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ECONOMIC EFFICIENCY OF RICE PRODUCTION AMONG THE SMALL-SCALE WOMEN FARMERS IN THE FEDERAL CAPITAL TERRITORY, NIGERIA

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Abstract

This study evaluated the economic efficiency of rice production among the small-scale women farmers in the Federal Capital Territory, Nigeria. A multi-stage sampling technique was used to select 100 small-scale women rice farmers. The primary data were collected with the aid of a well-designed and well-structured questionnaire. The data were analyzed using descriptive statistics, farm budgeting technique, financial analysis, the Stochastic production frontier efficiency model, and the Tobit dichotomous regression model. The results show that 88% of women rice farmers were below 50 years old. The mean age was 44 years. Averagely, they were small-scale farmers with 1.31 hectares of farm land. The labor input in man-days constituted the highest percentage of about 50.8% of the total costs of activities involved in rice production. The net farm income and gross margin ratio was estimated at 416,800 Naira and 0.63 respectively. This shows that the rice production by women farmers was profitable and worthwhile. The mean allocative, economic, technical efficiency scores were 50.3%, 50.8%, and 51.20% leaving the efficiency gaps of 49.7%, 49.2%, and 48.8% for improvement respectively. The significant factors influencing the economic efficiency of the rice production among women farmers include the following: - farm size, labor input, household size, seed input, fertilizer input, chemical input, farm experience, and access to credit. The major constraints encountered by women rice farmers include the following: inadequate credit facilities (1st), high cost of labor (2nd), high cost of fertilizers (3rd) and high cost of herbicides (4th). The study recommends that farm inputs such as improved seeds, fertilizer input, chemical input and herbicides should be made available to women farmers at affordable prices. Credit facilities devoid of rigorous administrative procedures at low interest rate should be made available to women farmers

Keywords: economic efficiency**,** rice production, Tobit regression model, small-scale women farmers, Abuja, Nigeria

INTRODUCTION

Rice (*Oryza sativa* L.) is among the most valuable and essential cereal crops cultivated and consumed globally by a large mass of the world population (Ojo et al., 2020., and Ibitoye et al., 2014). Rice is a staple food in several African countries including Nigeria and

constitutes a large portion of the diet on a regular basis (Lu et al., 2018). Rice is cultivated or grown in almost all agro-ecological zones in Nigeria by smallholder farmers or on a relatively small-scale basis. Rice is grown under varieties of ecology, namely: tropical climatic conditions, subtropical climatic conditions, and temperate conditions with the weather varying from the arid and semi-arid regions as well as humid to semi-humid conditions (Rao et al., 2017). Rice production systems, therefore, include irrigated lowland, rain-fed upland, rain-fed lowland, irrigated upland, deep water, and floating systems. All these systems are commonly practiced in the South of Asia, East of Asia, and Africa (Rao et al., 2017). Nigeria is the leading consumer of rice in the continents and one of the largest producers of rice in Africa. Nigeria is also the largest rice importer in the world (Ojo et al.,2020). Nigeria still ranks third with Iraq (after Philippines and China) in the group of major rice importing countries in the world (Ojo et al., 2020). Rice is an important food security crop, the importance of rice made the United Nations designate the year 2004 as the international rice year (Rai, 2004). There have been numerous cases of development and economic growth in different communities in history as a result of the massive production of rice (Ajala & Gana, 2015). Rice is one of the most important staple food commodities for billions of people around the world considering its relevance in many growing communities and it is evident in the increased level of active consumption in many households.

Rice has become the second most produced cereal globally after maize reaching more than 510 million tons, with China producing more than 211 million tons in 2022 alone (Shahbandeh, 2023). It is one of the most demanded food commodities in many continents of the world today. In Nigeria, rice is a popular food commodity and it turned out to be a crucial constituent of household diet across different regions of the nation (Ogunleke & Baiyegunhi, 2019). According to USDA (2016), the annual consumption of rice in Nigeria was estimated at 5 million tons, the quantity supplied was about 2.7 million tons, with a demand-supply gap of about 2.3 million tons, today filled in by importation (Obih and Baiyegunhi, 2017). The demand for rice in 2018 alone was 6.4 million tons (Familusi & Oranu, 2020). The rice demand in Nigeria has not been met in the last 40 years and it keeps increasing significantly at a very fast propelling rate because the domestic production and the quantity supplied is not sufficient to meet the demand and has therefore resulted in food shortage within the country (Familusi & Oranu, 2020). In other West African countries, the shortage of rice is also very prominent as a result of a fast-propelling demand gap in relation to domestic production (Kathiresan et al., 2020). The imbalances in the production rates of rice relative to the demand is notably a result of the fast-growing population in Nigeria, thereby pushing the country forward to fight the resulting problem of food insecurity (Terwase & Madu, 2014). The problems faced by the small-scale farmers in regards to the rice production are related to inadequacy in the production and management of agricultural activities (Abdullah et al., 2013). Some of the inadequacies in the production include the following: inadequate access to inputs, funds, technology base, inadequate infrastructures, increased rates of interest, inappropriately funded research institutes, the poorly funded and equipped public extension system, difficulty in acquiring certified seeds, inappropriate distribution system of fertilizers, poor investment schemes of the public sector regarding agriculture (Nkwabi et al., 2021). Furthermore, the small-scale rice farmers experience problems of insufficient and inefficient labor, land tenure system, inadequate capital, finance and credit facilities (Nkwabi et al., 2021).

