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ECONOMIC ANALYSIS OF SMALL-SCALE RICE PROCESSING IN GIWA LOCAL GOVERNMENT AREA OF KADUNA STATE

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ABSTRACT: This study presents an economic analysis of small-scale rice processors in Giwa Local Government Area of Kaduna State, Nigeria, focusing on their socio-economic characteristics, profitability, income determinants, and operational constraints. Primary data were collected from 102 respondents using a structured questionnaire. Data were analyzed using descriptive statistics, gross margin analysis, and Ordinary Least Squares (OLS) regression. The findings reveal that rice processing is predominantly carried out by women (83.33%) and youth, with low levels of formal education, as only 19.61% attained tertiary education. The processors operate at a small scale. Profitability analysis indicates that rice processing is economically viable, yielding a gross margin of ₦190,300 monthly with a profit margin of 29%. OLS results show that grain type, number of employees, paddy sourcing strategy, credit access, and energy cost significantly influence income ($p < 0.01$). Major constraints include lack of mechanized threshers (97.1%), insufficient capital (93.1%), labor shortages (88.2%), and inadequate storage facilities (81.4%). The study concludes that although rice processing is profitable, its scale and profitability are constrained by technological, financial, and infrastructural challenges. To improve outcomes, interventions should promote mechanization, expand financial access, develop post-harvest infrastructure, and strengthen vocational training to enhance labor productivity and technical capacity.

Key words: Rice processing, Profitability analysis, Income determinants, Ordinary Least Square, Kaduna State

INTRODUCTION

Rice processing is an important part of Nigeria's agricultural sector and has the potential to bring significant value to the country. Rice is a staple food in Nigeria and an important food and calorie source for the population. The majority of Nigerians, regardless of ethnic group, rely on rice for their daily diet (Raheem,2021). Eating one cup of rice (65 g net weight) provides 53 g of carbohydrates. This corresponds to 23.6% of the daily carbohydrate requirement and 10.6% of the daily energy requirement of 2000 calories (Edia,2023 and Obianefo, et al 2022). The reason is that processing promotes local production and consumption of rice. Processing rice can add value to the grain and reduce post-harvest losses. Rice processing or milling is a combination of operations that turn paddy into high-quality white rice and is highly dependent on processors' management capabilities (Ibitoye, et al 2014).

Majority of rice processing in Africa is carried out by small farm-level processors (USAID, 2019). To date, much of the research has focused on smallholder rice production, with a few studies directed towards milled rice processing in Nigeria.

Rice processing will help improve Nigeria's economic stability and the livelihoods of those who depend on the business for survival. Rice processing also has the potential to create jobs within the country and generate additional income for farmers who are in the business of small-scale rice processing options. This will help to reduce poverty within the country and improve the overall standard of living. Rice processing can help reduce the cost of the crop, improve shelf-life, and make it more affordable to the general public (Osabuohien et al 2018). One of the main challenges of rice processing value chain is inadequate infrastructure. Many African countries lack the basic infrastructure needed to transport and store the harvested rice. This is compounded by the lack of

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resources within the industry, with many small rice millers not having the funds to purchase the necessary equipment for processing. Again, access to market is a major issue for the rice processing value chain in Africa.

Small scale rice processing in Giwa local government area in Kaduna state faces lots of challenges including but not limited to high cost of paddy rice, lack of modern milling and storage facilities and lack of fund for their processing operation. Thus, there is need to boost their processing capacity and profitability to enhance food security and sustainability. The lack of information and empirical data on the processor's economic performance in the study area necessitated this study. Therefore, this study conducted an economic analysis of small-scale rice processors in Giwa Local Government Area of Kaduna State, Nigeria. Specifically, it examined the socio-economic characteristics of rice processors, assessed the profitability of their enterprises, identified the factors influencing their income, and identified the major challenges to small-scale rice processors in the study area.

