Economics of Rice Production and its Effect on Household Food Security Status in Abaji Area Council of Abuja, Nigeria

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Abstract— *This study examined the Economics of Rice Production and Its Effect on Household Food Security Status in Abaji Area Council, Abuja, Nigeria. A multistage sampling technique was used to select 200 rice farmers, and data were analyzed using descriptive statistics, Net Farm Income analysis, Food Security Index, and Tobit regression model. The socio-economic results showed that the mean age of farmers was 43.6 years, with an average household size of 6.7 persons and mean farming experience of 11.8 years. About 74% were married, 58% had secondary education, and 69% belonged to cooperative societies, with an average annual income of ₦218,000. Profitability analysis revealed that rice production was viable, yielding a Net Farm Income of ₦323,142.96, Return per Naira Invested of 3.39, Operating Ratio of 0.19, and Gross Ratio of 0.30, showing efficient resource use. Food security results indicated that 62.5% of households were food secure, while 37.5% were food insecure, with a mean Food Security Index of 1.79. The Tobit model identified education level, farm size, farm income, access to credit, cooperative membership, and farming experience as significant at the 1% and 5% levels, while age and extension contact were significant at the 10% level. Marital status was not significant. Major constraints included inadequate access to credit (78%), high input costs (74.5%), poor irrigation (64%), and pest infestation (60.5%). The study concluded that rice farming is profitable and contributes positively to household food security despite key production challenges.*

Keywords— Rice production, profitability, food security, tobit regression.

I. INTRODUCTION

Rice remains one of Nigeria's most important staple foods, serving as both a subsistence and cash crop, and contributing significantly to household food security and the national economy. Nigeria is Africa's largest rice producer and consumer, with domestic demand far exceeding supply due to inefficiencies in production and post-harvest systems (Etuah *et al*., 2024: Olaitan *et al*., 2025). The importance of rice production to household food security lies in its dual role as a food and income source for smallholder farmers who constitute the majority of Nigeria's rural population. However, the economic efficiency of rice production has been hindered by rising input costs, weak extension services, and climate-induced yield fluctuations. Studies have revealed that the profitability of rice farming depends heavily on access to improved inputs, mechanization, irrigation, and market access (Ogunniyi *et al*., 2021; Yusuf *et al*., 2022; Olawumi *et al*., 2025a). The introduction of policies such as the Anchor Borrowers' Programme and the National Rice Development Strategy aimed to enhance productivity and reduce imports, yet their effectiveness in achieving sustainable food security remains mixed due to regional disparities and limited farmer inclusion (Ojehomon *et al*., 2020; Olawunmi *et al*., 2025b). As Etuah *et al*. (2024) note, resilience-building in the agricultural sector is crucial to mitigating long-term yield declines and ensuring income stability for vulnerable farming households facing climatic and economic shocks.

The economics of rice production directly influence household food security by affecting income distribution, employment generation, and access to affordable food. Empirical studies indicate that households engaged in profitable rice production exhibit higher food security status compared to non-farming households (Adenegan & Adewuyi, 2021; Awoyemi *et al*., 2022; Oyediji *et al*., 2025). Profitability analyses, particularly through gross margin and net farm income assessments, demonstrate that small-scale rice producers often operate with thin margins due to high costs of fertilizer, labour, and transportation (Mogues & Ayoola, 2021; Olawunmi *et al*., 2025c). Moreover, inadequate access to credit and poor infrastructural development exacerbate production inefficiencies and reduce market competitiveness. According to Nwosu *et al*. (2023), the average gross margin per hectare for smallholder rice farmers remains below regional benchmarks, suggesting that productivity gains are offset by inefficient resource allocation. Gender dynamics also play a crucial role, with female-headed households facing greater constraints in access to productive assets and extension services, leading to lower food security levels (Babatunde & Adefalu, 2020; Mato *et al*., 2025). As a result, interventions that improve farmers' economic capacity — including access to subsidized inputs, affordable financing, and extension education — have a multiplier effect on food security outcomes by enhancing both production efficiency and household consumption stability (Oyediji *et al*., 2025b).