Another important source of starch for residential and industrial needs has been rice. According to Ashogbon and Akintayo (2013) the alkaline de-proteination process is typically

used to separate it from rice flour. Rice can be used in big textile industries for producing clothing and cosmetics. The husks and straw can be used in refining fuel, feeding ruminant livestock, making bricks, etc. They can also be used for making a local hat, mat, strawboard, rope pillow and fan. The bran wax can be used for bran oil extraction. Bran can also be used in some industries for producing chocolate, lipstick and leather.

Women account for more than half of the work force by participating in different agricultural activities, either directly or indirectly. In sub-Saharan Africa women are the backbone of the agricultural sector. Women account for 60% of the agricultural production, 70% of the agricultural labor, and 80% of the food production (Alabi et al., 2021). The roles of women, the main actors in sub-Saharan African agriculture have not been recognized. The lack of appropriate policy recommendations and program strategies made the contributions of women to agriculture invisible. Furthermore, there are no qualitative and quantitative data on the role of women in sub-Saharan agriculture and rural development. The absence of statistical data the role and status of women is a significant constraint to the understanding of their situations (Alabi et al., 2021). Omiunu (2014) clearly noted that, women-owned farms performed less than men owned farms, because they faced various challenges that had negative influences on their performances. Rural women play important roles in the rice-based farming systems as unpaid family workers, hired laborers, income earners and major caretakers of family health and nutrition – roles that have been overshadowed by the gender insensitivity of policy makers (Kandiwa, 2013).

Efficiency can be defined as the possibility of firms producing a certain level of output at minimum cost or a certain optimum level of product from a given bundle of inputs. Efficiency of a firm comprises of two components, technical and allocative efficiency, and a combination of the two components gives a measure of the total economic efficiency (overall efficiency). Economic efficiency is achieved when both allocative and technical efficiencies have been attained. In other words, economic efficiency is the product of technical and allocative efficiencies. A technically efficient firm is the one that produces the maximum output for a given number of inputs and given level of production technology available. The firm's technical efficiency is the ability to produce maximum output from a minimum quantity of inputs (Obianefo et al.,2021). Allocative efficiency produces the optimal mix of outputs using the optimal number of inputs given the production technology and the prices it faces.

OBJECTIVES OF THE STUDY

The broad objective is to evaluate the economic efficiency of rice production among small-scale women farmers in the Federal Capital Territory, Nigeria. The specific objectives are to:

(i) describe the socio-economics characteristics of women rice farmers,

(ii) analyze the costs, returns and profitability of rice production,

(iii) evaluate the technical (TE), allocative (AE) and economic efficiency (EE) scores of rice production among small-scale women farmers,

(iv) evaluate the factors influencing the economic efficiency of rice production among small-scale women farmers, and

(v) determine the constraints faced by small-scale women rice farmers in the study area.

METHODOLOGY

This research was conducted in Gwagwalada Area Council of the Federal Capital Territory, Nigeria. Gwagwalada Area

Council lies between Latitude 8º 55'N and Longitude 7º 00'E. It encompasses a total land mass of 2,316 square kilometers of the total land mass of the Federal Capital Territory - 8,000 square kilometers. The crops grown in the area are rice, millet, sorghum, groundnut, yam and maize. The cross-sectional data were used, collected from primary sources. The targeted respondents consist of small-scale women rice producers. The data were sourced with the aid of a semi-structured questionnaire administered through an interview schedule. The sampling method adopted to carry out this research is a multi-stage random sampling technique that was employed to avoid bias. In stage one, Gwagwalada Area Council was purposively selected because of the proximity to the researcher. In stage two, two wards were randomly selected. In stage three, two villages were selected. In stage four, using Yamane (1967) formula (Equation 1) for estimating sampling size, proportionate-random sampling technique was employed to select about fifty (50) small-scale women rice producers from each village respectively from a list of small-scale rice producers obtained from the Agricultural Development Project (ADP) making it a total sample size of one hundred (100) small-scale women rice producers in the study.

