Economics of rice production/processing (RP/P) enterprises in Ibaji, Kogi Eastern Senatorial district, Nigeria

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ABSTRACT

Background and Objective: There has been a steady increase in rice consumption among different categories of people in Nigeria. The closure of Nigeria's borders against rice importation has further strengthened home-based production, processing, and consumption. The study focused on rice production/processing (RP/P) in Ibaji, Kogi Eastern Senatorial district, Nigeria. The study described the socio-economic characteristics and activities of respondents, estimated their costs and returns, determined the effects of some selected variables on rice selling prices, and identified problems encountered in the enterprise.

Methodology: A multi-stage sampling technique was used to elicit primary data from 120 respondents with the aid of a well-structured questionnaire coupled with personal interviews. Data obtained were analyzed using descriptive statistics, gross margin analysis, and multiple regression analysis.

Main Results: The results showed that most respondents were female (75.00%), with a mean age of 36 years. Additionally, most were married (81.67%), with a mean household size of six members. Land clearing, planting, weeding, pesticide application, and fertilizer application activities were major planting activities, while major processing activities were parboiling, dehulling, winnowing, cleaning, and packaging. Furthermore, the results showed that respondents earned an average revenue of $323.5 per annum on rice production/processing. They incurred a total cost of $162.6 per annum on rice production/processing with an average gross profit of $166.8 per annum. Also, the study showed that transportation cost (0.53; $P < 0.01$), distance to market (0.55; $P < 0.05$), quality of produced/processed paddy rice (-1.41; $P < 0.01$), and processing cost (0.07; $P < 0.01$) with R-square value of 0.513 had significant effects on selling price of rice respectively. Moreover, inadequate credit facilities, shortage of processing facilities, high cost of processing, inadequate transportation infrastructure, and high cost of transportation were the problems faced by the respondents (ranging from 65.8–100%).

Conclusions: The enterprise was dominated by productive married women with profitable returns. Therefore, the generation of adequate capital is imperative for business expansion and the purchase of adequate processing, storage, and transport facilities.

Keywords: Rice, production, processing, price, profitability, problem

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INTRODUCTION

Rice *(Oryza sativa* L.*)* is one of the main staple foods for 70% of the population of the world (Dixon *et al*., 2001). It is an important annual crop in Nigeria and one of the major staples that can provide a nation's population with the required food security of 2,400 calories per person per day (FAO, 2005). Commercially, it is the most important cereal after wheat. It is widely consumed, and there is hardly any country in the world where it is not utilized in one form or the other. In Nigeria, rice is one of the few food items whose consumption has no cultural, religious, ethnic, or geographical boundary.

Rice has become the most important staple food and the most common cereal food crop in Nigeria (Ukwuru *et al.,* 2018). It is the fastest-growing commodity in Nigeria's food basket (Akande, 2003), with an annual consumption growing rate (Tiamiyu *et al.,* 2014). Rice is a staple food for more than half of the world's population, and in Asia alone, more than 2,000 million people obtain 60–70% of their calories from rice and its products (Hossain and Narciso, 2004). Rice cultivation is the principal activity and source of income for millions of households around the globe, and several countries in Asia and Africa are highly dependent on rice as a source of foreign exchange earnings and government revenue.

Despite the increase in rice production and importation, the government has always proposed serious attention in the area of primary production, that is, raising the domestic output of rice. Rice is one of the most common and important grains consumed in almost every household today in Nigeria. Despite its importance, the marketable surplus has not been able to meet up with the increasing demand as a result of the increasing population. In agriculture as a whole, marketing surplus plays a very vital role in determining the amount of rice that is available in the market for sale (Garth *et al.,* 2016). Bamidele *et al*. (2010) reported that due to the contribution of rice to the percapitulatory consumption of Nigerians, the demand for rice has been increasing at a much faster rate than domestic production. Rahji and Adewumi (2008) estimated local rice farmers' output to be three million tonnes, while the demand by the populace summed up to five million tonnes.

