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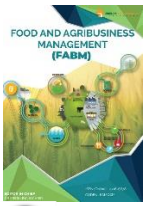

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RESEARCH ARTICLE

ECONOMIC EFFICIENCY OF RICE PRODUCTION AMONG SMALLSCALE WOMEN FARMERS IN FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT

This study evaluated economic efficiency of rice production among smallscale women farmers in Federal Capital Territory, Nigeria. A multi-stage sampling technique was used to select 100 smallscale women rice farmers. Primary data were collected with the aid of well-designed and well-structured questionnaire. Data were analyzed using descriptive statistics, farm budgeting technique, financial analysis, Stochastic production frontier efficiency model, and Tobit dichotomous regression model. The results show that 88% of women rice farmers were less than 50 years of age. The mean age was 44 years. Averagely, they are smallscale farmers with 1.31 hectares of farm land. The labour input in mandays constitutes the highest percentage of about 50.8% of 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 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 economic efficiency of rice production among women farmers include: - farm size ($P < 0,01$), labour input ($P < 0.05$), household size ($P < 0.05$), seed input ($P < 0.01$), fertilizer input ($P < 0.05$), chemical input ($P < 0.05$), farm experience ($P < 0.05$), and access to credit ($P < 0.05$). The major constraints encountered by women rice farmers include: - inadequate credit facilities (1st), high cost of labour (2nd), high cost of fertilizers (3rd) and high cost of herbicides (4th). The study recommended that farm inputs such as improved seeds, fertilizer input, chemical input and herbcides 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, Smallscale Women Farmers, Abuja, Nigeria

1. INTRODUCTION

Rice (*Oryza sativa* L.) is 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 mostly all agro-ecological zones in Nigeria but by smallholder farmers or on a relatively smallscale. 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 staple food commodities for billions of people around the world considering its relevance in many

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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 recording more than 510 million tonnes with China producing more than 211 million tonnes 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 has turned out to be a crucial constituent of various 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 MT, the quantity supplied was about 2.7 million MT, with a demand-supply gap of about 2.3 million MT, which is today filled in by importation (Obih and Baiyegunhi, 2017). The demand for rice consumption in 2018 alone was 6.4 million tons (Familusi & Oranu, 2020). The demand for rice 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 value and quantity supplied is not sufficient to meet the demand and has therefore resulted to food shortage within the country (Familusi & Oranu, 2020). In other West African countries, shortage of rice is also very prominent as a result of fast propelling demand gap to the country domestic production. (Kathiresan et al., 2020). The imbalances in the productions rates of rice relative to its demand is notably as a result of the fast-growing population numbers in the country thereby pushing the country forward to fight the resulting problem of food insecurity (Terwase & Madu, 2014). The problems small-scale farmers face in regards to the production of rice are the various inadequacy in production and management of agricultural activities (Abdullah et al., 2013). Some of the inadequacies in production includes; inadequate access to inputs, funds, technology base, inadequate infrastructures, increased rates of interest, research institutes are inappropriately funded, public extension system are poorly funded and equipped, difficulty in acquiring certified seeds, inappropriate distribution system of fertilizers, poor schemes for the investment of the public sector on agriculture (Nkwabi et al., 2021). Furthermore, small-scale rice farmers' experiences problems of insufficient and inefficient labour, 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 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 chocolate industries, lipstick industries and leather industries.

Women account for more than half of the work force by participating in different activities, either directly or indirectly. In sub-Saharan Africa women are the backbone of the agricultural sector. Women accounted for 60% of agricultural production, 70% of agricultural labor, and 80% of food production (Alabi et al., 2021). The roles of women, the main actor 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 information on the role and status of women is a significant factor constraint to understanding their situations (Alabi et al., 2021). Omiunu (2014) clearly noted that, women-owned farmers perform less than men owned farmers, because they are combated with various challenges that have negative influences on their performances. Rural women play important roles in rice-based farming systems as unpaid family workers, hired labourers, income earners and major caretakers of family health and nutrition; the role which has been overshadowed by gender insensitivity by 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, but that a combination of the two components give a measure of total economic efficiency (overall efficiency). Economic efficiency is achieved when both allocative and technical efficiencies have been attained. Economic efficiency is the product of technical and allocative efficiencies. A technical efficient firm is the one that produces the maximum output for a given amount of inputs given the 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 amount of inputs given the production technology and the prices it faces.

2. Objectives of the Study

The broad objective is to evaluate economic efficiency of rice production among smallscale women farmers in 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 smallscale women farmers,

(iv) evaluate factors influencing economic efficiency of rice production among smallscale women farmers, and

(v) determine the constraints facing smallscale women rice farmers in the study area.

