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ORIGINAL ARTICLE

ECONOMIC ANALYSIS OF RICE PRODUCTION IN THE SOUTHERN AGRICULTURAL ZONE OF NIGER STATE, NIGERIA

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ABSTRACT
Rice is an important staple food and a significant cash crop in Nigeria; nonetheless, its production encounters several challenges that limit optimal performance, mostly in the southern agricultural zone of Niger State. This study evaluates the economic profitability and technical efficiency of rice production in the zone while examining the major socio-economic factors affecting efficiency. A multistage sampling technique was employed to select 180 rice farmers from three Local Government Areas: Bida, Lapai, and Mokwa. structured questionnaires and interviews were used to gather primary data. The analytical tools used comprised descriptive statistics, gross margin analysis, and the stochastic frontier production function, which is appropriate for measuring production inefficiencies. The results revealed that the average age of the rice farmers was 32 years, and their mean farming experience was 18 years. Eighty per cent of the respondents were married, and 32.78% of them were males. The average gross margin per hectare was ₦1,025,058.85, and the return on investment stood at 2.39, indicating significant profitability. The mean technical efficiency was 77.68%, revealing a 22.32% efficiency shortfall that could be addressed through improved practices. Major determinants of efficiency included access to credit, extension services, farm size, and education level. The results revealed that the average age of the rice farmers was 32 years, and their mean farming experience was 18 years, though hindered by technical inefficiencies. It could be recommended that targeted policy interventions to enhance input delivery systems, strengthen extension services, improve rural infrastructure, and facilitate access to affordable credit to boost productivity and sustainability in rice farming.
KEYWORDS: *Economic performance, profitability analysis, resource-use efficiency.*

INTRODUCTION

Rice (*Oryza sativa*) is one of the world's most vital principal foods, providing nourishment for over half of the world's population and making a major contribution to calorie consumption, particularly in developing nations (FAO, 2023). In Nigeria, rice holds a vital position in ensuring the nation's food security, serving as a major source of income for millions of rural households. In spite of being the leading rice producer in Africa, Nigeria remains one of the largest global importers of rice, highlighting a persistent gap between domestic production and consumption. Recent estimates indicate that Nigeria's yearly rice demand is about 7.9 million metric tons, whereas domestic

production is roughly 5.4 million metric tons (Federal Ministry of Agriculture and Rural Development, 2023). The Southern Agricultural Zone of Niger State is endowed with fertile soils and favourable climatic conditions that make it highly suitable for rice cultivation. However, despite this ecological advantage, the productivity of rice farmers in the region remains suboptimal. Various structural and institutional constraints including high input costs, limited mechanization, poor infrastructure, and restricted access to credit, have undermined the region's potential. Moreover, socio-economic variables such as farmers' education level, farming experience, household size, and access to extension services exert a considerable influence on their productivity and technical efficiency. Efficient resource use is crucial to enhancing agricultural productivity, particularly in countries where land and other farm inputs are becoming increasingly scarce. According to production theory, maximizing output from given input levels requires not only adequate resources but also their efficient allocation. Hence, evaluating technical efficiency offers a vital insight into how well farmers convert available resources into output under prevailing conditions. This research adopts the Stochastic Frontier production approach to evaluate technical efficiency while also assessing the profitability of rice farming in the study zone. Previous studies, such as Abiola et al. (2021) and Yusuf and Adeola (2022) have examined technical efficiency in rice farming in Nigeria's North-Central and found substantial room for improvement. Similarly, Eze and Obasi (2022) emphasized the importance of input use particularly fertilizers and agrochemicals in enhancing yields, while Oladele and Ayodeji (2023) stressed the role of seed quality. While several studies have investigated rice production in other parts of Nigeria, there seems to be limited empirical evidence focusing on the technical efficiency and economic viability of rice production specifically in the southern agricultural zone of Niger State. Addressing the knowledge gap is critical for crafting effective, localized policy responses to improve rice production and reduce reliance on imports. Based on the foregoing, the study examined the socio-economic characteristics of rice farmers, analyzed their technical efficiency, and evaluated the profitability of rice production within the study area.