In order to bridge the gap between supply and demand for rice in Nigeria, the government intervened by increasing import tariffs so that local production could be encouraged (Bamidele *et al*., 2010). However, Rahji and Adewumi (2008) reported that out of about 25 million hectares of land cultivated for various food crops, only about 6.37% was cultivated for rice. During this period, the average national yield was 1.47 t/ha. Generally, the price of rice determines the availability of the marketable surplus in the market. This is because the interest of every farmer is to be able to make sufficient profit from the sales of what they produce, supply, and market. The demand for rice is rising speedily at an estimated rate of 10% per annum (Kuku-Shittu and Pradesha, 2013), due to population growth and urbanization (Adejumo-Ayibiowu, 2010). Even though there is a growing demand for rice in Nigeria, a corresponding increase in supply is lacking, thereby leading to a persistent demand-supply gap.

In various attempts to provide information on rice production, processing, and marketing in Nigeria and to recommend appropriate solutions on how to improve the enterprise, many scholars (Afolami *et al.,* 2012; Ayanwale and Amusan, 2014) have carried out studies on aspects of the performance of rice marketing and production in the country. In the study area, farmers combine the production and processing of rice as an enterprise. Ibaji rice (a popular name for the rice cultivar) is one of the locally cultivated varieties with little or no stone content. The name Ibaji rice is given to show the geographical location where the rice is cultivated in the Eastern Senatorial district, Kogi State, Nigeria. Apart from Ibaji rice, there are other locally cultivated rice that derived their nomenclatures from the names of the locations where they are cultivated. For instance, Ofada rice is cultivated in Ofada, Ogun State, and Igbemo rice is cultivated in Igbemo Ekiti, Ekiti State. However, the actual variety of rice cultivated in Ibaji is FARO-44 (SIPPI), which is an improved rice variety. Rice farmers in Ibaji preferred this improved variety because of its early maturity within 120 days. The variety is known for high yield, stress-tolerant,

and resistant to blast disease with long and quality grain. The peculiarity of the rice enterprise in Ibaji is that the producers are the processors of their produce (rice paddy), unlike in other places where production and processing are treated as separate enterprises. Since the area is known for rice production and processing, which are operated as a single enterprise, there is a need to fill the existing gap, as against the previous empirical studies (Shaibu and Shaibu, 2017; Adisa *et al*., 2019). Rice activities were considered separately in terms of production, processing, and marketing. Therefore, this study analyzed the economics of rice production/processing in the study area. The study-specific objectives were meant to 1) describe the socio-economic characteristics of the respondents, 2) examine various activities performed by the respondents, 3) estimate the costs and returns of the respondents, 4) determine the effects of some selected variables on the selling price of rice, and 5) identify problems faced by the respondents in the study area.

MATERIALS AND METHODS

This study was conducted in Ibaji, Kogi Eastern Senatorial district, Nigeria. Ibaji is one of the Local Government Areas in Kogi Eastern Senatorial district, Nigeria. It is a popular area where FARO-44 (SIPPI) improved rice production/processing, which is predominantly a business venture among dwellers. The respondents were classified as small-scale farmers because most of the rice farmers in the area usually cultivate less than five hectares of land per cropping season. The area lies off the shores of the river Niger and occupies a total area of 1,377 km^2. The average temperature is 29 °C, with the area hosting a number of rivers and tributaries. The humidity level is at an average of 53%, while the total annual rainfall is estimated at 1,450 mm. The climate is affected by two major air masses, the tropical maritime air mass and tropical continental air mass, producing wet and dry season. The wet season, which lasts for a period of six months, usually begins around April and ends in October. About 70% of the rain in the area falls between July and September, with mean annual rainfall between 1,523 and 1,625 mm. The vegetation in the area is Guinea savanna, characterized by short grasses and trees that grow rapidly during the rainy season. The land is a very fertile floodplain, suitable for agriculture and fishing. No wonder fishing and rice production/processing are their preoccupations. They also engage in the production of other crops like yam, cassava, and others.

Sampling Procedure

The study population comprised all small-scale rice farmers in the Kogi Eastern Senatorial district. A multi-stage sampling technique was employed for the study. Primary data were collected from 120 rice farmers using a well-structured questionnaire and personal interviews. The questionnaire as an instrument for data collection was validated by three senior colleagues in this field of study, the reliability was ascertained using the test and re-test method, and the instrument was structured in line with the study objectives. The study was conducted between May 2021 and December 2021, considering the period between rice production and processing in the study area. The first stage entails the purposive selection of all farmers who produce and process rice on a small scale in the study area, which was due to a higher concentration of rice producers/processors. In stage two, three villages were randomly selected. Thirdly, 120 respondents were selected with respect to the number of registered rice producers/processors across the selected villages.