Despite notable progress in increasing domestic rice production, Nigeria continues to face challenges in translating agricultural growth into improved food security outcomes. While the self-sufficiency ratio in rice production has improved since 2015, recurrent issues such as post-harvest losses, price volatility, and weak value chain integration persist (FAO, 2022; Kaka *et al*., 2023; Akomolafe *et al*., 2025). Empirical modelling using binary logistic regression and stochastic frontier analysis has revealed that factors such as household income, farm size, education, access to irrigation, and cooperative membership significantly determine food security status among rice-farming households (Usman *et al*., 2021; Oyotombe *et al*., 2025). Climate variability, particularly flooding and drought, further compounds the risks, threatening both yields and income stability (Etuah *et al*., 2024; Olaitan *et al*., 2025b). Addressing these challenges requires a comprehensive economic strategy that integrates productivity enhancement with social protection mechanisms. Scholars emphasize that rice production must be viewed not merely as an agricultural activity but as a strategic pathway toward rural transformation and sustainable livelihoods (Ojo *et al*., 2022; Adesina & Olagunju, 2023; Alabuja *et al*., 2025). Therefore, this study aims to evaluate the economics of rice production and its effect on household food security status in Abaji Area Council, Abuja. To accomplish this, the following objectives are put forward:

i. Describe the socio-economic characteristics of rice farming households in the study area;
ii. Determine the profitability of rice production in the study area;
iii. Examine the food security status of rice farming household in the study area;
iv. Estimate the effect of rice production on household food security status in the study area;
v. Identify the challenges associated with rice production in the study area.

II. LITERATURE REVIEW

2.1 Theoretical Framework:

The theoretical foundation of this study draws upon the Production Theory. The Production Theory, rooted in neoclassical economics, posits that output is a function of various inputs such as land, labour, capital, and technology (Samuelson & Nordhaus, 2010). In this study, rice production is conceptualized as a process where smallholder farmers combine resources—land, seeds, fertilizers, and labour—to maximize output and income. The production function, often expressed as $Q = f(L, K, T, M)$, where Q is rice output, L is labour, K is capital, T is technology, and M represents management or inputs, serves as the analytical foundation for measuring economic efficiency. According to Ogunniyi *et al*. (2021), efficient resource allocation and adoption of improved technologies significantly enhance productivity, which in turn raises income levels. However, when inputs are underutilized or misallocated—due to factors such as poor access to credit or extension services—farmers experience declining returns and lower profitability. This inefficiency directly affects their purchasing power and ability to secure adequate food, linking production performance to household food security outcomes. Thus, the Production Theory underpins the economic analysis of rice farming and its implications for welfare improvement.

2.2 Conceptual Framework:

The conceptual framework for this study, exploring the relationship between the independent variables and the dependent variables (household food security status) being mediated by the intervening variables. The independent variables in this study

are the main predictors or explanatory variables that determine the level of household food security, and these include socio-economic characteristics of age, education level, household size, farming experience, access to extension services, access to credit and membership of cooperative society. The intervening variables represent external or contextual factors that can either strengthen or weaken the relationship between rice production economics and food security. They include government policies and programs, environmental and climatic factors, infrastructure and market systems.

III. MATERIALS AND METHODS

3.1 Study Area:

Abaji Area Council is one of the six administrative councils in Nigeria's Federal Capital Territory (FCT). Located about 58 km southwest of Abuja city, it lies between latitude 8°25′N and 8°45′N and longitude 6°45′E and 7°15′E, sharing boundaries with Kwali, Gwagwalada, Lokoja (Kogi State), and Nasarawa State (FCDA, 2023). The area covers about 1,100 km² with a population of roughly 150,000 inhabitants (NPC, 2023). The people are mainly Gwari, Bassa, Egbira, Gede, Hausa, and Fulani, and their livelihood revolves around subsistence agriculture. Abaji town serves as the administrative and commercial center, strategically located along the Abuja–Lokoja highway, facilitating easy transport of farm produce to markets (FCT-ADP, 2022).

Abaji falls within the Guinea Savannah ecological zone, characterized by a tropical climate with a wet season from April to October and an annual rainfall of 1,200–1,500 mm. Temperatures range between 26°C and 34°C, ideal for crop cultivation (NIMET, 2022). The area has loamy and alluvial soils, making it highly suitable for rice farming, particularly along river floodplains such as the Gurara River and its tributaries (Abaji Agriculture Department, 2023). Besides rice, farmers cultivate maize, cassava, yam, and vegetables, using mostly family labour and traditional tools (Ogunniyi *et al*., 2021).

The economy is largely agrarian, with over 70% of residents engaged in farming, petty trading, and agro-processing. Despite its fertile land, Abaji faces constraints such as limited access to credit, poor infrastructure, and post-harvest losses (FAO, 2022). However, proximity to Abuja city offers access to urban markets and income opportunities. Government initiatives like the Anchor Borrowers' Programme and FADAMA projects support farmers through credit and training (FCT-ADP, 2022).