MATERIALS AND METHODS

Study Area

Giwa Local Government Area is one of the 23 LGAs in Kaduna State, located in the northern part of Nigeria. Geographically, it lies between latitudes 10°50′ and 11°15′ North and longitudes 7°15′ and 7°45′ East. The LGA is situated within the Northern Guinea Savannah agro-ecological zone, characterized by distinct wet and dry seasons, fertile soils, and suitable climatic conditions that support the cultivation and processing of staple crops such as maize, sorghum, and particularly rice.

According to the National Population Commission's 2006 census, Giwa LGA had a population of approximately 286,427. Based on an annual growth rate of 2.6%, the projected population as of 2024 is estimated to be around 474,000 people. The area comprises several towns and villages, with Giwa town serving as the administrative headquarters.

Agriculture is the mainstay of the local economy, employing a majority of the population. In recent years, rice production and processing have become increasingly prominent, driven by rising local demand and support from government and private sector initiatives. Small-scale rice processors play a critical role in the local rice value chain by adding value to harvested paddy through dehusking, polishing, and packaging. These activities provide employment opportunities, particularly for women and youth, and contribute significantly to household income in the area.

Sampling Procedure and Sample Size

A two-stage sampling technique was employed to select respondents for this study. In the first stage, a purposive selection of four wards viz: Mahuta, Hayin Malam, Shika, and Hayin Agwai was carried out from the eleven wards in Giwa Local Government Area. These wards were selected based on their high concentration of small-scale rice processors, as identified through preliminary field assessments and local knowledge.

In the second stage, a random sampling technique was used to select individual rice processors from each of the chosen wards. The number of respondents selected from each ward was based on 10% of the rice processors listed in the sampling frame for that ward, resulting in a total sample size of 102 rice processors used for the study

Method of Data Collection

The study utilized primary data, which were collected through the administration of a structured questionnaire. The questionnaire was designed to elicit information on the socio-economic characteristics of small-scale rice processors, input and output levels, income, costs, and challenges encountered in the processing activities. Trained enumerators, fluent in the local language, assisted in administering the questionnaires to ensure clarity and accuracy of responses. The data collected were analyzed using a combination of descriptive statistics, Gross Margin analysis, and Ordinary Least Squares (OLS) regression, in line with the study's objectives.

Descriptive Statistics

Descriptive tools such as frequencies, percentages, means, and standard deviations were used to summarize the socio-economic characteristics of respondents and to identify major constraints faced by rice processors. This approach provided a foundational understanding of the distributional patterns in the dataset (Adenuga *et al*., 2021).

Gross Margin Analysis

Gross Margin (GM) was used to assess the profitability of small-scale rice processing. The GM model estimates the difference between total revenue (TR) and total variable costs (TVC), expressed as:

$GM=TR-TVC$GM = TR - TVC

This method is appropriate for smallholder enterprises where fixed costs are minimal or difficult to allocate. (Rahman et al., 2020)

Ordinary Least Squares (OLS) Regression

The OLS regression model was used to determine the socio-economic factors influencing the output and income of small-scale rice processors. The general form of the model and the explicit form is specified as:

$$Yi=\beta0+\beta1X1+\beta2X2+\cdots+\beta nXn+\epsilon_i$$

$$Yi=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\beta6X6+\beta7X7+\beta8X8+\epsilon i$$

Where,
Yi = Dependent variable (Income of rice processors)
β0 = Intercept
$\beta_1-\beta_{10}$ = Coefficients of the independent variables
X_1-X_n = Independent variables (e.g., age, education, experience, access to credit, processing capacity)
ϵi = Error term assumed to be normally distributed with mean zero and constant variance
Independent variables
X_1 = cost of processing (₦)
X_2 = grain size (1 long grain, 0 short grain)
X_3 = number of employees (numbers)
X_4 = access to technology and equipment (1 access,0 no access)
X5= Price of processed rice (₦/kg)
X_6 = Credit Access (amount received ₦)
X_7 = Labour cost (₦)
X_8 = Energy cost (electricity, fuel, heating processes (₦)
X_9 = Source of paddy (Direct from farm=1, other marketers=0)
X_{10} = Cost of paddy rice (₦)
e= Error term

The OLS technique was chosen for its robustness in estimating linear relationships and its suitability for cross-sectional data (Adepoju et al., 2022). The model aligns with similar studies on small-scale agro-enterprises (Ayanwale & Adedokun, 2021).