Data obtained were analyzed using descriptive statistics (mean/mode, frequency, and percentage) to describe the respondents' socio-economic characteristics and examine various activities performed by the respondents. Gross margin analysis was used to estimate the costs and returns of the respondents. In contrast, multiple regression analysis (linear, semi-log, double-log, and exponential functional forms) was used to determine the effects of some selected variables on the average selling price of rice.

Model Specification

Gross margin analysis

Gross margin analysis (GMA) is an analytical tool used to assess the financial performance of an enterprise. It estimates the costs and returns of single and combined enterprises in agribusiness and other financial activities. The study followed other authors such as Djokoto and Zigah (2021), Nkadimeng *et al.* (2021), and Yahaya *et al*. (2017) in estimating the costs incurred and returns that accrued to the respondents in this study. The model was specified as follows:

$$GM = TR - TVC \quad \text{-------- (1)}$$

$$\text{Profit } (\pi) = TR - TC \quad \text{-------- (2)}$$

$$TC = TFC + TVC \quad \text{---------(3)}$$

where GM is gross margin ($/ha), TR is total revenue ($/ha), TVC is total variable costs ($/ha), TC is total costs, and TFC is total fixed cost. The following profitability ratios were calculated:

$$\text{Benefit-cost ratio (BCR)} = TR/TC \quad \text{-----(4)}$$

Multiple Regression Analysis

Multiple regression analysis (MRA) is an analytical tool used for predicting the value of a variable whose value depends on other variables that can influence or affect it. The predictive variable or dependent variable (Y) in this study is the average selling price of rice. In contrast, the independent variables (Xs) whose effects were determined on the dependent variable were the transportation cost, distance to the market, quality of paddy rice, and cost of processing. The study employed the tool premise on other past empirical studies by Amah and Atuboyedia (2020), Isa *et al.* (2020), Bansal *et al*. (2021), and Musa *et al.* (2023). The MRA model was specified as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + e_1 \quad \text{-------(5)}$$

where Y is the average selling price of rice, X_1 is the transportation cost, X_2 is the distance to the market, X_3 is the quality of produced/processed rice paddy, X_4 is the processing cost, a is the intercept, $b_1 - b_4$ is coefficients to be estimated, e_1 is the error term. It is expected that the value of each of the variables, that is, $b_1 - b_4$, was positively related to the price of rice in the area.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

The results in Table 1 showed that the majority (75.00%) of the respondents were female. The involvement of many women in rice production/ processing could be linked to the fact that women engage more in food processing. In this area, the bulk of rice produced was directly processed by the producers, no wonder women were more involved in its production in the area. This finding agrees with Medagbe *et al*. (2020), who asserted the significant contribution of women in rice farming, processing, and marketing. in their study. The mean age of the respondents was 36 years. The respondents were young individuals who were still active and productive. They can undergo various activities from rice production until it get to the ultimate consumers. The result is in consonance with earlier studies by Girei and Onuk (2016) and Samarpitha *et al*. (2016), who reported that rice farmers are of productive age.

Moreover, most of the respondents (81.67%) were married, while others were single and widowed. This implies that the majority of the respondents were responsible. This will lead to increased productivity since their children could help in their production and processing activities, thus reducing the cost of labor and increasing productivity. This may also indicate that most of these rice farmers were mature persons who had access to the opinions and advice of their spouses in making rational decisions. The study agrees with the findings of Adam and Bidoli (2018), in which 63% of rice processors were married.

The results showed that 73.34% of the respondents were formally educated from primary to tertiary education. Farmers with high literacy levels tend to be more efficient in terms of food items production, processing, and marketing activities. This study is in agreement with the findings of Akarue and Ofoegbu (2012), and Danmaigoro

et al. (2023), who asserted that, generally, rice farmers are knowledgeable.