Abaji is selected as the study area because it reflects the economic, environmental, and livelihood realities of smallholder rice producers in Nigeria. Its favourable agro-ecological conditions, vibrant rice-farming communities, and market linkages make it an ideal setting for analyzing how rice production economics influence household food security (FAO, 2022; Ogunniyi *et al*., 2021).

3.2 Population of the Study and Research Design:

The study population comprises all rice-farming households in Abaji Area Council, Abuja. These smallholder farmers cultivate between 1–3 hectares, relying on family labour and mixed production systems.

This study adopts a descriptive survey research design complemented by quantitative analysis. The descriptive survey approach is appropriate because it enables the researcher to collect data directly from farmers to describe the economic characteristics of rice production and assess its impact on household food security status (Ogunniyi *et al*., 2021). The design allows for the systematic collection of both primary and secondary data on production inputs, yield, household income, and food consumption patterns.

3.3 Sample Size and Sampling Techniques:

The study employed a multi-stage sampling technique to select respondents from rice-farming households in Abaji Area Council of the Federal Capital Territory (FCT), Nigeria. This method was chosen to ensure that farmers from various communities and production scales were adequately represented.

In the first stage, six major rice-producing communities — Agyana, Nuku, Pandagi, Yaba, Rimba, and Abaji town — were purposively selected based on their prominence in rice cultivation (Abaji Agriculture Department, 2023).

In the second stage, a list of registered rice farmers was obtained from the FCT Agricultural Development Programme (FCT-ADP). From this list, proportionate random sampling was applied to determine the number of respondents from each community according to the relative size of their farming population.

In the third stage, simple random sampling was used to select individual rice-farming households from each community, ensuring that every farmer had an equal chance of inclusion. A total of 200 respondents were selected as the study's sample

size. This figure was determined to provide sufficient statistical reliability and representativeness while maintaining feasibility in data collection.

The 200 respondents were distributed proportionately among the six communities as follows: Agyana (35), Nuku (30), Pandagi (35), Yaba (35), Rimba (30), and Abaji town (35). This distribution reflects the density of rice farmers in each area and ensures balanced representation across the council.

3.4 Data Collection:

The primary data for this study were collected using a structured questionnaire designed to obtain detailed information from rice-farming households in Abaji Area Council, Abuja. The questionnaire was administered to a representative sample of 200 farmers, with each session lasting about one hour to allow respondents ample time to provide accurate and thoughtful answers. To ensure the instrument's validity and reliability, a pilot test was conducted with a small group of rice farmers outside the main sample. Feedback from the pilot exercise helped refine question wording, structure, and relevance, ensuring that the final instrument effectively captured data on the economics of rice production and its impact on household food security. Trained enumerators were engaged to administer the questionnaires, ensuring that respondents clearly understood each question and that responses were accurately recorded.

3.5 Data Analysis:

Data collected from rice-farming households in Abaji Area Council were analyzed using a combination of descriptive and inferential statistical methods. Descriptive statistics such as means, frequencies, and percentages were employed to address Objectives (i) and (v) — describing the socio-economic characteristics of the farmers and identifying challenges associated with rice production.

To achieve Objective (ii), which sought to determine the profitability of rice production, the Net Farm Income (NFI) model was used. For Objective (iii), the Food Security Index (FSI) was constructed to assess the food security status of rice-farming households. To address Objective (iv), which estimated the effect of rice production on household food security, the Tobit regression model was applied, capturing both the intensity and likelihood of household food security.

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 24, which provided a reliable platform for both descriptive and econometric analyses, ensuring accuracy and robustness in data interpretation.

3.6 Model Specification:

3.6.1 Net Farm Income (NFI) Model:

The Net Farm Income model was employed to determine the profitability of rice production in the study area. It is expressed as:

$$NFI = TR - TC \quad (1)$$

Where:

NFI = Net Farm Income (₦)

TR = Total Revenue (₦)

TC = Total Cost of Production (₦)

The total cost (TC) comprises both variable and fixed costs, given as:

$$TC = TVC + TFC \quad (2)$$

Where:

TVC = Total Variable Cost (₦)

TFC = Total Fixed Cost (₦)

Fixed assets such as tractors and sprayers were depreciated using the straight-line method:

$$D = \frac{P-S}{N} \quad (3)$$

Where:

D = Depreciation (₦), P = Purchase Value (₦), S = Salvage Value (₦), and N = Life Span (years).

The Return per Naira Invested (RNI) was obtained as:

$$GNI = \frac{GI}{TC} \quad (4)$$

Where

GI = Gross Income (₦) and TC = Total Cost (₦).