$$n = \frac{N}{1+N(e^2)} = 100 \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where,

n = Desired Sample Size

= Sample Frame (Number)

e =Maximum Acceptable Margin of Error as Determined by the Researcher (5%)

The following descriptive and inferential statistics were used for data analysis:

Descriptive Statistics: This involves the use of frequency distributions, percentages, mean, standard deviation to summarize the socio-economic characteristics of women rice farmers in the study area as stated in the specific objective one (i) and determine the constraints faced by small-scale women rice farmers as stated in the specific objective four (iv).

Farm Budgetary Technique: The gross margin and the net farm income analysis of the rice production among the small-scale women farmers were estimated using the following models:

$$GM = TR - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \quad (3)$$

Where

P_i = Price of Rice ($\frac{₦}{Kg}$),

Q_i = Quantity of Rice (Kg),

P_j = Price of Variable Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Variable Inputs (Units),

TR = Total Revenue obtained from Sales of Rice Production (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

The farm budgetary technique was used to analyze the profitability of rice production among the small-scale women rice farmers as stated in the specific objective two (ii).

Financial Analysis: According to Alabi et al. (2020), the gross margin ratio is defined as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Revenue} \quad (4)$$

According to Olukosi and Erhabor (2015), the operating ratio (OR) is defined as:

$$Operating\ Ratio = \frac{TVC}{GI} \ldots\ldots\ldots\ldots\ldots 5)$$

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

The rate of return per Naira invested (RORI) in the rice production is stated as follows:

$$RORI = \frac{NFI}{TC} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where,

NFI = Net Farm Income from Rice Production (Naira),

TC = Total Cost (Naira)

The financial analysis was used to analyze the profitability of rice production among the small-scale women rice farmers as stated in the specific objective two (ii).

Stochastic Production Frontier Model

According to Alabi *et al*. (2022), the stochastic production frontier model is stated as follows:

$$Y_i = f(X_i, \beta_i) e^{v_i - u_i} \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

The stochastic production frontier model was used to estimate the technical, economic and allocative efficiency scores as stated specifically in the objective three (iii).

Economic Efficiency (EE)

The economic efficiency was derived from the product of TE and AE for individual women rice producers. The EE of rice production is therefore specified as:

$$EE_i = TE_i \text{ X } AE_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where,

EE_i= Economic Efficiency (Number)

TE_i = Technical Efficiency (Number)

AE_i= Allocative Efficiency (Number)

This was used to achieve specifically objective three (iii) that is to determine the AE, TE, and EE scores of the rice production, and four (iv) that is to evaluate the factors influencing the EE of rice production among small-scale women rice farmers,

Tobit Dichotomous Regression Model: The dichotomous Tobit response model following Gujarati (2004) is defined as follows:

$$Y_i^* = X_i \beta + \varepsilon_i$$

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon_i \ldots\ldots (9)$$

$$Y_i = \begin{cases} 1 \; if \; Y_i^* \geq 1 \\ Y_i^* \; if \; 0 < Y_i^* < 1 \\ 0 \; if \; Y_i^* \leq 0 \end{cases}$$

Y_i^* = Latent or Unobserved Variable of Economic Efficiency Scores

Y_i = Efficiency Score, EE (Number)

X_1 = Farm Size (Hectares)

X_2 = Labor Input (Man-days)

X_3 = Household Size (Number)

X_4 = Seed Input (Kg)

X_5 = Fertilizer Input (Kg)

X_6 = Chemical Input (Litre)

X_7 = Farm Experience (Years)

X_8 = Access to Credit (Amount)

ε_i = Disturbance Term,

$\beta_1 - \beta_8$ = Regression Coefficients,

β_0 = Constant Term,

This was used to achieve specifically objective four (iv) that is to evaluate the factors influencing the EE of rice production among small-scale women rice farmers.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Small-scale Women Rice Farmers