The mean household size is six persons. It implies that the respondents could engage some of their household members in rice production and processing activities. However, a large household size could lead to a huge proportion of income being spent on consumption, which may restrict farm business expansion and reduce the quantity of rice to be sold. The fact that farmers' propensity to commercialize their production declines with increasing numbers of household members was reported by Lapar *et al*. (2003).

The mean years of production/processing experience of the respondents was 22 years. This showed that most of the rice farmers in the study area had acquired the necessary experience and had been involved in the business for a long period, which enabled them to possess perfect information about the rice enterprise. This agrees with Samarpitha *et al*. (2016), who reported that the majority (66.99%) of the respondents in the study area had over ten years of experience in rice farming and processing. Experience plays a very important role in the performance of any enterprise. The higher the experience in an enterprise, the more informed and skillful entrepreneurs become.

The mean farm size of the respondents was 2.99 ha. The implication is that farmers in the area operated on a small scale. This finding agrees with that of Adamu and Bakari (2015), who reported that the majority of rice farmers in Taraba State, Nigeria, were smallholder farmers who cultivated less than five hectares with the consequence that rice farming operations were not mechanized. Randela *et al*. (2008) opined that increased market participation is a function of land productivity and that land size is an important resource needed to achieve optimum productivity.

The results in Table 1 also showed that the majority (95.00%) of the respondents inherited their farmland for rice cultivation. This implies that there is a limitation in their scope of expansion with respect to an area of land cultivated and the quantity of paddy rice produced, which may be due to excessive land fragmentation among family members. The results also showed that the majority (92.50%) of the respondents were members of cooperative societies. Their involvement in cooperative societies is one of the key determinants of marketing participation, as it gives farmers the opportunity for increased market power, which enables selling their produce at remunerative prices and satisfactory profit (Adenegan *et al*., 2013). Group/association membership also assists in getting relevant information on prices, price trends, and other market conditions (Adenegan *et al*., 2013).

Table 1 Socio-economic characteristics of respondents

Socio-economic characteristics	Frequency	Percentage	Mean/Mode
Sex			
Female	90	75.00	
Male	30	25.00	
Total	120	100.00	Female
Age (year)			
21–30	37	30.83	
31–40	47	39.17	
41–50	26	21.67	
51–60	10	8.33	
Total	120	100.00	36 years

Table 1 Cont.

Socio-economic characteristics	Frequency	Percentage	Mean/Mode
Marital status			
Single	18	15.00	
Married	98	81.67	
Widow	4	3.33	
Total	120	100.00	Married
Level of education			
No formal education	32	26.67	
Primary education	47	39.17	
Secondary education	39	32.50	
Tertiary education	2	1.67	
Total	120	100.00	Primary education
Household size (person)			
1–5	58	48.33	
6–10	45	37.50	
11–15	13	10.83	
16–20	4	3.33	
Total	120	100.00	6 persons
Production/processing experience (year)			
1–10	11	9.17	
11–20	38	31.67	
21–30	47	39.17	
31–40	24	20.00	
Total	120	100.00	22 years
Farm size (ha)			
0.5–1.5	9	7.50	
1.6–2.5	3	2.50	
2.6–3.5	86	71.67	
3.6–4.5	18	15.00	
Above 4.5	4	3.33	
Total	120	100.00	2.99 ha
Source of farmland			
Inherited	114	95.00	
Purchased	1	0.83	
Rent	5	4.17	
Total	120	100.00	Inherited
Cooperative society			
Non-member	9	7.50	
Members	111	92.50	
Total	120	100.00	Yes

Note: Data collected by field survey in 2021.

Activities Performed by the Respondents

The results in Table 2 showed that 98.3% of the respondents were engaged in land clearing and other production activities: planting (94.2%), weeding (92.5%), and fertilizer application (91.7%). This implies that rice farmers in the study area engaged in various rice production activities. The results agree with the findings of Zalkuwi (2019), who asserted that land clearing and land preparation were predominantly carried out by rice farmers on farms.

Also, the results showed that the following major processing activities were carried out by the respondents: packaging (100%), bagging (99.2%), winnowing (98.3%), parboiling (98.3%), dehulling (98.3%), cleaning (88.3%), and milling machine (70.8%). This study agrees with the findings of Adam and Bidoli (2018), who reported parboiling, winnowing, and other rice processing activities in their study on rice processing in Kebbi State.