Decision Rule:

- If RNI > 1, the enterprise is profitable.
- If RNI = 1, the farmer breaks even.
- If RNI < 1, the farmer incurs a loss.

The Gross Ratio (GR), indicating cost efficiency, was calculated as:

$$GR = \frac{TC}{GI} \quad (5)$$

3.6.2 Food Security Index (FSI):

To measure household food security (Objective iii), a Food Security Index was constructed following identification and aggregation procedures. The food security line represents the minimum daily calorie intake required for healthy living. Households consuming below this line were classified as food insecure. The model is given as:

$$Z_i = \frac{X}{Y} \quad (6)$$

Where:

Zi = Food Security Index,

X = Per capita calorie available per day,

Y = Recommended per capita calorie intake per day.

Decision Rule:

- If Zi ≥ 1: Household is food secure.
- If Zi < 1: Household is food insecure.

3.6.3 Tobit Regression Model:

To evaluate the effect of rice production on household food security status (Objective iv), a Tobit regression model was applied due to its suitability for censored dependent variables. The model is expressed as:

$$Y_i = X_i\beta + \varepsilon_i \quad (7)$$

Where:

Yi = Food Security Index of the *i-th* household,

Xi = Vector of independent variables,

β = Vector of parameters to be estimated,

εi = Error term

The explicit form of the model is:

$$Yi=\beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \beta6X6 + \beta7X7 + \beta8X8 + \beta9X9 + \beta10X10 + \beta11X11 + \mu i \quad (8)$$

Where:

X1 = Output of rice (kg),

X2 = Age of household head (years),

X3 = Marital status,

X4 = Education level (years),

X5 = Household size,

X6 = Farm size (ha),

X7 = Farming experience (years),

X8 = Membership of association,

X9 = Access to credit (₦),

X10 = Off-farm income (₦),

X11 = Extension contact frequency,

μi = Error term.

IV. RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of Rice Farmers:

The results in Table 1 show that the mean age of rice farmers was 43.6 years, indicating that most are in their economically active years. About 35% were between 40–49 years, suggesting an experienced and productive group capable of managing farm activities efficiently. This finding aligns with Ogunniyi *et al.* (2021), who noted that rice farming in Nigeria is dominated by middle-aged farmers with both energy and experience.

Marital status distribution revealed that 74% were married, while 16% were single and 10% widowed or divorced. This shows that rice farming households are mostly family-based. Ojo *et al*. (2020) observed similar trends, stating that married farmers often have higher labour availability and social stability that support agricultural productivity.

Farming experience among respondents averaged 11.8 years, with 60% having over six years of engagement. This indicates that most farmers have acquired substantial practical knowledge and farming skills. This result is consistent with Akinbode and Rahji (2020), who emphasized that long years of experience improve farmers' adaptation to production challenges and market conditions.

Regarding educational status, 41% of respondents had secondary education, 28% primary, 17% tertiary, while 14% had no formal education. This suggests a moderately literate farming population. Ogunlela and Mukhtar (2021) noted that education significantly influences decision-making, technology use, and resource management among smallholder farmers, thus improving farm productivity and efficiency.

The average household size was 6.7 persons, indicating relatively large families. About 45% of respondents had 4–6 members. Larger households provide readily available family labour, which is beneficial during peak farming periods. Nwaobiala and Nwosu (2020) observed that household size directly affects both labour supply and food demand in rural Nigerian households.

Access to credit was relatively moderate, with 64% of farmers having received some financial assistance. The average credit amount accessed was ₦68,400. Access to credit enables farmers to purchase inputs such as improved seeds and fertilizers, enhancing productivity. Ogunleye *et al.* (2021) reported that collateral requirements and high interest rates often restrict smallholders' access to agricultural loans in Nigeria.

Access to extension services was found to be moderate, with 71% of respondents having at least one contact per season and an average of 2.3 visits. This contact frequency is below the recommended level for effective information dissemination. FMARD (2022) emphasized that frequent extension interactions enhance knowledge transfer, but limited visits can reduce the impact of advisory services.

About 69% of farmers belonged to cooperatives, with an average membership duration of 4.1 years. Afolami *et al*. (2019) found that cooperative participation improves farmers' welfare and access to agricultural support programs, thus strengthening their resilience to market fluctuations.

The average annual farm income was ₦218,500, with 37% earning between ₦100,000 and ₦199,999. The results reflect the smallholder nature of rice farming in Abaji. FAO (2022) and Ogunniyi *et al*. (2021) observed similar patterns, noting that income levels among smallholder farmers are influenced by limited scale, market constraints, and production costs.