3. Methodology

This research study was conducted in Gwagwalada Area Council of the Federal Capital Territory, Nigeria. Gwagwalada Area Council lies between Latitude 8° 55'N and Longitude 7° 00'E. It encompasses a total land mass of 2,316 square kilometers of the 8,000 square kilometer of the total land mass of Federal Capital Territory. The crops grown in the area are rice, millet, sorghum, groundnut, yam and maize. The cross sectional data were used, which were collected from primary sources, the target respondents consist of the small-scale women rice producers. The data were sourced with the aid of a semi-structured questionnaire administered through interview schedule. The sampling method that was adopted to carry out this research is a multi-stage random sampling technique, this was employed with the aim of avoiding bias. In the 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) smallscale women rice producers from from each village respectively from a list of smallscale rice producers gotten from Agricultural Development Project (ADP) making it a total sample size of one hundred (100) smallscale women rice producers in the study.

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

Where,

n = Desired Sample Size

N = 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 specific objective one (i) and determine the constraints faced by smallscale women rice farmers as stated in specific objective four (iv).

Farm Budgetary Technique: Gross margin and net farm income analysis of rice production among smallscale women farmers were estimated using the following models:

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

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

Where

P_i = Price of Rice ($\frac{N}{Kg}$),

Q_i = Quantity of Rice (Kg),

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

X_j = Quantity of Variable Inputs (Units),

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

TVC = Total Variable Cost (N),

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 smallscale women rice farmers as stated in specific objective two (ii).

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

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

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

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

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

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

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

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 smallscale women rice farmers as stated in specific objective two (ii).

Stochastic Production Frontier Model

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

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

The stochastic production frontier model was used to estimate the technical, economic and allocative efficiency scores as stated specifically in objective 3 (iii).

Economic Efficiency (EE)

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:

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

Where,

EE_i= Economic Efficiency (Number)

TE_i = Technical Efficiency (Number)

AE_i= Allocative Efficiency(Number)

This was used to achieve specifically objectives 3(iii) which is to determine the AE, TE, and EE scores of rice production, and 4 (iv) which is to evaluate factors influencing EE of rice production among smallscale women rice farmers,

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

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

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

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

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

Y_i = Efficiency Score, EE (Number)

X_1 = Farm Size (Hectares)

X_2 = Labour Input (Mandays)

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 4 (iv) which is to evaluate factors influencing EE of rice production among smallscale women rice farmers.

4. Results and Discussion

4.1 Socio-Economic Characteristics of Smallscale Women Rice Farmers

Table 1 shows the socio-economic characteristics of women rice farmers. The variables under consideration include: - age, marital status, level of education, household size, farm experience, farm size, and output produced. About 88% of women rice farmers were less than 50 years of age. The mean age was 44 years. Also, 92% of women farmers had less than 20 years' of farm experience in rice production. The mean farm experience was 11 years. These statistics show that rice women farmers are agile, strong, still in their productive age and better experienced to handle the farming challenges with vigor, this would help them in adopting new technologies in rice production. A study deduced that as producers grow older, they increase their rice production (Miassi et al., 2023). Their experiences acquired as well as income accumulated over the years are features that allow them to increase the areas for rice production. This is similar to the results of (Umar et al., 2020; Obianefo et al., 2021). In addition, 84% of 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 reported that the average number of household size of rice producers Benin Republic, West Africa is seven people (Miassi et al., 2023). The average farm size was 1.31 hectares, this shows that women rice farmers were smallscale or smallholder farmers. The mean output of rice produced by women farmers were 1925Kg. Other findings obtained the mean rice yield of 8172Kg (Standard deviation = 4631.72) in Anambra State, Nigeria. Similarly, Ojo et al. (2020) obtained the mean rice yield of 12, 207.52 Kg (Standard deviation = 5,296.52) in Southwest, Nigeria (Obianefo et al., 2021).

Table 1: Distribution of Women Rice Farmers based on the Socio-Economic Features			
Socio-Economic Characteristics	**Frequency**	**Percentage**	**Mean**
Age (Years)			
20 – 30	02	02.00	
31 – 40	32	32.00	
41 – 50	44	44.00	**44.00**
51 – 60	22	22.00	
Marital Status			
Single	14	14.00	
Married	84	84.00	
Widow	02	02.00	
Level of Education			
Primary	16	16.00	
Secondary	24	24.00	
Tertiary	52	52.00	
Adult Education	02	02.00	
Non-Formal	02	02.00	
Household Size (Number)			
1 – 5	16	16.00	
6 – 10	58	58.00	
11 – 15	20	20.00	**9.00**
16 – 20	04	04.00	
21 – 25	02	02.00	
Farm Experience (Years)			
1 – 10	52	52.00	
11 – 20	40	40.00	
21 – 30	08	08.00	**11.00**
Farm Size (Hectare)			
< 1	46	46.00	
1.1 – 2.0	32	32.00	
2.1 – 3.0	20	20.00	**1.31**
3.1 – 4.0	02	02.00	
Output Produced (50Kg Bag)			
1 – 20	20	20.00	
21 – 40	40	40.00	
41 – 60	24	24.00	
61 – 80	12	12.00	**38.50**
81 – 100	04	04.00	
Total	**100.00**	**100.00**	