METHODOLOGY

The research was carried out in the southern Agricultural zone of Niger State, Nigeria, located in the central region of the country and comprising three distinct agricultural zones. Niger State South Agricultural zone (Zone A) comprising Bida, Agaie, Lapai, Mokwa, Katcha, Lavun, Edati, Gbako, Niger East Agricultural zone (Zone B) comprising Suleja, Paikoro, Gurara, Rafi, Chanchanga Tafa, Shiroro, Munya, Bosso and Niger North Agricultural zone (Zone C) comprising Kontagora, Rijau, Magama, Wushishi, Mashegu, Mariga, Agwara, Borgu. The southern agricultural zone of Niger State, Nigeria, is a significant area for agricultural activities, including rice production. The area has a tropical climate with clearly defined wet and dry seasons, receiving annual rainfall between 1,200 mm and 1,500 mm, which provides suitable conditions for rice cultivation (Usman and Bello, 2021).

Using a multistage sampling technique, a total of 180 rice farmers were randomly selected from three Local Government Areas. In stage 1, three local Government areas (Bida, Lapai and Mokwa) were deliberately chosen from the eight local Government areas in the Southern Agricultural Zone due to their high levels of rice production. Stage 2: From each of the three selected Local

Government Areas, three communities were randomly chosen, bringing the total number of communities selected for the study to nine. Stage 3: At this stage, 10% was randomly selected (proportional allocation) out of the total of 1,798 registered rice farmers on a list gotten from Niger State Agricultural Development Programme. This gave a total of 180 respondents for the study. Primary data were obtained through a structured questionnaire designed to collect information on inputs, outputs, and the socio-economic characteristics of rice farmers. The input data gathered included labour, capital, fertilizer, seed, agrochemicals, and farm size. Socio-economic data collected include age, household size, farming experience, educational level, extension contact, access to credit, non-farm income, cooperative membership, and production constraints. Data were collected during the 2023/2024 farming season to ensure accuracy and relevance. The questionnaire was distributed and collected with the help and collaboration of agricultural extension officers in the study zone. Table 1 shows sampling frame of rice farmers in the study zone.

Table 1: Sampling frame of rice farmers

Local Govt Area	Village	No. of registered farmers	10% selected number of rice farmers
Bida	Garatu	285	29
	Doko	250	25
	Wadata	193	19
Mokwa	Kudu	180	18
	Kpaki	150	15
	Ndakogitu	186	19
Lapai	Evuti	203	20
	Takuti	179	18
	Lapai	172	17
TOTAL = 3	**9**	**1,798**	**180**

Source: Niger State Agricultural and Mechanization Development Authority (NAMDA, 2024)

Gross Margin Analysis was used to estimate profitability:

GM=TR−TVCGM = TR-TVC

Where GM = Gross Margin, TR = Total Revenue, TVC = Total Variable Cost

Stochastic Frontier Analysis (SFA) using a Cobb-Douglas production function estimated technical efficiency.

The Technical Efficiency of the farmer is expressed as follows:

TEi = Yi/Yi

Where

TEi = Technical efficiency of the ith farmer

Yi = Observed output of the ith farmer (kg)

Yi = Potential output (kg).

In its log form, the Cobb-Douglas stochastic frontier production function was stated as follows:

$$LnY_i = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 V_i - \mu_i$$

Where:

ln = natural logarithm

Y = Output of paddy rice (kg)
β_0 = constant or intercept
$\beta_1 - \beta_6$ = estimated regression coefficients
X_1 = Farm size (ha)
X_2 = Seed (kg)
X_3 = Fertilizer (kg)
X_4 = Herbicides (Liters)
X_5 = Insecticides (Liters)
X_6 = Labour (Man-days)
V_i = random variability in the production that cannot be influenced by the farmer.
μ_i = deviation from maximum potential output attributed to technical inefficiency

RESULTS

Table 2 displays the socio-economic characteristics of rice farmers in the study area. The age distribution shows most farmers are young, with an average age of 32 years. Males make up 67.22%, while female farmers account for 32.78%. The majority of farmers (78.33%) are married, which positively impacts household labour availability. The average household size is five members, influencing labour supply and production costs. Education levels are low, with 44.44% of farmers lacking formal education. Farm sizes average 1.17 hectares, with 85% of farmers cultivating less than 1 hectare, limiting economies of scale, mechanisation, and expansion. Farming experience averages 18 years. About 82.78% of rice farmers are members of at least one cooperative society, whereas 17.22% are not members. A large proportion of respondents (94.44%) have access to extension services, likely due to their participation in cooperative societies, which generally facilitate contact with extension agents.