Costs and Returns of Respondents

The results in Table 3 showed that the total variable cost (TVC) expended by respondents was $156.6 per annum, and the total revenue (TR) that accrued to the respondents was $323.5 per annum with a gross profit of $166.8 per annum. The results indicated a benefit-cost ratio (BCR) of 1.02, which implies that for every $1 invested in rice enterprises, $1.02 was realized. Thus, rice production/processing is a profitable enterprise in the area, as revealed in the study. No wonder many of the respondents have stayed long in the business for upward of 20 years in the area.

Table 2 Production and processing activities performed by the respondents

Activities	Frequency*	Percentage
Production activities		
Land clearing	118	98.3
Manuring	47	39.2
Fertilizer application	110	91.7
Weeding	111	92.5
Planting	113	94.2
Pesticide application	111	92.5
Processing activities		
Packaging	120	100.0
Dehulling	118	98.3
Picking	44	36.7
Winnowing	118	98.3
Bagging	119	99.2
Cleaning	106	88.3
Parboiling	118	98.3
Sorting	2	1.7
Destoning	44	36.7
Warehousing	45	37.5
Milling machine	85	70.8

Note: * Multiple responses. Data collected by field survey in 2021.

Table 3 Average costs and returns of rice enterprise among respondents

Items	Quantity	Unit	Unit price/Cost ($)	Total value ($)
Return				
Sales	3.89	Bag/50kg	83.2	323.5
A. Total return (TR)				323.5
Variable costs				
Production	LS	LS	LS	96.9
Processing	LS	LS	LS	49.8
Storage	LS	LS	LS	3.1
Transportation				3.0
Loading and offloading				1.3
Taxes and levies				1.1
B. Total variable costs (TVC)				156.6
C. Gross profit = A – B				166.8
Fixed costs				
Rents				3.4
Depreciation on fixed items				2.6
D. Total fixed costs (TFC)				6.0
E. Total cost (TC) = B + D				162.6
F. Operating profit = A – E				160.8
Benefit cost ratio (BCR)				1.02

Note: LS = least square. Data collected by field survey in 2021.

Effect of Some Selected Variables on the Selling Price of Rice

The results in Table 4 show the four functional forms of multiple regression analysis. The overall significance of the analysis was ascertained by the F-statistics as indicated in the table. From the results, the linear and exponential forms have the same number of significant variables and slight differences in their R-square values. However, the linear functional form has a higher R-square and was chosen for this study. The value of the R-square for the linear functional form was 0.513. This implies that the independent variables (transportation cost, distance to market, quality of processed paddy rice, and processing cost) in the model explained up to 51.31% of the variation in the selling price of rice. In comparison, the remaining 48.69% were embedded in the error term. Thus, these four variables were the determinants of the selling price of rice in the study area.

The coefficient of transportation cost (0.53) is significantly positive ($P < 0.01$). This suggests that transportation costs affected the selling price placed on the commodity by the respondents. The result implies that the selling price increases with an increase in transportation costs, which may be due to bad road networking, payment of revenue, and other illegal charges on the road. The result is supported by the findings of Uzonwanne *et al.* (2020), who revealed that owners and drivers of means of transportation in Anambra State, Nigeria, usually add illegal charges on the transport fare of foodstuff traders which increases selling prices of consumable items. The coefficient of distance to market (0.55) is significantly positive ($P < 0.05$). The implication of the result is that the selling price increases with respect to the distance covered before purchasing the inputs for production/ processing and conveying the commodity to the marketplace. Therefore, the longer the distance from

the farmgate/processing shed to the point of sale (the marketplace), the higher the selling price of rice. Also, the quality of paddy rice produced/ processed had a significantly negative coefficient (-1.41; $P < 0.05$). The implication is that the less the quality of paddy rice processed by the producers/processors, the lower the price buyers will be willing to pay for the commodity. Thus, the respondents would be forced to lower the selling price of rice. In addition, processing cost had a positive coefficient (0.07; $P < 0.01$). The implication is that the higher the cost incurred during rice paddy processing, the higher the selling price placed on the commodity by the producers/processors or vice versa. Since the enterprise is viable in the study area, there could be high numbers of people queueing up for the few available processing facilities, thus leading to a high cost of processing, which eventually translates to a high selling price on the part of the respondents. The respondents may need to increase the selling price in order to recover their production/processing costs and make an appreciable profit from their commodity.