Source: Field Survey (2023)

4.2 Institutional Variables Accessed by Women Rice Farmers

Table 2: Distribution of Institutional Variables Accessed by Women Rice Farmers		
Institutional Variables	**Frequency**	**Percentage**
Member of Cooperative Association		
Yes	10	10.00
No	90	90.00
Sources of Capital		
Personal Savings	72	72.00
Friends and Family	16	16.00
Banks/Financial Institutions	02	02.00
Cooperatives	08	08.00
Money Lenders	02	02.00
Access to Credit		
Yes	12	12.00
No	88	88.00
Amount of Credit Accessed (Naira)		
None	88	88.00
100,000	06	06.00
150,000	05	05.00
200,000	01	01.00
Extension Contact		
Yes	22	22.00
No	78	78.00
Number of Extension Contact/Month		
None	78	78.00
Once	14	14.00
Twice Thrice	04	04.00
Total	**100.00**	**100.00**

Source: Field Survey (2023)

Table 2 presented the distribution of institutional variables accessed by women rice farmers. The institutional variables under consideration include: member of cooperative association, sources of capital, access to credit, amount of credit accessed in Naira, extension contact, and number of contact per month. About 90% of women rice farmers do not belong to any member of cooperative association, while 10% were members of cooperative societies. Member of cooperatives enables the women rice farmers have access to credit facilities, purchase farm inputs (eg fertilizer input) at affordable prices, and sell their farm produce in bulk. According to Adamu et al. (2021) who documented that members of cooperative association expose women rice farmers to vital information as well as access to production inputs. The sources of capital for rice production include: - personal savings (72%), friends and family (16%), banks/ financial institutions (02%), cooperatives (8%), and money lenders (2%). About 88% of women rice farmers do not have access to credit facilities, while 12% have access to credit facilities. According to Adamu et al. (2021) who reported that access to credit facilities will go a long way in improving the individual farm enterprises in terms of agricultural production. 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 has the boldness, courage and technical know-how required to approach banks or financial institutions for credit or loan facilities. Also, Asogwa et al. (2014) who stated that level of education raises women farmers' knowledge and level of awareness about the needs for loan for increased rice or agricultural output. These results are in line with the findings of Chiandio et al. (2017) who reported that institutional credit facilities facilitate and increases the productivity of the farmers. According to Miassi et al. (2023) who that reported that lack of access to agricultural financing will force producers to cultivate small hectares of farm. In addition, 22% of women rice farmers have contact with extension agents, while 78% do not have contact with extension agent. Extension agents disseminate new research findings, innovations, new technologies to farmers.

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

Table 3 presented the costs, returns and profitability of rice production among women farmers. The revenue obtained and costs incurred were based on the prevailing market prices as at the time of the field survey. The costs include: - the variable cost and the fixed cost. The total variable cost (TVC) was 260,500 Naira and this accounted for 93.20% of total cost of rice production. The variable costs include: - 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 total cost of rice production. The fixed costs include: - land (5%), taxes (0.72%), and fixed input (01.07%). The fixed inputs include: hoe, sickles, sprayers, cutlass, harrow, plough, and water pump. The gross income, gross margin and net farm income of rice production were calculated at 696,300 Naira, 435,800 Naira and 416,800 Naira respectively. This shows that 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. A studies obtained GMR of 0.8618 for rice production among women farmers in Abuja, Nigeria (Alabi et al., 2021; Alabi et al., 2004; Alabi, 2008).

Table 3: Costs, Returns and Profitability of Rice Production among Smallscale Women Farmers

Variable	Units	Quantity	Price	Value	%TC
(a) Total Revenue	50Kg Bag	30	23,210	696,000	
(b) Variable Cost					
Seed Input	Kg	5	3,000	15,000	05.37
Land Clearing	Mandays	5	15,000	75,000	26.83
Planting	Mandays	6	2,500	15,000	05.37
Fertilizer	50Kg Bag	3	24,000	72,000	25.76
Chemical	Litres	9	3,500	31,500	11.27
Harvesting	Mandays	6	2,000	12,000	04.29
Bagging	Mandays	30	200	6,000	02.15
Beating	Mandays	10	2,500	25,000	08.94
Transportation	Number	30	300	9,000	03.22
Total Variable Cost (TVC)				**260,500**	**93.20**
(c) Fixed Cost (Depreciated)					
Land	Ha	1	-	14,000	05.00
Taxes			-	2,000	00.72
Fixed Input (Hoe, Sickles, Sprayers, Cutlass, Harrow, Plough, Water Pump)	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

