. The majority (72.7%) of the respondents were Christians, 2.7% were Muslims, while 24.5% were Traditionalists, and this implies that the study area was dominated by Christians.

Rice management practices

The area of land cultivated by the farmers is very important. The size of land cultivated determines to a large extent the crop population on the farm and consequently the quantity of harvest. Table 2 reveals that majority of the farmers (90.9%) cultivated land sizes of 1-3 hectares while about 8.2% of the farmers cultivate land size that were greater than 3 hectares. This finding is corroborated by the work of Aminu *et al*. (2021) where it was reported that a majority of the Nigerian farmers operate at the small scale level. The majority (91.8 %) of the farmers were not members of any cooperative society, while only 8.2% were. Membership of associations has been found to enhance the interaction and cross-fertilization of ideas among people (Bamire *et al.*, 2002).

A majority (60.0%) of the respondents were traders, thus indicating that most of the respondents in the study area were fully engaged in off-farm activities. Dary and Kuunibe (2012) found that engagement in off-farms activities is widespread in Ghana.

Table 2: The Distribution by Management practices

Variable	Frequency	Percentage
Farm Size (Ha)		
<1	1	0.9
1.1-3	100	90.9
>3	9	8.2
Mean	**2.11**	
Member of Cooperative		
No	101	91.8
Yes	9	8. 2
Other Occupation		
Rice farming only	23	20.9
Self employed	18	16.4
Paid employment	3	2.9
Trading	66	60.0
Types of Labour		
Family	10	9.1
Hired	77	70.0
Both	23	20.9

Source: Field survey 2023

Similarly, Leliveld and Babatunde (2012) found similar results in Kwara State, Nigeria. Off-farm activities provide vital income diversification and access to cash at key moments especially in West Africa, where the risks of farming are high and rural savings, credit and insurance mechanisms are poorly developed or not available (Adewunmi *et al.* 2013). The type of labour used in the study area is mostly hired labour. This clearly indicate that a large amount of resources is invested on labour requirements. This finding is corroborated with the assertions of

Duvvuru and Motkuri (2013) that rice production is labour-intensive and relies on a significant usage of paid or hired labour in most cases.

Average costs and return to rice production in the study area

Table 3 shows the average cost and return of rice production in the study area. From the result, the total revenue (TR) was calculated to be ₦174,309.09, while the total cost (TC) was ₦136,102.93 which is a sum of the total variable cost and total fixed cost.

Table 3: Average Costs and Return to Rice Production in the Study Area

Cost items	Amount (₦)	% of TC
Variable costs		
Cost of rice	3,809.54	2.79
Transportation	1,310.91	96.32
Agrochemicals	13,417.16	9.86
Labour Cost		
Land preparation cost	55,640.91	40.88
Planting cost	10,054.55	7.39
Weeding	9,922.73	7.29
Harvesting cost	12,787.27	9.39
Threshing/winnowing cost	12,416.36	9.12
Bagging cost	1,416.36	1.04
Market charges	1,021.82	0.75
Maintenance cost	1,572.72	1.15
Total Labour Cost	**102, 238.18**	75.12
Total Variable Cost (TVC)	**123,370.33**	90.64
Fixed Costs (depreciated)		
Cost of land/rent	5,127.27	3.75
Sickle	850.88	0.36
Sprayers	2,224.92	1.63
Boots	1,209.55	0.88
Hand gloves	810.76	0.59
Pails/bowls	915.27	0.67
Knives	564.91	0.42
Cutlass	1,029.04	0.76
Total Fixed Cost (TFC)	**12,732.60**	9.36
Total Cost	**136,102.93**	
Returns		
Total Revenue (TR)	**174,309.09**	
Gross Margin (TR - TVC)	**50,938.76**	
Net Farm Income (GM - TFC)	**38,206.16**	
Return on Naira Spent (NFI/TC)	**0.28**	

Source: Field survey data, 2023

The total variable cost (TVC) is a sum of all the labour costs, cost of seeds, transportation and Agrochemicals, which were ₦102,238.18, ₦3,809.54, ₦96.32 and ₦13,417.16 respectively. The total fixed cost (TFC) was N12,732.60. The net farm income (NP) was calculated to be N38, 206.16 which means that on average a rice farmer in the study area earned a profit of ₦38,206.16. The benefit:cost ratio was calculated to be 0.28, which implies for every 100kobo in costs the farmer can expect a benefit of 28 kobo. This indicates that rice production is profitable in the study area. This is in line with Ben-chendo *et al.* (2015) who had a benefit-cost ratio of ₦1.77, and inferred that rice production was profitable in Onicha Local Government Area of

Ebonyi State. The total variable cost was calculated to be 90.64% of total cost. Total labor cost was 75.12% of the total costs. Most of the costs incurred were on labour, in line with Okam *et al.* (2016) who revealed that labour was the most used variable among the respondents in rice production. This situation is expected, since most of the rice farm operations including land clearing, levelling, planting, weeding, fertilizer application, spraying and harvesting which required the use of one form of manual labour or the other.