Table 4 Regression analysis showing the effects of some selected variables on selling price of rice

Variable	Linear	Semi-log	Double-log	Exponential
Transportation cost	0.53 (P = 0.000)	17723.84 (P = 0.001)	0.254 (P = 0.000)	6.06e-06 (P = 0.000)
Distance to the market	0.55 (P = 0.011)	9813.43 (P = 0.073)	0.179 (P = 0.005)	8.94e-06 (P = 0.001)
Quality of produced/ processed paddy rice	-1.41 (P = 0.018)	-25330.17 (P = 0.002)	-0.282 (P = 0.002)	-0.000 (P = 0.042)
Processing cost	0.07 (P = 0.001)	52127.91 (P = 0.000)	0.617 (P = 0.000)	8.67e-07 (P = 0.001)
Constants	-1231.392 (P = 0.937)	-649925.3 (P = 0.000)	0.912 (P = 0.536)	-9.736 (P = 0.000)
Number of observations	120	120	120	120
F (4, 115)	30.30	18.25	23.57	30.27
Prob> F	0.000	0.000	0.000	0.000
R-square	0.513	0.388	0.451	0.513
Adjusted R-square	0.496	0.367	0.431	0.496

Note: Data collected by field survey in 2021.

Problems Faced by the Respondents

In Table 5, the major problems encountered by the respondents were inadequate credit facilities (100%), shortage of processing facilities (100%), which leads to low quantity of rice produced and lack of uniformity in price, high cost of processing (82.5%) and inadequate transportation infrastructure (68.3%), which leads to high cost of transportation (65.8%). Inadequate credit affected respondents' investment behaviors, productivity, and expansion of enterprise negatively, thus, their production and processing are on a small scale. These affirm the findings of Akarue and Ofoegbu (2012), who stated that the major problems limiting rice processing and marketing are inadequate capital, price fluctuation, and high transportation costs. Similarly, Zalkuwi (2019) also reported inadequate credit facilities as a vital problem for rice farmers in the study. Poor pricing (43.3%), poor packaging (43.3%), price fluctuation (35.0%), inconsistent government policies (35.0%), high cost of labor (20.0%), and inadequate buyers (15.8%) were the other problems in rice enterprise in the area. Nwali and Maureen (2019) further reported inadequate capital, price fluctuations, and poor road networking as limitations to rice farmers.

Therefore, the farmers should generate adequate capital for their business venture as a group to purchase adequate processing, storage, and transport facilities since their major means of livelihood are from rice enterprises. The government should also aid the enterprise expansion by constructing good road networking to ease movement in and out of the area. This would attract buyers across the country and, in the long run, lead to the expansion of rice production/processing enterprises in the area. It is not out of place if rice producers/processors in the area could be assisted both in cash or kind by governmental and non-governmental organizations in expanding the enterprise to enhance production, processing, and consumption of home-base rice as stipulated.

Table 5 Distribution of respondents according to problems faced during rice production/processing

Problems	Frequency (*)	Percentage
Inadequate credit facilities	120	100.0
Shortage of processing facilities	120	100.0
High cost of processing	99	82.5
Inadequate transportation infrastructure	82	68.3
High transportation cost	79	65.8
Poor prices	52	43.3
Poor packaging and measurements	52	43.3
Price fluctuation	42	35.0
Inconsistent government policies	42	35.0
High cost of labor	24	20.0
Inadequate buyers	19	15.8

Note: Data collected by field survey in 2021. * Multiple responses.

CONCLUSIONS

The study showed that the majority of the respondents were female farmers who processed the rice they produced. Rice production and processing were considered a single small-scale agribusiness in the area. The combination of the production/processing was a profitable enterprise in the area. The selling price of rice was determined by transportation cost, distance to the market, quality of paddy rice produced/processed, and processing cost. The problems encountered by the respondents include inadequate credit facilities, shortage of processing facilities, high cost of processing, inadequate transport facilities, and high transportation costs.

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