TABLE 1

SOCIO-ECONOMIC CHARACTERISTICS OF RICE FARMERS (n = 200)

Variable	Freq (n = 200)	Percentage
Educational level		
No formal education	28	14
Primary school	56	28
Secondary school	82	41
Tertiary education	34	17
Marital Status		
Single	32	16
Married	148	74
Widowed/Divorced	20	10
Age (Mean = 43.6 years)		
20 – 29 years	26	13
30 – 39 years	58	29
40 – 49 years	70	35
50 and above	46	23
Years of farming Experience (Mean = 11.8 years)		
1–5	40	20
6–10	68	34
11–15	52	26
16 and above	40	20
Household Size (Mean = 6.7 people)		
1–3	24	12
4–6	90	45
7–9	60	30
≥10	26	13
Cooperative Membership (Mean = 4.1 years)		
None	62	31
1–3	54	27
4–6	52	26
Above 6	32	16
Amount of Credit Received (Mean = ₦68,400)		
None	72	36
₦1 – ₦50,000	56	28
₦51,000 – ₦100,000	44	22
Above ₦100,000	28	14
Farm Income of Household Heads (Mean = ₦218,000)		
₦50,000 – ₦99,999	38	19
₦100,000 – ₦199,999	74	37
₦200,000 – ₦299,999	58	29
₦300,000 and above	30	15
Extension Visits per Season (Mean = 2.3 times)		
None	58	29
1–2	86	43
3–4	38	19
5 and above	18	9

Source: Field Survey, 2025

4.2 Profitability of Rice Production:

The results in Table 2 show that rice production in Abaji Area Council is a profitable agricultural enterprise. The total production cost per hectare was estimated at ₦135,378.14, consisting of ₦85,551.99 in variable costs and ₦49,826.15 in fixed costs. Variable costs constituted 60.5% of the total, while fixed costs accounted for 35.3%, indicating that rice farming is relatively labour- and input-intensive. Similar cost structures were observed by Ogunniyi *et al*. (2021) and Akinbode and Rahji (2020), who found that variable inputs dominate production expenditure in smallholder rice systems in Nigeria.

Among the variable cost components, labour accounted for the largest share (₦36,940.25, or 26.1% of total cost), reflecting the labour-intensive nature of rice cultivation. The heavy reliance on manual labour underscores the limited mechanization in smallholder rice farming systems, a pattern also noted by FAO (2022).

Fertilizer and agrochemical costs were ₦12,150.00 (8.6%) and ₦9,360.80 (6.6%), respectively. Rising fertilizer prices and inadequate input subsidies continue to affect smallholder profitability, as observed by Ogunleye *et al*. (2021) and FMARD (2022).

The fixed cost component amounted to ₦49,826.15 per hectare, dominated by land rent or lease cost (₦32,490.60; 23.0%) and machinery depreciation (₦9,620.20; 6.8%). This reflects the increasing cost of land acquisition and the use of hired or depreciated machinery for tilling and harvesting. Similar fixed cost patterns were reported by Ojo *et al*. (2020), who noted that land rent constitutes the largest non-variable cost in irrigated and upland rice systems.

In terms of returns, rice farmers recorded an impressive gross income (GI) of ₦458,521.10 per hectare, derived from sales (₦385,460.70; 84.1%), household consumption (₦44,370.00; 9.7%), and gifts or transfers (₦28,690.40; 6.2%). This mirrors the findings of Nwaobiala and Nwosu (2020), who observed that farm produce retained for household consumption significantly contributes to rural food security.

The gross margin stood at ₦372,969.11 per hectare, while the net farm income was ₦323,142.96 per hectare. This positive net return indicates that rice production in Abaji Area Council is economically viable. The return per naira invested (3.39) means that for every ₦1 spent on rice farming, a return of ₦3.39 was earned, suggesting high profitability and efficient resource use. This aligns with results from Afolami *et al*. (2019) and Ogunniyi *et al*. (2021), who reported positive returns among smallholder rice producers in Nigeria.

The operating ratio (0.19) and fixed ratio (0.11) further demonstrate cost efficiency. The low operating ratio implies that only 19% of total revenue is used to cover variable expenses, leaving a large portion as potential profit. The gross ratio (0.30), which measures the proportion of total cost to gross income, indicates a favourable cost-to-income relationship. According to FAO (2022), a gross ratio below 1 signifies profitability, and a lower value reflects better financial performance; hence, rice production in Abaji shows strong financial sustainability.