Profit efficiency of rice production in the study area

The maximum likelihood estimates for parameters of the stochastic frontier production model among the sampled rice farmers in the study area is presented in Table 4. The estimate of the sigma-square is significantly different from zero at five percent level, attesting to the goodness of fit of the model. The variance ratio (gamma) is estimated to be 0.744. This suggests that the systematic influences that are unexplained by the production function are dominant sources of error. That is, the profit efficiency effects are significant in the stochastic frontier model, and that the traditional production function with no efficiency effect is not an adequate procedure in this regard. The estimated Gamma of 0.744 implies that about 74% of the variation in the actual profit from maximum profit among rice farmers was due to the differences in farmers' cultural practices rather than random variable. The result shows that the coefficients of pesticide ($p<0.10$) and costs of market charges were negative and statistically significant at 10 and 1% levels of probability respectively. This implies that the gross margin of the rice farmers decreases with cost of pesticide and market charges in the study area. An increase in the costs of pesticide and market charges by ₦1 decreased gross margin by ₦1.818 and ₦2.691 respectively. However, the coefficients of costs of purchase ($p<0.01$), fertilizer ($p<0.01$), and labor ($p<0.05$) were found to have a positive significant relationship with gross margin in this study. This implies that an increase in the cost of purchase, fertilizer and labor, resulted in an increase in gross margin or output in the study area. This finding is agrees with Aminu *et al.* (2020) who reported that fertilizer input and labour had a positive significant relationship with agricultural output.

Table 4: Maximum Likelihood Estimate of Parameters of Cobb-Douglas Stochastic Frontier Profit Function Model for Rice Production in the Study Area

Variable	Parameters	Coefficient	T-ratio	Sig.
Profit model				
Constant	β0	9.320	2.658***	0.009
Cost of purchase (₦)	β1	6.899	3.849***	0.000
Transportation (₦)	β2	-0.123	-.019	0.985
Fertilizer (₦)	β3	2.320	3.167***	0.002
Labour (₦)	β4	2.644	2.499**	0.014
Pesticide (₦)	β5	-0.896	-1.818*	0.072
Market charges (₦)	β6	-6.652	-2.691***	0.008
Sigma square	σ2	0.561	2.44**	
Gamma	ɣ	0.744		

** Significant at 1%, ** significant at 5%, *** significant at 10%*

Factors affecting profit efficiency of rice production in the study area

The estimates of factors affecting profit efficiency of rice production are presented in Table 5. Since the parameters of the efficiency levels enter the production model as dependent variables,

a variable with a negative sign in the efficiency parameters means the corresponding variable reduces inefficiency and increases efficiency (Otieno *et al.,* 2012). The result in Table 5 indicates that three variables (age, education and farm size) had significant effects on profit efficiency at 10, 1 and 5 percent levels of significance respectively. Age ($p<0.10$) of the farmers was found to have a positive, but significant, relationship with profit inefficiency. This implies that profit inefficiency increased with age of the farmers in the study area; older farmers were therefore more inefficient compared to the younger farmers in the study area. However, education ($p<0.05$) and farm size ($p<0.01$) cultivated by the rice farmers were negative and significant. This implies that profit inefficiency in rice production decreased with education and farm size of the respondents. A year increase in education of the respondents would decrease profit inefficiency of the farmers by 2.187%. This conforms to *a priori* expectations and the findings of Oumaruo and Zhou (2016) and Djomo *et al.,* (2016) that technical inefficiency in rice production decreases with higher levels of education.