Technical Efficiency of Farmers

Table 3 presents the technical efficiency levels of rice farmers in the study area. Estimated technical efficiency levels span from 41% to 100%. On average, rice farmers in the study area operated at a mean technical efficiency of 0.7768. This suggests that, given the existing technology and resources, the average farmer achieves approximately 77.68% of their possible production capacity. Consequently, an inefficiency gap of approximately 22.32% is observed, signifying the unutilized production potential which highlights the importance of promoting and adopting modern agricultural practices. Encouraging the use of improved varieties, efficient farming techniques, and better crop management which can aid in narrowing the efficiency gap and increasing overall production, the most efficient farmer scored 0.93, while the least efficient scored 0.45.

Table 2: Socio-Economic Characteristics of the Rice Farmers

Variable	Frequency (n=180)	Percentage	Mean
Age (years)			32 years
21 - 30	74	41.11	
31 - 40	88	48.89	
41 - 50	7	3.89	
50 and above	11	6.11	
Sex			
Female	59	32.78	
Male	121	67.22	
Marital status			
Married	141	78.33	
Single	39	21.67	
Household size			5 persons
1 - 5	110	61.11	
6 - 10	70	38.89	
Level of education			
No formal	80	44.44	
Primary	47	26.11	
Secondary	42	23.33	
Tertiary	11	6.11	
Farm size(ha)			1.17
0.1 - 1.00	153	85	
1.01 - 2.00	23	12.78	
2.01 - 3.00	4	2.22	
Method of land acquisition			
leased	15	8.33	
Gift	72	40	
Inheritance	93	51.67	
Farming experience(years)			18 years
1 - 10	18	10	
11 - 20	144	80	
20 and above	18	10	
Membership of a cooperative			
No	10	5.56	
Yes	170	94.44	
Extension contacts			
No	31	17.22	
Yes	149	82.78	

Table 3: Level of rice Farmers' Technical Efficiency

Class of efficiency	Frequency (n =180)	Percentage
0.41 – 0.50	8	4.44
0.51 – 0.60	15	8.33
0.61 – 0.70	30	16.67
0.71 – 0.80	47	26.11
0.81 – 0.90	42	23.33
0.91 – 1.00	38	21.11
Mean score	0.7768	
Minimum score	0.4105	
Maximum score	0.9810	

Profitability of Rice Production

Table 4 presents the profitability analysis of rice producers in the study area. The analysis revealed that the total variable cost of rice production per hectare was ₦429,368.15, underscoring the considerable capital outlay necessary for effective rice production. Among the primary cost elements, fertilizer represented the largest share at ₦177,169.67, accounting for 41.3% of the total expense. Labour accounted for the second-highest share of total variable costs at 33.9% (₦145,419.43), highlighting the labour-intensive nature of rice farming in the study area.

Table 4: Costs and Returns of Rice Production Per Hectare in the Study Area

Item	Unit Cost (₦)	Qty	Amount (₦/ha)	% of total Cost
Revenue (bag)	**40,400.75**	**36**	**1,454,427.00**	
Labour (man-day)	2,423.66	60	145,419.43	33.9
Seed (kg)	641.84	60	38,510.43	9.0
Fertilizer (bag)	17,716.97	10	177,169.67	41.3
Herbicide (litre)	10,153.44	4	40,613.74	9.5
Insecticide (litre)	2,654.03	1	2,654.03	0.6
Transportation	—	1	25,000.85	5.8
Total Variable Cost (TVC)	**—**	**—**	**429,368.15**	
Fixed Cost				
Depreciation on equipment	—	1	₦9,015.12	
Rent on land	—	1	₦30,112.32	
Total Fixed Cost (TFC)	—	—	**39,127.44**	
Total Cost (TVC + TFC)	—	—	**468,495.59**	
Gross Margin GM (TR-TVC)	—	—	1,025,058.85	
Net Farm Income (GM - TFC)	—	—	985,931.41	
Return on Investment (GM / TVC)	—	—	2.39	

Transportation costs amounted to 5.8% (₦25,000.85), while expenditures on seed (₦38,510.43) and herbicide (₦40,613.74) accounted for 9.02% and 9.5%, respectively. The total fixed cost was ₦39,127.44, contributing minimally to overall expenses. The total production cost, summing up to ₦468,495.59, emphasizes the high financial demands associated with rice cultivation. However, the total revenue of ₦1,454,427.00 reflects a significant return on investment, demonstrating the financial gains achievable in the sector.