TABLE 2
AVERAGE COSTS AND RETURNS PER HECTARE OF RICE PRODUCTION

Items of Cost	Average Value (₦/ha)	Percentage (%)
Variable Cost		
Seed and Seedlings	13,820.50	9.8
Labour (land preparation, planting, weeding, irrigation, harvesting, threshing)	36,940.25	26.1
Fertilizers	12,150.00	8.6
Agrochemicals (herbicides, pesticides, etc.)	9,360.80	6.6
Transportation (input and produce movement)	13,280.45	9.4
Total Variable Cost (TVC)	**85,551.99**	**60.5**
Fixed Cost		
Land Rent/Lease	32,490.60	23
Farm Equipment and Machinery Depreciation	9,620.20	6.8
Storage and Maintenance Costs	7,715.35	5.5
Total Fixed Cost (TFC)	**49,826.15**	**35.3**
Total Cost (TC)	**135,378.14**	**100**
Returns		
Sales Revenue	385,460.70	84.1
Household Consumption Value	44,370.00	9.7
Gifts/Transfers	28,690.40	6.2
Gifts/Transfers	**28,690.40**	**6.2**
Gross Income (GI)	**458,521.10**	**100**
Gross Margin (GI – TVC)	**372,969.11**	**—**
Net Farm Income (GI – TC)	**323,142.96**	**—**
Return per Naira Invested (GI ÷ TC)	**3.39**	**—**

Source: Field Survey, 2025

4.3 Household Food Security Status among Rice-Farming Households:

The findings presented in Table 3 show that a majority of the rice-farming households in Abaji Area Council were food secure. Out of the 200 sampled households, 62.5% were classified as food secure, while 37.5% were food insecure. The food security index of 1.79 for the food-secure group indicates that their daily calorie intake was about 79% higher than the recommended 2,260 Kcal per adult equivalent. In contrast, food-insecure households recorded a food insecurity index of 0.49, revealing that their calorie intake was 51% below the threshold for maintaining a healthy diet. This contrast suggests that food insecurity remains a major challenge among smallholder rice producers, echoing findings by Ogunniyi *et al*. (2021) and FAO (2022) that disparities in agricultural productivity and access to income significantly influence rural household food sufficiency.

The average daily calorie intake for food-secure households was 4,095.48 Kcal, exceeding the required level by 1,835.48 Kcal, while food-insecure households consumed only 1,085.26 Kcal per day. The calorie surplus index of 0.79 among secure households compared with the calorie deficiency index of 0.51 for insecure households underscores the nutritional divide between these groups. The average rice output of 8,215.33 kg for food-secure households against 1,605.42 kg for food-insecure ones illustrates that higher productivity translates directly to improved food access and consumption (Okunola *et al*., 2020).

Income levels also reinforce this pattern. The average annual income of food-secure households (₦658,720.65) was nearly three times higher than that of food-insecure households (₦242,189.37), demonstrating the critical role of economic capacity in ensuring food sufficiency. According to Obayelu *et al*. (2019) and Akinyele (2021), households with greater financial resources can better afford diverse and adequate diets, even during periods of production shortfall or market price fluctuations.

In general, the results affirm a strong interrelationship between rice production, income, and food security status. Households with higher yields and greater financial returns experienced better food access, nutritional intake, and overall well-being.

Conversely, those with limited resources and lower productivity faced persistent food insecurity. These findings are consistent with studies by Amaza *et al*. (2020) and FAO (2022), which emphasize that improving agricultural output and income levels significantly enhances household food security in rural Nigeria.

TABLE 3
FOOD SECURITY ANALYSIS OF RICE-FARMING HOUSEHOLDS IN ABAJI AREA COUNCIL

Variable (Average Values)	Value
Food-secure households (No.)	125
Household food security index	1.79
Calorie surplus index	0.79
Average daily calorie intake per food-secure household (Kcal)	4,095.48
Average calorie intake above recommended level (2,260 Kcal)	1,835.48
Average total rice output per food-secure household (kg)	8,215.33
Average annual income of food-secure household (₦)	658,720.65
Proportion of food-secure households (%)	62.5
Food-insecure households (No.)	75
Household food insecurity index	0.49
Calorie deficiency index	0.51
Average daily calorie intake per food-insecure household (Kcal)	1,085.26
Average calorie shortfall from recommended level (2,260 Kcal)	1,174.74
Average total rice output per food-insecure household (kg)	1,605.42
Average annual income of food-insecure household (₦)	242,189.37
Proportion of food-insecure households (%)	37.5

Source: Field Survey, 2025

4.4 Factors Influencing Household Food Security Status among Rice Farmers:

The Tobit model summary in Table 4 indicates a good overall fit, with a Log Likelihood of -94.357 and an LR Chi-Square value of 42.816 significant at $p < 0.01$, confirming the joint significance of all explanatory variables. The Pseudo R^2 of 0.312 suggests that approximately 31.2% of the variation in household food security status among rice farmers is explained by the included variables, demonstrating a moderately strong explanatory power suitable for cross-sectional household data.