RESULTS AND DISCUSSION

Socioeconomic and Institutional Characteristics of Rice Processors

The result presented in Table 1 reveals insights into the demographic and economic profile of rice processors. The sector is predominantly female-dominated, with 83.33% of respondents being women. This aligns with findings by Oluwatayo and Adedeji (2019), who emphasized the active role women play in agricultural processing activities across Nigeria, particularly in post-harvest operations such as rice milling, parboiling, and packaging. In terms of age distribution, the majority of processors 64% fall within the 21–40 years age brackets, with mean age of 31 years indicating a youthful and active workforce. This is consistent with the national pattern observed by NBS (2020), which highlighted increasing youth engagement in agro-processing due to rising unemployment and agribusiness initiatives. Result on marital status revealed, more than half of respondents were married, which may influence labor allocation and decision-making within households. Studies have shown that marital status often affects access to productive resources and credit, with married individuals enjoying more social capital and financial stability (Adebayo et al., 2018).

Results on their educational status indicates that 29% of respondents have secondary education. This implies a relatively low level of formal education among processors, which could limit their access to extension services,

market information, and modern processing techniques. According to FAO (2017), low education levels among agro-processors can hinder their ability to adopt innovations and meet regulatory standards for food safety and quality.

Table 1: Socioeconomic and Institutional Characteristics of Rice Processors

Variable	Category	Frequency (n = 102)	Percentage (%) / Mean
Sex	Female	85	83.33
	Male	17	16.67
Age (years)	15–20	18	17.48
	21–30	36	34.95
	31–40	30	29.13 /Mean: 31.49
	41–50	12	11.65
	51–63	7	6.80
Marital Status	Single	23	22.55
	Married	57	55.88
	Widow/Widower	4	3.92
	Divorced	18	17.65
Education Level	Primary	45	44.12
	Secondary	30	29.41
	Quranic	27	26.47
Processing Scale (tons/year)	1–50	20	19.61
	51–200	30	29.41
	201–500	12	11.76
Access to Modern Equipment	Yes	76	74.51
	No	26	25.49
Access to Credit	Yes	76	74.51
	No	26	25.49
Amount of Credit Accessed (₦)	₦20,000–₦50,000	28	27.45
	₦60,000–₦100,000	20	19.61
	₦101,000–₦200,000	30	29.41/ Mean: ₦151,422.55
	₦300,000 and above	24	23.53
Cooperative Membership	Yes	58	56.86
	No	44	43.14
Access to Technology and Equipment	Yes	59	57.84
	No	43	42.16

Source: Field Survey, 2024

The scale of rice processing among the respondents is largely small- to medium-scale, with 29.41% processing between 51–200 metric tons annually. This reflects the general structure of Nigeria's agro-processing industry, which is predominantly informal and characterized by low capital intensity (USAID, 2020). Such scale limitations affect competitiveness and the ability to meet rising urban demand for quality rice.

In terms of financing, the majority of rice processors rely on family support and personal savings (60.78%). As noted by Adegbite and Machethe (2020), limited access to credit facilities restricts investment in equipment and technology, ultimately affecting productivity and profitability. On institutional variables Access to modern rice processing equipment was reported by 74.51% of the respondents. This is encouraging, as modern equipment such as de-stoners, milling machines, and parboilers enhance product quality, reduce losses, and increase efficiency. This aligns with the findings of Adeoye et al. (2021), who noted that the adoption of improved post-harvest technologies significantly improves the profitability and competitiveness of small-scale rice processors in Nigeria. Similarly, 74.51% of processors reported having access to credit, which is a crucial input for scaling operations, investing in equipment, and purchasing raw materials. Yet, the actual amount of credit accessed varies

widely. The mean credit accessed was ₦151,422.55, indicating modest funding levels. Studies by Ogundele and Olayemi (2023) stress that while access to credit has improved marginally, most agro-processors still face limitations in obtaining large loans due to lack of collateral, high interest rates, and bureaucratic hurdles.