Total Variable Cost (TVC): This represents the sum of all expenses that change in direct proportion to the level of production. These include expenses such as seeds, fertilizer, pesticides, labour, and fuel that change as output increases or decreases.

Fixed Cost (FC): These are expenses that remain unchanged regardless of the level of production within a specific period. Examples include land rent, equipment depreciation, and loan interest.

Total Fixed Cost (TFC): This is the total of all fixed costs incurred during production and remains constant no matter the quantity of output.

Total Cost (TC): The total expenditure on production, calculated by summing the total fixed and total variable costs.

Gross Margin (GM): The amount remaining after subtracting total variable costs from total revenue, reflecting the efficiency of variable input utilization.

Total Revenue (TR): The total income earned from selling the output (such as rice) during a production period.

Net Farm Income (NFI): The residual income after subtracting all production costs (both fixed and variable) from total revenue. It represents the farmer's profit.

Return on Investment (ROI): A measure of profitability that indicates how efficiently investment resources are used to generate profit. It is expressed as a percentage.

DISCUSSION

Socio-economic characteristics of the rice farmers

The socio-economic characteristics of rice farmers indicated a predominantly youthful population, having an average age of 32 years. This aligns with Adeoye (2021), who observed that younger farmers in Nigeria tend to adopt modern farming practices more readily, improving productivity and efficiency. However, limited access to land and capital remains a major constraint for this group.

Gender distribution showed that males constituted 67.22% of rice farmers, while females made up 32.78%. This aligns with the findings of Yusuf and Adeola (2022), who reported that rice production is largely dominated by male farmers due to its labour-intensive nature, although female participation in processing and marketing remains significant. Addressing gender-based barriers to land, credit, and input access is therefore essential.

The majority (78.33%) of farmers were married, indicating potential access to family labour. This finding agrees with Ibrahim and Usman (2022), who reported that married farmers are often more productive because of labour contributions from family members. However, the associated financial obligations may pressure farmers to increase productivity to sustain household welfare.

Regarding household size, 61.11% of farmers had between 1 and 5 members, with an average household size of five. This result is comparable to Ume et al. (2012), who found that while larger

households provide more labour, they also have higher consumption demands. Balancing these factors is crucial for efficient labour management.

In terms of education, 55.56% of the farmers had formal education. Education improves the ability of farmers to understand and apply improved practices. Oladele and Ayodeji (2023) also found that educated farmers are more likely to adopt improved seeds and fertilizer, boosting productivity. Krugman and Wells (2020) similarly emphasized education as vital for efficient resource allocation.

The dominance of smallholder farms (average 1.17 ha) indicates limited economies of scale. Ali et al. (2021) and Adamu and Bello (2021) both found that larger farms achieve higher productivity due to better resource utilization. Land fragmentation and insecure tenure therefore limit productivity potential.

Most farmers (80%) had 11–20 years of farming experience, suggesting deep practical knowledge. However, as Yusuf and Adeola (2022) noted, experience does not always translate into innovation—older farmers may be resistant to adopting new technologies. Continuous training and extension services can bridge this gap.

About 82.78% of farmers belonged to cooperatives, which enhance access to inputs and credit. Ibrahim and Usman (2022) highlighted that cooperative membership significantly improves productivity by easing input acquisition and extension contact. Thus, strengthening cooperative structures remains important.

Technical Efficiency of Farmers

The study revealed a significant variation in technical efficiency among rice farmers in the study area. The average technical efficiency was estimated to be 0.7768, indicating that the typical farmer achieves about 77.68% of their potential output given the current technology and resources. This indicates that productivity could be improved through more efficient use of inputs.