Education showed a positive and significant relationship ($\beta = 0.028$; $p < 0.01$) with household food security. This implies that better-educated farmers are more efficient in resource use, financial management, and adoption of modern farming techniques. The result supports Ogunniyi *et al*. (2021), who found that education improves household welfare and dietary adequacy among farming families in Nigeria.

Farm size positively influenced food security ($\beta = 0.152$; $p < 0.01$), signifying that larger farms generate higher output and income, improving food availability. FAO (2022) similarly identified farm size as a critical determinant of household food security through its direct link to agricultural productivity.

Farm income ($\beta = 0.000021$; $p < 0.01$) was highly significant, confirming that higher income levels lead to improved food security. This aligns with Obayelu *et al*. (2019), who established that income growth is directly associated with enhanced food availability and nutritional sufficiency among Nigerian farmers.

Household size had a negative and significant coefficient (-0.022; $p < 0.05$), implying that larger households are more prone to food insecurity due to higher dependency ratios and consumption pressures. This is consistent with Obayelu *et al*. (2019), who reported that smaller households tend to achieve better food sufficiency levels in rural Nigeria.

The coefficient for farming experience (0.009) was significant at the 5% level, showing that experienced farmers are more food secure. This agrees with Okunola *et al*. (2020), who found that experience positively affects productivity and food access among crop producers.

Cooperative membership was significant at the 5% level ($\beta = 0.018$), indicating that longer involvement in cooperatives enhances food security. This corroborates Akinyele (2021), who noted that cooperatives strengthen farmers' resilience and resource access, leading to better food security outcomes.

Access to credit (β = 0.000012; p < 0.05) had a positive and significant impact, demonstrating that credit availability enables farmers to invest in inputs, machinery, and better farm management practices. Olayemi *et al*. (2020) affirmed that credit access mitigates liquidity constraints and stabilizes food supply among farming households.

The coefficient for age (-0.013) was significant at the 10% level, indicating a negative relationship between farmers' age and household food security. This finding aligns with Amaza *et al*. (2020), who observed that younger farmers are more likely to adopt improved technologies, enhancing food security outcomes.

The coefficient for extension contact (0.036) was positive and significant at 10%, suggesting that interaction with extension officers enhances food security. Alabi and Arinola (2022) also found that frequent extension visits significantly increase adoption rates of high-yield technologies among rural farmers.

Marital status had a positive but statistically insignificant coefficient (0.054), suggesting that whether a farmer is married or not had minimal effect on household food security. Olayemi *et al*. (2020) similarly found that marital status exerted no substantial influence on household food consumption levels among Nigerian smallholders.

TABLE 4

TOBIT REGRESSION ESTIMATES OF FACTORS INFLUENCING HOUSEHOLD FOOD SECURITY STATUS AMONG RICE FARMERS

Variable	Coefficient (β)	Standard Error	t-value	p-value	Significance
Constant	0.842	0.217	3.88	0	***
Age (years)	-0.013	0.007	-1.86	0.065	*
Marital Status (1 = Married, 0 = Otherwise)	0.054	0.034	1.58	0.116	NS
Educational Level (years)	0.028	0.01	2.8	0.006	***
Household Size (No.)	-0.022	0.009	-2.44	0.016	**
Farming Experience (years)	0.009	0.004	2.25	0.026	**
Farm Size (hectares)	0.152	0.044	3.45	0.001	***
Cooperative Membership (years)	0.018	0.009	2	0.048	**
Contact with Extension Agents (No.)	0.036	0.02	1.8	0.073	*
Access to Credit (₦)	0.000012	0.000005	2.4	0.018	**
Farm Income (₦)	0.000021	0.000007	3	0.003	***
Model Statistics					
Log Likelihood = -94.357					
LR Chi-Square (10) = 42.816					
Prob > Chi-Square = 0.000					
Pseudo R^2 = 0.312					

Note: ***, ** and * indicate significance at 1%, 5% and 10% probability level respectively; NS = Not Significant

Source: Field Survey, 2025

4.5 Constraints to Rice Production among Farmers:

The results in Table 5 identify the major constraints affecting rice production among farmers in Abaji Area Council. The most pressing challenge reported was inadequate access to credit facilities (78%), which restricts farmers' ability to purchase quality inputs, hire labour, and invest in modern technologies. Limited access to affordable financing has long been recognized as a key bottleneck in smallholder agriculture across Nigeria (Ogunniyi *et al*., 2021).