Table 1 shows the socio-economic characteristics of women rice farmers. The variables under consideration include the following: age, marital status, level of education, household size, farm experience, farm size, and output produced. About 88% of the women rice farmers were below 50 years old. The mean age was 44 years (Figure 1). Also, 92% of the women farmers had less than 20 years of farm experience in rice production. The mean farm experience was 11 years. These statistics show that women farmers are agile, strong, still in their productive age and better experienced to handle farming challenges with vigor - all this would help them in adopting new technologies in rice production. Miassi et al. (2023) deduced that as producers grew older, they increased their rice production. The experiences acquired as well as the income accumulated over the years are the features that allow them to increase the areas for rice production. This is similar to the results found by Umar et al. (2020) and Obianefo et al. (2021). In addition, 84% of the women rice farmers were married, and 98% had formal education. The household size was large with an average of 9 persons per household. This is in consonance with the findings of Miassi et al. (2023) who reported that the average household size of the rice producers in Benin Republic,

West Africa is seven people. The average farm size was 1.31 hectares which shows that women rice farmers were small-scale or smallholder farmers. The mean output of rice produced by women farmers was 1925 Kg. Obianefo et al. (2021) pointed to the mean rice yield of 8172 Kg (Standard deviation = 4631.72) in Anambra State, Nigeria. Similarly, Ojo et al. (2020) noted the mean rice yield of 12, 207.52 Kg (Standard deviation = 5,296.52) in Southwest, Nigeria.

Institutional Variables Accessed by Women Rice Farmers

Table 2 presents the distribution of institutional variables accessed by women rice farmers. The institutional variables under consideration include the following: membership in a cooperative association, sources of capital, access to credit, amount of credit accessed in Naira, extension contact, and number of contacts per month. About 90% of the women rice farmers did not belong to a cooperative association, while 10% were members of cooperative societies. Membership in cooperatives enables the women rice farmers to have access to credit facilities, to purchase farm inputs (e.g. fertilizer input) at affordable prices, and to sell their farm produce in bulk.

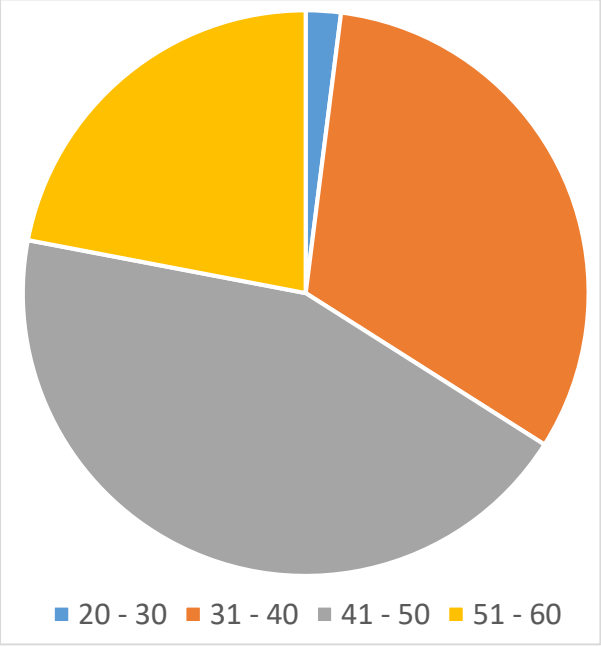

Figure 1: Age Distributions of Women Rice Farmers in the Study Area

Table 1: Distribution of Women Rice Farmers Based on Socio-Economic Features

Socio-Economic Characteristics	Percentage	Mean
Age (Years)		
20 – 30	02.00	
31 – 40	32.00	**44.00**
41 – 50	44.00	
51 – 60	22.00	
Marital Status		
Single	14.00	
Married	84.00	
Widow	02.00	
Level of Education		
Primary	16.00	
Secondary	24.00	
Tertiary	52.00	
Adult Education	02.00	
Non-Formal	02.00	
Household Size (Number)		
1 – 5	16.00	
6 – 10	58.00	**9.00**
11 – 15	20.00	
16 – 20	04.00	
21 – 25	02.00	
Farm Experience (Years)		
1 – 10	52.00	
11 – 20	40.00	**11.00**
21 – 30	08.00	
Farm Size (Hectare)		
< 1	46.00	
1.1 – 2.0	32.00	**1.31**
2.1 – 3.0	20.00	
3.1 – 4.0	02.00	
Output Produced (50 Kg Bag)		
1 – 20	20.00	
21 – 40	40.00	
41 – 60	24.00	**38.50**
61 – 80	12.00	
81 – 100	04.00	
Total	**100.00**	

Source: Field Survey (2023)