This finding is consistent with Yusuf and Adeola (2022), who observed that rice farmers in Nigeria had an average technical efficiency of 75.3%, suggesting that a significant number were not utilizing their resources optimally. Likewise, Ali et al. (2021) reported that rice farmers in Pakistan exhibited efficiency levels ranging from 40% to 98%, with an average of 78.5%, further highlighting the ongoing presence of technical inefficiencies even in areas with comparable agricultural environments. The observed technical efficiency levels have several important implications for the rice producers in Niger State and the broader agricultural landscape in Nigeria. The study reveals that rice farmers have considerable room for improving how they utilize available resources. By improving their technical efficiency, these farmers can considerably boost their output without needing extra resources. This optimization of resource use is vital for enhancing productivity and income, particularly in environments with limited resources.

This result is strengthened by Ibrahim and Usman (2022), who noted that better access to extension services and training can enable farmers to close the efficiency gap by adopting more effective farming methods. Similarly, Oladele and Ayodeji (2023) pointed out that using high-quality seeds and fertilizers significantly contributes to improved technical efficiency among rice farmers in Nigeria, underscoring the importance of optimizing resource use.

Profitability of Rice Production

The gross margin was ₦1,025,058.85 per hectare, and the return on investment was 2.39. This indicates that for every ₦1 invested in rice production, ₦2.39 was realized as a net profit. These findings are consistent with previous studies (Ahmed *et al*., 2023; Chidiebere-Mark et al., 2019) and affirm the economic viability of rice farming in the study area. Key cost components, fertilizer accounted for the highest proportion (₦177,169.67), representing 41.3% of the total cost. Labour accounted for 33.9% (₦145,419.43), highlighting the labour-intensive nature of rice cultivation in the study area. This finding agrees with Ume et al. (2012), who reported that rice farming in Ebonyi State was highly profitable, recording a gross margin of ₦1,210,000 per hectare, thereby emphasizing the strong economic potential of rice production. In addition, Oladele and Ayodeji (2023) observed that farmers who adopted improved seed varieties and efficient input use recorded an ROI of 2.7, further confirming the profitability of adopting best practices in rice farming.

The computed gross margin of ₦1,025,058.85 and net farm income of ₦985,931.41 demonstrate that rice production is highly profitable. An ROI of 2.39 implies that for every ₦1 invested in the enterprise, a profit of ₦2.39 is achieved. This level of profitability confirms that rice production is a viable economic activity in Niger State, capable of providing substantial income for farmers. Such profitability serves as a key incentive for continued and expanded rice cultivation, which can contribute to regional food security and economic stability. Ibrahim and Usman (2022) supported this assertion, noting that the high profitability of rice farming in Northern Nigeria had encouraged more farmers to adopt improved farming technologies to enhance efficiency and yield. Furthermore, Oladele and Ayodeji (2023) emphasized that access to quality inputs, particularly improved seed varieties and fertilizers, significantly increased farmers' profitability by enhancing productivity, aligning with the findings of this study.

However, the high profitability levels provide an opportunity for reinvestment in improved farming technologies, better inputs, and mechanization, which can further enhance productivity and efficiency. The study’s findings also highlight the potential for smallholder farmers to transition into commercial-scale production, thereby improving their financial well-being and lessening their reliance on subsistence agriculture.

This is in agreement with Adeoye (2021), who found that increased profitability among smallholder rice farmers in Nigeria led to higher reinvestment in mechanization and modern inputs, ultimately improving efficiency and sustainability. However, Eze and Obasi (2022) presented a contrasting view, arguing that while rice farming is profitable, high production costs, particularly for fertilizers and labour, often limit smallholders' ability to scale up operations, making it difficult for them to transition to commercial production.

In general, the study confirms that rice farming in Niger State is a highly profitable enterprise; however, targeted measures such as better access to affordable inputs and increased mechanization are essential to maintain and boost profitability. Addressing key challenges such as high input costs, inadequate credit facilities, and limited mechanization will be crucial in maximizing the economic benefits for rice farmers.

CONCLUSION

It could be concluded that rice farming in Niger State Southern Agricultural Zone. is both profitable and economically viable. However, technical inefficiencies persist, with significant potential for output improvement. Addressing these inefficiencies through targeted policy interventions is crucial. The government should strengthen agricultural extension services to promote efficient production practices. The government should also improve farmers' access to credit to support the timely purchase of inputs. Additionally, the government should invest in farmer education and training to enhance knowledge and input-use efficiency. Such interventions can enhance productivity and profitability, thereby promote food security and foster rural development in the region.

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