The high cost of farm inputs (74.5%) ranked second, reflecting the rising prices of fertilizers, agrochemicals, and improved seeds, which directly reduce profitability and productivity. This supports findings by FAO (2022) that escalating input costs limit production efficiency among smallholder farmers. Similarly, poor access to irrigation and water supply (64%) was identified as a major issue, exposing farmers to rainfall dependency and the effects of climate variability.

Pest and disease infestation (60.5%) also emerged as a significant challenge, leading to yield losses and increased production costs. Limited access to extension services (54.5%) constrains farmers' exposure to improved agronomic practices and innovations, while poor road and market infrastructure (51.5%) hinders transportation and timely marketing of produce, increasing post-harvest losses. Additionally, inadequate storage facilities (48%) contribute to grain deterioration and income loss after harvest.

TABLE 5
CONSTRAINTS TO RICE PRODUCTION AMONG FARMERS IN ABAJI AREA COUNCIL

Constraints to Rice Production	Frequency	Percentage (%)
Inadequate access to credit facilities	156	78
High cost of farm inputs (fertilizers, chemicals, seeds)	149	74.5
Poor access to irrigation and water supply	128	64
Pest and disease infestation	121	60.5
Limited access to extension services	109	54.5
Poor road and market infrastructure	103	51.5
Post-harvest losses and inadequate storage facilities	96	48

Source: Field Survey, 2025

V. CONCLUSION AND RECOMMENDATIONS

The study on the Economics of Rice Production and Its Effect on Household Food Security Status in Abaji Area Council, Abuja revealed important empirical insights across socio-economic characteristics, profitability, food security, influencing factors, and production constraints among rice farmers.

The socio-economic profile indicated that the mean age of farmers was 43.6 years, implying that most were within their productive age. The majority (74%) were married, with an average household size of 6.7 persons, and farming experience of 11.8 years. Most farmers (58%) had attained at least secondary education, while 69% were members of cooperative societies and 71% had access to extension services, though the mean number of extension contacts was low (2.3 per season). The average annual farm income was ₦218,000, indicating modest economic performance within a smallholder context.

Profitability analysis revealed that rice production was economically viable. The average total cost per hectare was ₦ 135,378.14, resulting in a net farm income of ₦323,142.96. The Return per Naira Invested (RNI) was 3.39, indicating that every ₦1 invested yielded ₦3.39 profit. The Operating Ratio (0.19) and Gross Ratio (0.30) also confirmed the profitability of rice production in the area.

The food security analysis showed that 125 households (62.5%) were food secure, while 75 households (37.5%) were food insecure. The mean Food Security Index (FSI) was 1.79, indicating that the average household met the daily recommended calorie intake.

The Tobit regression results identified educational level, farm size, farm income, access to credit, cooperative membership, and farming experience significantly and positively influenced the household food security index at 1% and 5% levels. In contrast, age and extension contact were significant at the 10% level, indicating weaker but still relevant effects. Marital status was not statistically significant, implying limited influence on food security outcomes.

Finally, the major constraints to rice production identified were inadequate access to credit (78%), high cost of inputs (74.5%), poor irrigation (64%), pest and disease infestation (60.5%), limited extension access (54.5%), poor infrastructure (51.5%), and post-harvest losses (48%).

Based on the findings of the study, the following recommendations are made to enhance productivity, profitability, and household food security among rice farmers:

1. Government and financial institutions should develop farmer-friendly credit schemes with low interest rates and flexible repayment terms. This will enable smallholder rice farmers to acquire necessary inputs and technologies to expand production efficiently.
2. The cost of fertilizers, improved rice seeds, herbicides, and machinery should be subsidized or made available through cooperative societies to reduce production costs and improve profitability.
3. Extension agents should increase their coverage and frequency of contact with farmers. Regular training on improved agronomic practices, pest management, and post-harvest handling should be institutionalized to boost yields and food security.
4. Government should invest in irrigation facilities, rural roads, and market infrastructure to enhance year-round rice production, reduce post-harvest losses, and facilitate access to input and output markets.

Adult education and training programs should be introduced to improve the literacy and management skills of farmers, enhancing their ability to adopt modern farming technologies and make informed production decisions.

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