Table 2: Distribution of Institutional Variables Accessed by Women Rice Farmers

Institutional Variables	Percentage
Membership in a Cooperative Association	
Yes	10.00
No	90.00
Sources of Capital	
Personal Savings	72.00
Friends and Family	16.00
Banks/Financial Institutions	02.00
Cooperatives	08.00
Money Lenders	02.00
Access to Credit	
Yes	12.00
No	88.00
Amount of Credit Accessed (Naira)	
None	88.00
100,000	06.00
150,000	05.00
200,000	01.00
Extension Contact	
Yes	22.00
No	78.00
Number of Extension Contact/Month	
None	78.00
Once	14.00
Twice Thrice	04.00
Total	**100.00**

Source: Field Survey (2023)

According to Adamu et al. (2021) membership in a cooperative association exposes women rice farmers to vital information as well as to access to production inputs. The sources of capital for rice production include the following: personal savings (72%), friends and family (16%), banks/ financial institutions (02%), cooperatives (8%), and money lenders (2%) (Figure 2). About 88% of the women rice farmers did not have access to credit facilities, while 12% had access. According to Adamu et al. (2021) access to credit facilities will go a long way in improving the individual farm enterprises in terms of agricultural production. The access to agricultural credit by women rice farmers has the propensity to break the vicious cycle of poverty and raise the purchasing power of farm households. This is in line with Alabi and Anekwe (2022) who reported that educated farmers have the boldness, courage and technical know-how required to approach banks or financial institutions for credit or loan facilities. Also, Asogwa et al. (2014) stated that the level of education raises women farmers' knowledge and level of awareness about the needs for borrowing money for increased rice or agricultural output. These results are in line with the findings of Chiandio et al. (2017) who reported that institutional credit facilitates and increases the productivity of farmers. According to Miassi et al. (2023) the lack of access to financing will force producers to cultivate small hectares of land. In addition, 22% of the women rice farmers has made a contact with extension agents, while 78% did not. Extension agents disseminate new research findings, innovations, new technologies to farmers.

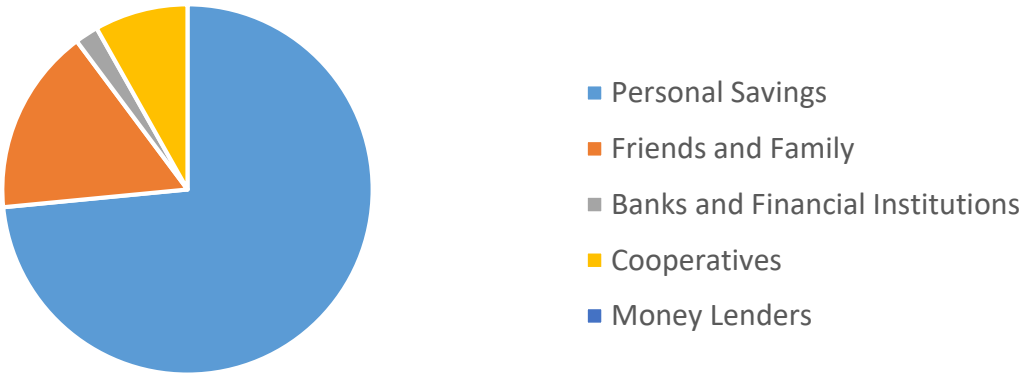

Figure 2: Distributions of Women Rice Farmers According to Sources of Capital

Analysis of Costs, Returns, and Profitability of Rice Production among Women Farmers

Table 3 presents the costs, returns and profitability of the rice production among women farmers. The revenue obtained and costs incurred were based on the prevailing market prices at the time of the field survey. The costs include variable and fixed costs. The total variable cost (TVC) was 260,500 Naira and this accounted for 93.20% of the total cost of rice production. The variable costs include the following: seed input (5.37%), land clearing (26.83%), planting (5.37%), fertilizer (25.76), chemical (11.27%), harvesting (4.29%), bagging (2.15%), beating (8,94), and transportation (3.22%). The total fixed cost was calculated at 19,000 Naira and this accounted for 6.80% of the total cost of rice production. The fixed costs include: land (5%), taxes (0.72%), and fixed input (01.07%). The fixed inputs are: hoe, sickles, sprayers, cutlass, harrow, plough, and water pump. The gross income, the gross margin and the net farm income of rice production were calculated at 696,300 Naira, 435,800 Naira and 416,800 Naira respectively. This shows that the rice production among women farmers was profitable. The GMR was calculated at 0.63, this implies that for every one Naira invested in rice production by women farmers, 63 kobo covered interest, expenses, taxes, profits and depreciation. This is in line with Alabi et al. (2021) who obtained the GMR of 0.8618 for rice production among women farmers in Abuja, Nigeria. This result is also in line with the findings of Alabi et al. (2004), and Alabi (2008).