Table 5: Factors Affecting Profit Efficiency of Rice Production in the Study Area

Variable	Parameters	Coefficient	T-ratio	Sig.
(Constant)	δ0	-4.011	-1.846*	0.081
Sex	δ1	0.100	0.233	0.816
Age	δ2	0.148	1.885*	0.062
Education	δ3	-0.448	-2.187**	0.039
Total household size	δ4	0.610	0.582	0.562
Experience	δ5	2.130	0.789	0.432
Farm size	δ6	-8.894	-7.377***	0.000
Type of labour	δ7	-0.524	-0.267	0.790
Production system	δ8	0.438	0.347	0.729
Extension contact	δ9	-0.736	-0.968	0.335
Cooperative	δ10	0.562	0.256	0.798

Source: Field survey data, 2023

Frequency distribution of profit efficiency scores of rice production

From the result in Table 6, the profit efficiency of rice production in the study area ranged from 11% to 97%. Majority (55.5%) of the rice farmers were concentrated around 0.61 and 0.80 profit

Table 6: Frequency Distribution of Profit Efficiency of Rice Production in the study area

Efficiency Range %	Frequency	Percentage
≤0.2	4	3.6
0.21-0.40	9	8.2
0.41-0.60	15	13.6
0.61-0.80	61	55.5
>0.81	21	19.1
Minimum	0.11	
Maximum	0.97	
Mean	0.76	

Source: computed from Frontier 4.1 MLE/Survey data 2023

efficiency, 8.2% percent of the rice farmers achieved between 0.61and 0.80 profit efficiency, 13.6% percent between 0.41and 0.60 profit efficiency, while 19.1% achieved more than 0.8 profit efficiency level. The mean profit efficiency was 0.76. This implies that the rice farmers realized about 76 percent of the potential profit efficiency level, indicating that rice production was about 24% below the frontier. This also means that a significant proportion of the profit was lost due to inefficiency factors in the study area.

Constraints to rice production in the study area

Production credit facilitates and enables farmers to purchase the inputs needed and in adequate quantities. Production credit can be sourced from both formal and informal institutions. However, the inherent risks in agricultural production have been reported to affect the ability of farmers to obtain credit from formal institutions.

Table 7: Constraints Encountered on Rice Farming

Constraints	Frequency	Percentage
Inadequate capital	99	90.0
High cost of production	103	93.6
Labour shortage	55	50.0
Poor access to markets	33	30.0
High cost of fertilizer	73	66.4
Pest and disease attack	82	74.5
Availability/accessibility of water	35	31.8
Poor access to production credit	87	79.1
Poor pricing/variability in prices of rice	89	80.9
Poor road network/poor access road	69	62.7
Low productivity	48	43.6
Inadequate post-harvest knowledge and handling	54	49.1
Inadequate storage facilities	77	70.0
Unavailability of irrigation facilities	73	66.4
Poor market information	56	50.9
Competition from imported brands	67	60.9
Unavailability of modern and affordable processing facilities	69	62.7
Climate change that affects crop production/output	68	61.8
Lack of favourable government policy	71	64.5
Lack of timely access to improved rice seed and other input	93	84.5

Source: Field survey data, 2023

About 84.5% of the farmers stated that they were constrained by lack of timely access to improved rice seeds and other inputs. The Federal Government through the Ministry of Agriculture provides seeds, fertilizers and other inputs to rice farmers to increase rice production. However, the late supply of these inputs hampers production and yield. This is because, to achieve optimum yield, planting and other production activities are carried out during specific periods. This is in line with the findings of Longtau (2013) that farmers in Ebonyi State are faced with the problem of late arrival of input for paddy production.

Conclusion and Recommendations

Rice production in Onicha LGA Ebonyi state is profitable.it is an important agricultural enterprise that should be encourage among farmers, considering the fact that it is a major staple. The promotion of rice production among farmers will increase availability and affordability of the grain, enhance income generation of farmers; and improve food security at the household and national level. The study also reveals that the age of farmers, household size, farm size and other characteristics influences the profit and marketing of rice production in the study area. Given the ecological features including climatic and soil conditions, Onicha LGA, has the potential of producing rice that could feed the whole nation especially when adequate attention in terms of necessary inputs are provided by the government. This study therefore recommends;

- Appropriate, timely and sustained policies that will address the problems of rice production to ensure sustained and large scale rice production in the study area.
- Regular visits by extension workers to rice farms in the study area in order to disseminate and educate farmers on new innovations and technologies for rice production and marketing, and to highlight the benefits of using improved variety of rice.
- Access to better credit facilities by farmers in order to enhance profitability of rice production in the study area.
- Access to improved varieties of rice seeds, fertilizers and capital at subsidized rates from government and non-governmental institutions.

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