4.4 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 smallscale 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 of this is that the farmers were economically inefficiency, technically inefficient and allocative inefficient. That is, the women rice farmers were inefficient in deriving maximum output from input, given the available resources. The minimum AE, EE and TE scores of 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, smallscale women rice farmers were 5% economically efficient, while on the maximum, the smallscale women rice farmers were 97% economically efficient. The result of the stochastic production efficiency frontier further indicates that technical efficiency varied widely (standard deviation, 0.2572) among the sampled smallscale women rice farmers, with minimum and maximum values of 0.07 and 0.96 respectively. The wide variations in technical efficiency estimates is an indication that most of the smallscale 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 exists wide

opportunities for improving on 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 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 is an indication that most of the women rice farmers still allocate their resources inefficiently in the production process and there still exists opportunities for improving on their current level of allocative efficiency. This result suggests that the women rice farmers were not minimizing production costs, thus indicating that they were utilized the inputs in the 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 is an indication that most of smallscale women rice farmers were still economically inefficient in the use of resources for production and there still exists opportunities for improving on 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, the more the likelihood or probability of the 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 in their findings concluded that TE, AE and EE of smallscale or smallholder farmers in Nigeria varied widely between minimum and maximum values and was an indication of their inefficiencies. Furthermore, the research study 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	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
0.00 – 0.20	12	12.00	16	16.00	19	19.00
0.21 – 0.40	18	18.00	21	21.00	12	12.00
0.41 – 0.60	29	29.00	20	20.00	25	25.00
0.61 – 0.80	27	27.00	31	31.00	34	34.00
0.81 – 1.00	14	14.00	12	12.00	10	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)

4.5 Factors Influencing Economic Efficiency of Rice Production among Women Farmers

The factors influencing economic efficiency of rice production among women farmers was evaluated using Tobit dichotomous regression model and presented in Table 5. The factors under consideration include: - farm size, labour 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 economic efficiency of rice production among women farmers at ($P < 0.01$). Labour input, household size, fertilizer input, chemical input, farm experience, and access to credit were significant factors influencing economic efficiency of rice production among women farmers at ($P < 0.05$). All the variables except household size had positive coefficient. The coefficient of farm size (0.3128) was positive and significant at 1% probability level. A one-hectare increase in farm size will lead to the likelihood of marginal increase in 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 farm experience will lead to the likelihood or probability of marginal increase in 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 farm experience acquired by smallholder rural women farmers will lead to 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 likelihood or probability of marginal decreases in the economic efficiency of smallscale women rice farmers by 5.36%. This result is in line with findings of Kazeem (2020) who reported that households with more members are 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 variations in 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
Labour 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 ($P < 0.01$).

4.6 The Constraints Facing Women Rice Farmers

The constraints facing women rice farmers was presented in Table 6. About twelve (12) constraints facing women rice farmers 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 labour (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), problem of diseases (11th), and problem of pest infestation (12th). This result is in line with Alabi et al. (2021) who identified lack of fertilizer input, lack of credit facilities, bad road infrastructures, lack of improved seed inputs, lack of labour 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 facing rice farmers in Benin Republic in West Africa include: - inefficiency of agricultural equipment, difficult in accessing inputs, inferior seed quality, lack of access to agricultural credit, limited availability of labour, and difficult accessing the market

Table 6: Distribution of Women Rice Farmers base on their Constraints

Constraints	*Frequency (f)	Percentage	Rank
Inadequate Credit Facilities	148	08.93	1st
High Cost of Labour	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

5. Conclusion and Recommendations

This research study has established that 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 are literate and had formal education with considerable number of experiences in rice production. The women rice farmers had on the average about 11 years of farm experience. Average, they have total number of 9 people per household. In terms of institutional variables, majority of women rice farmers do not extension contact, and they do not have access to credit facilities. The source of capital is through personal savings and they do not belong to any member of cooperative association. The labour input in mandays constitutes the highest percentage of about 50.8% of total costs of activities involved in rice production. The net farm income and gross margin ratio was calculated at 416, 800 Naira and 0.63 respectively. The mean AE, EE and TE scores of 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 economic efficiency of rice production include: - farm size, labour input, household size, seed input, fertilizer input, chemical input, farm experience, and access to credit facilities. These predictors explained 75.62% of variations in the economic efficiency of rice production among women rice farmers. The major constraints encountered by women rice farmers include: - inadequate credit facilities (1st), high cost of labour (2nd), high cost of fertilizers (3rd), and inadequate extension services (4th). Based on this research findings, the following recommendations were made: -

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

(ii) Credit facilities should be provided at 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 producing area to nearby market

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

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