Table 3. Costs, Returns and Profitability of Rice Production among Small-scale Women Farmers

Variable	Units	Quantity	Price	Value	%TC
(a) Total Revenue	50 Kg Bag	30	23,210	696,000	
(b) Variable Cost					
Seed Input	Kg	5	3,000	15,000	05.37
Land Clearing	Man-	5	15,000	75,000	26.83
Planting	days	6	2,500	15,000	05.37
Fertilizer	Man-	3	24,000	72,000	25.76
Chemical	days	9	3,500	31,500	11.27
Harvesting	50 Kg Bag	6	2,000	12,000	04.29
Bagging	Litres	30	200	6,000	02.15
Beating	Man-days	10	2,500	25,000	08.94
Transportation	Man-days	30	300	9,000	03.22
Total Variable Cost (TVC)	Man-days			**260,500**	**93.20**
(c) Fixed Cost (Depreciated)	Number				
Land		1	-	14,000	05.00
Taxes			-	2,000	00.72
Fixed Input (Hoe, Sickles, Sprayers, Cutlass, Harrow, Plough, Water Pump)	Ha Number	7	-	3,000	01.07
Total Fixed Cost (TFC)				**19,000**	**06.80**
(d) Total Cost (b + c)				279,500	**100.00**
(e) Gross Income (GI)				696,300	
(f) Gross Margin (GM)				435,800	
(g) Net Farm Income (NFI)				416,800	
(h) Rate of Return on Investment				1.49	
(i) Operating Ratio (OR)				0.37	
(j) Gross Margin Ratio (GMR)				0.63	

Source: Field Survey (2023) One Naira = 950 USD

Farm Level Allocative (AE), Economic (EE) and Technical Efficiency (TE). Scores of Rice Production among Women Farmers

The frequency distribution of the allocative efficiency (AE), economic efficiency (TE), and technical efficiency (EE) scores of the small-scale women rice farmers as obtained from the stochastic production frontier analysis is presented in Table 4. The mean AE, EE and TE scores were 0.503, 0.508, and 0.5120 respectively. The frequencies of occurrences of the predicted AE, EE and TE ranges indicate that the highest number of women rice farmers had AE, EE and TE between 0.41 – 0.80. The sample frequency distribution indicates a clustering of EE, and TE in the region of 0.61 – 0.80, and AE in the region of 0.41 – 0.60 efficiency ranges, representing 12%, 10% and 27% respectively. The implication is that the farmers were economically, technically and allocatively inefficient. The women rice farmers were inefficient in deriving maximum output from input, given the available resources. The minimum AE, EE and TE scores of the rice production among the women rice farmers as found in Table 4 are 0.09, 0.05 and 0.07 respectively, while the maximum AE, EE and TE scores of the rice production among women farmers are 0.95, 0.97 and 0.96 respectively. This means that on the minimum, the small-scale women rice farmers were 5% economically efficient, while on the maximum, the small-scale women rice farmers were 97% economically efficient. The result of the stochastic production efficiency frontier further indicates that the technical efficiency varied widely (standard deviation, 0.2572) among the sampled small-scale women rice farmers, with minimum and maximum values of 0.07 and 0.96 respectively. The wide variations in the technical efficiency estimates is an indication that most of the small-scale women rice farmers were still using their resources inefficiently and also using crude implements or using traditional technologies in the production process and there still exist wide opportunities for improving their current level of TE. This result suggests that the women rice farmers were not utilizing their production resources efficiently, indicating that they were not obtaining the maximum output from their given quantities of inputs. On the other hand, the predicted allocative efficiency varied widely (standard deviation = 0.2450) among the women rice farmers, with minimum and maximum values of 0.09 and 0.95 respectively. The wide variations in allocative efficiency estimates are an indication that most of the women rice farmers still allocate their resources inefficiently in the production process and there still exist opportunities for improving their current level of allocative efficiency. This result suggests that the women rice farmers were not minimizing production costs, thus indicating that they utilized the inputs in wrong proportions, given the input prices. Also, the EE varied widely (standard deviation = 0.2586) among the women rice farmers, with minimum and maximum values of 0.05 and 0.97 respectively. The wide variations in EE estimates are an indication that most of the small-scale women rice farmers were still economically inefficient in the use of resources for production and there still exist opportunities for improving their current level of EE. This result further suggests that the sampled farmers were not maximizing profit. The implication of this findings is that the more economically inefficient the women rice farmers were, the more the likelihood or probability of increased poverty status and food insecurity among the farmers. This is consistent with the findings of Onuche & Oladipo (2020) and Asogwa et al. (2011) who concluded that the TE, AE and EE of small-scale or smallholder farmers in Nigeria varied widely between minimum and maximum values and was an indication of their inefficiencies. Furthermore, the research revealed that for the minimum AE, EE and TE of women rice farmers to become the most AE, EE and TE, they will need to realize about 90.5% $[1 - (\frac{0.09}{0.95}) \times 100]$output level closer to the production frontier (i.e. her output is closer to the maximum output obtainable from resources combined), 94.8%