Result on cooperative societies participation shows that 56.86% are while 43.14% are non-members. Cooperatives serve as vital platforms for accessing credit, training, and collective bargaining. A recent study by Eze et al. (2022), showed that processors in cooperatives were more likely to access subsidized inputs, financial services, and market linkages. Therefore, strengthening cooperative engagement could serve as a strategic pathway for processor empowerment.

In terms of access to technology and equipment, only 57.84% reported having access. This suggests that despite improvements, substantial gaps persist in technological diffusion. Limited access to innovation remains a major constraint to growth in Nigeria's agro-processing subsector. According to FAO (2023), enhancing access to processing technologies is crucial for improving rice quality to meet consumer preferences and reduce post-harvest losses.

Cost and Returns of Rice Processing

The cost and return analysis offer a comprehensive view of the profitability and viability of rice processing as a livelihood activity in the study area. The total variable cost incurred monthly by rice processors was ₦683,750, while the total revenue realized was ₦874,050, resulting in a gross margin (GM) of ₦190,300.

The major component of the cost structure is the purchase of paddy rice, accounting for 67.3% of total expenses. which showed that the raw material cost in agricultural processing often dominates the cost structure due to high farmgate prices and supply variability. The processing cost constitutes 25.7%, confirming that operational processing fees including parboiling, drying, milling, and polishing are significant. Other operational costs such as electricity (1.54%), water (1.42%), transportation (0.95%), and equipment maintenance or amortization (2.08%) are relatively lower. This suggests that while infrastructural services are necessary, their impact on total cost is less pronounced. However, their reliability can still significantly affect efficiency and output quality.

The rice processors recorded a return on investment (ROI) of 0.29. This means for every ₦1.00 invested; the processor earns 29k**,** representing a profit margin of 29%**,** which is a positive return and reflects moderate profitability under current conditions. This return suggests that rice processing is economically viable, though subject to input price fluctuations and infrastructure constraints. These findings align with Otekunrin et al. (2019), who emphasized the profitability of agro-processing among smallholders but noted that profitability can be enhanced through better access to improved equipment, credit, and stable supply chains.

Table 2: Cost and Return of Rice Processors in the Study Area (Month)

Variables	Unit	Quantity	Unit Price (₦)	Cost (₦)
Paddy rice	100kg	23	25,000	575,000
Fuel	Litre	4	900	3,600
Electricity	Monthly	-	-	12,000
Water	Monthly	-	-	10,000
Sacks	Per bag	23	250	5,750
Processing cost	Per 100kg	23	9,000	207,000
Transportation	-	-	-	7,500
Labour	Person-days	4	750	3,000
Total Variable Cost				823,850
Total Revenue				1,058,500
Gross Margin				234,650
Return on Investment				0.285 (28.5%)

Source: Field Survey, 2024

Determinants of Rice Processors' Income

Results on Table 3 revealed that rice processors' income is significantly influenced by grain type, number of employees, direct sourcing of paddy, credit access, and energy cost at 1% level of significance. These significant variables collectively explain a substantial portion of the variance in rice processors' income, as indicated by the high Adjusted R-square value of 0.872.

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Grain size had a positive and highly significant effect on income ($p < 0.01$), indicating that rice processors handling long grain varieties earn higher income. This is expected as long grain rice commands premium market prices due to better appearance and cooking quality

Number of employees also had a strong positive effect ($p < 0.01$), showing that an increase in workforce enhances productivity and output. Source of paddy (direct from farm) was another significant determinant ($p < 0.01$). Processors sourcing directly from farms benefit from fresher, cheaper raw materials, leading to higher margins.

Access to credit showed a positive effect on income ($p < 0.01$). Credit enables the purchase of better inputs, investment in efficient technologies, and smooth operations, Energy cost had a significant negative effect ($p < 0.05$), suggesting that rising expenses on electricity, fuel, and heating processes reduce income. Thus the need for cost-effective energy use.