$[1 - (\frac{0.05}{0.97}) \times 100]$ underutilization /minimum wastage of resources to be closer to the frontier, and $92.7\%\left[1 - \left(\frac{0.07}{0.96}\right) \times 100\right]$output and minimization of resource wastage/underutilization of resources in rice production to be able to achieve TE in rice production.

Table 4: Summary Statistics of Allocative, Economic and Technical Efficiency Scores

	Allocative Efficiency	**Economic Efficiency**	**Technical Efficiency**
Efficiency Score	**Percentage**	**Percentage**	**Percentage**
0.00 – 0.20	14.00	16.00	19.00
0.21 – 0.40	18.00	21.00	12.00
0.41 – 0.60	29.00	20.00	25.00
0.61 – 0.80	27.00	31.00	34.00
0.81 – 1.00	14.00	12.00	10.00
Mean	0.503	0.508	0.5120
Standard Deviation	0.2450	0.2586	0.2572
Minimum	0.09	0.05	0.07
Maximum	0.95	0.97	0.96

Source: Field Survey (2023)

Factors Influencing the Economic Efficiency of Rice Production among Women Farmers

The factors influencing the economic efficiency of rice production among women farmers were evaluated using the Tobit dichotomous regression model and presented in Table 5. The factors under consideration include: farm size, labor input, household size, seed input, fertilizer input, chemical input, farm experience and access to credit. Farm size and seed input were the significant factors influencing the economic efficiency of rice production among women farmers at ($P < 0.01$). Labor input, household size, fertilizer input, chemical input, farm experience, and access to credit were significant factors influencing the economic efficiency of rice production among women farmers at ($P < 0.05$). All the variables except household size had a positive coefficient. The coefficient of farm size (0.3128) was positive and significant at 1% probability level. A one-hectare increase in the farm size will lead to the likelihood of a marginal increase in the economic efficiency of rice production among women farmers by 15.02%. Also, the coefficient of farm experience (0.1462) was positive and significant at 5% probability level. A one-year increase in the farm experience will lead to the likelihood or probability of a marginal increase in the economic efficiency of rice production among women farmers by 8.71%. This is in line with findings of Alabi et al. (2021) who reported that a one-year increase in the farm experience acquired by smallholder rural women farmers will lead to the probability or likelihood increase in output of rice by 11.79%. The coefficient of household size (-0.1671) was negative and significant at 5% probability level. This implies that an increase in the size of households will lead to the likelihood or probability of marginal decreases in the economic efficiency of small-scale women rice farmers by 5.36%. This result is in line with findings of Kazeem (2020) who reported that households with more members are more economically inefficient compared to smaller households. The maximum likelihood estimates showed that the Log Likelihood value was 61.3407, the Chi square value was 91.43

which was significant at 1% probability level. The Pseudo R square was 0.7562, this implies that 75.62% of the variations in the economic efficiency of rice productions were explained by the predictor variables included in the Tobit regression model.

Table 5: Maximum Likelihood Results of the Tobit Dichotomous Regression Model

Variables	Parameters	Coefficient	Standard Error	t-Value	ME
Constant	β_0	0.4865**	0.1672	2.91	0.0409
Farm Size	β_1	0.3128***	0.0848	3.69	0.1502
Labor Input	β_2	0.2514**	0.1098	2.29	0.0937
Household Size	β_3	-0.1671**	0.0756	2.21	-0.0536
Seed Input	β_4	0.1223***	0.0364	3.36	0.1106
Fertilizer Input	β_5	0.2673**	0.1087	2.46	0.1431
Chemical Input	β_6	0.1705**	0.0661	2.58	0.1092
Farm Experience	β_7	0.1462**	0.0560	2.61	0.0871
Access to Credit	β_8	0.1129**	0.0439	2.57	0.1303
Diagnostic Statistics					
Sigma		0.05613			
LR_{χ^2} (8)		91.43***			
Pseudo R^2		0.7562			
Log Likelihood		61.3407			
Prob $>_{\chi^2}$		0.00000***			

Source: Data Analysis (2023), ME=Marginal Effect

*Significant at ($P < 0.10$)., **Significant at ($P < 0.05$), ***Significant at ($P < 0.01$).