Table 3: Determinants of Rice Processors' Income

Variable	Coefficient	Std. Error	t-Value
Constant	1.0897	0.7830	1.3916
Cost of Processing (₦)	-0.2600	0.1440	-1.803
Grain Size (1=Long)	0.2980***	0.0760	3.9210
Number of Employees	0.6780***	0.1010	6.0490
Access to Technology	0.5720	0.6150	0.9290
Price of Processed Rice (₦/kg)	0.5172	0.2698	1.9160
Labour Cost (₦)	-0.0870	0.4870	-1.7980
Source of Paddy (1=Farm)	0.1856***	0.0690	2.6890
Access to Credit (₦)	0.7080***	0.0560	4.1270
Energy Cost (₦)	-0.5200***	0.2201	-2.3640
Cost of Paddy Rice (₦)	-0.2336	1.0020	-1.2680
R-squared	0.8970		
Adjusted R-squared	0.872		
F-Statistic	51.01		

Survey, 2024 *** Sig at 1%, ** Sig at 5% and *Sig at 10%

Constraint Faced by Rice Processors

The findings on table 4 reveal that rice processors face multiple interrelated constraints, with mechanization and capital access being the most critical. The unavailability of threshers (97.1%) emerged as the most significant challenge, indicating a major gap in post-harvest mechanization. This aligns with the observations of Musa et al. (2021), who emphasized that limited access to appropriate machinery hampers efficiency and increases post-harvest losses among Nigerian rice processors.

Inadequate capital (93.1%) was the second most reported constraint, consistent with Otekunrin et al. (2019), who noted that poor access to credit limits processors' ability to invest in modern equipment and storage facilities. Labour-use constraints (88.2%) and inadequate processing equipment (85.3%) further reinforce the dependency on manual labor due to technological deficiencies, leading to inefficiencies and low-quality output (Adeoye & Yusuf, 2020).

Storage limitations (81.4%) and grain breakage (74.5%) suggest weak post-processing infrastructure, which diminishes rice quality and market value. As documented by Akinola and Owolabi (2022), inadequate storage contributes to high post-harvest losses and discourages processors from scaling their operations. The high cost of equipment (71.7%) and transportation challenges (33.3%) further compound these issues, reflecting structural and logistical barriers within the rice value chain (Nwachukwu et al., 2018).

Field

Table 4: Constraint Faced by Rice Processors

Constraints	Frequency	Percentage	Rank
Unavailability of thresher	99	97.1	1st
Inadequate capital	95	93.1	2nd
Labour-use	90	88.2	3th
Inadequate processing equipment	87	85.3	4th
Inadequate storage facilities	83	81.4	5th
Breakage of grain	76	74.5	6th
Cost of Equipment	73	71.7	7th
Transportation	34	33.3	8th
Total	765	626.4	

Source: Field Survey, 2024

CONCLUSION

This study has demonstrated that rice processing in Giwa Local Government Area is economically viable, with a profit margin of 29%, indicating a moderate return on investment under prevailing market conditions. The sector, predominantly driven by young women, plays a significant role in rural livelihoods and food value addition, yet remains constrained by structural inefficiencies and limited resource access.

Key variables such as grain type, labor availability, input sourcing strategy, credit access, and energy costs significantly determined processors income, widespread constraints particularly the lack of mechanized threshers, inadequate capital, poor storage infrastructure, and high energy costs continue to limit processing and scalability. To enhance small-scale processing in the study area, there is a critical need for investment in post-harvest mechanization through equipment hiring centers and cooperative ownership to address the severe shortage of threshers and processing tools. Financial institutions should develop flexible, low-interest credit schemes tailored to processors, particularly women-led enterprises, to ease capital constraints. Capacity-building efforts must be intensified by ADPs and NGOs to improve technical knowledge, cost management, and technology adoption among less-educated and younger processors. Additionally, promoting active and efficient cooperatives, alongside investments in alternative electricity solutions such as solar and shared storage facilities, will significantly reduce post-harvest losses and improve rice processing in the study area.

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