Constraints Facing Women Rice Farmers

The constraints facing women rice farmers were presented in Table 6. About twelve (12) constraints were identified and evaluated. The constraints were ranked according to the problems with the highest frequency (multiple responses were allowed). Inadequate credit facilities have the highest frequency (f =148) and was ranked 1st. High cost of labor (f = 146), high cost of fertilizers (f = 144) and high cost of herbicides (f = 143) were ranked 2nd, 3rd and 4th respectively. The other constraints facing women rice farmers were inadequate extension services (5th), inadequate access to quality rice seeds (6th), inadequate marketing information (7th), difficulty to access market (8th), low rainfall (9th), herdsmen farmers clash (10th), diseases (11th), and pest infestation (12th). This result is in line with Alabi et al. (2021) who identified lack of fertilizer input, no credit facilities, bad road infrastructures, lack of improved seed inputs, lack of labor input and inadequate extension officers as constraints facing smallholder rural women rice farmers in Abuja, Nigeria. This is in agreement with Miassi et al. (2023) who reported that the production constraints faced by the rice farmers in Benin Republic in West Africa are: inefficient agricultural equipment, difficulties in accessing inputs, inferior seed quality, no access to agricultural credit, limited availability of labor, and difficult access to the market.

Table 6: Distribution of Women Rice Farmers Based on Their Constraints

Constraints	***Frequency (*f*)**	**Percentage**	**Rank**
Inadequate Credit Facilities	148	08.93	1st
High Cost of Labor	146	08.81	2nd
High Cost of Fertilizers	144	08.69	3rd
High Cost of Herbicides	143	08.63	4th
Inadequate Extension Services	142	08.57	5th
Inadequate Access to Quality Rice Seeds	138	08.33	6th
Inadequate Marketing Information	136	08.21	7th
Difficulty to Access Market	135	08.15	8th
Low Rainfall	133	08.03	9th
Herdsmen Farmers Clash	132	07.97	10th
Problem of Diseases	130	07.85	11th
Problem of Pest Infestation	129	07.79	12th
Total	**1656**	**100.00**	

Source: Field Survey (2023) *Multiple Responses

CONCLUSION AND RECOMMENDATIONS

This case study has established that the rice production among women rice farmers is profitable and worthwhile. The women rice farmers were young, agile in their productive stage with the mean age of 44 years. They were literate and had formal education with considerable experience in rice production: on the average about 11 years of farm experience. Averagely, they came from households with a total of 9 people. In terms of institutional variables, the majority of women rice farmers did not have an extension contact, nor access to credit facilities. Their source of capital is personal savings and they did not belong to any cooperative association. The labor input in man-days constitutes the highest percentage of about 50.8% of the total costs of activities involved in rice production. The net farm income and the gross margin ratio were calculated at 416, 800 Naira and 0.63 respectively. The mean AE, EE and TE scores of the rice production among women farmers was estimated at 50.3%, 50.8% and 51.20% leaving out inefficiency gap of 49.7%, 49.2% and 48.8% respectively. The significant factors influencing the economic efficiency of rice production include: farm size, labor input, household size, seed input, fertilizer input, chemical input, farm experience, and access to credit facilities. These predictors explained 75.62% of the variations in the economic efficiency of the rice production among women rice farmers. The major constraints encountered by women rice farmers include: inadequate credit facilities (1st), high cost of labor (2nd), high cost of fertilizers (3rd), and inadequate extension services (4th). Based on the research findings, the following recommendations could be given:

(i) Farm inputs (fertilizers, improved seeds, chemicals, and herbicides) should be made available to women rice farmers at affordable prices.

(ii) Credit facilities should be provided at a low interest rate devoid of rigorous administrative procedures and with no collateral securities.

(iii) Extension officers should be deployed in the area to disseminate innovations, new research findings and new technology to women farmers.

(iv) Access to market information should be provided by government and private

institutions to provide linkage from the producing area to the nearby market.

(v) Feeder roads should be constructed and rehabilitated for easy transport of farm produce from the producing areas to the nearby markets.

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