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Original Research Article
ISSN: 3041-5322
Journal homepage: agriculture.researchfloor.org

Profitability and Efficiency of Cassava Production in Ekiti State, Nigeria

Temitope Olanrewaju Bello*, Adegboyega Eyitayo Oguntade, Thomas Tope Afolayan

Department of Agricultural and Resource Economics, Federal University of Technology, P.M.B. 704, Akure, Nigeria.

ABSTRACT

This research examines the profitability and efficiency of cassava farming in Ekiti State, Nigeria, with a focus on evaluating the economic viability and production efficiency of this vital crop within smallholder farming systems. Cassava plays a crucial role in enhancing food security and generating rural incomes in Nigeria. The study adopts a comprehensive research approach, incorporating structured surveys and interviews with cassava farmers from selected communities in Ekiti State. To ensure a representative sample, a multi-stage sampling technique was applied. Data were gathered using a structured questionnaire, which captured information on socio-economic characteristics, cassava farming inputs and outputs, input costs, and tuber prices. Analytical methods included descriptive statistics, Gross Margin Analysis, and the Stochastic Frontier Production Model. Results highlight diverse profitability levels among cassava farmers and identify factors contributing to production inefficiencies. Strategies to enhance market access and patronage for cassava products were also explored. In Ekiti State, smallholder farmers typically realize ₦4.28 for every ₦1 invested in cassava production, with an observed increase of 1 kg in yield per 1-liter increase in agro-chemical use. Experienced farmers demonstrate higher technical efficiency, while average farmers could achieve up to a 7.5% increase in cost savings or production output by reaching the allocative efficiency levels of their most efficient counterparts. Poor patronage emerged as a critical constraint. Key recommendations include implementing targeted training programs to enhance the technical and allocative efficiency of less experienced farmers. Additionally, strategies should focus on improving market access and increasing patronage for cassava products to maximize profitability and efficiency in cassava farming within Ekiti State.

Keywords: *Cassava production, constraints, profitability, resource allocation, technical efficiency, Nigeria*

1. Introduction

Cassava (*Manihot esculenta*) is a staple crop that plays a crucial role in Nigeria's agricultural and economic systems. Renowned for its resilience and adaptability, cassava serves as a primary carbohydrate source and a key contributor to food security, particularly in the southern regions of the country. Nigeria is recognized as the world's leading producer of cassava, with an annual output of 60.8 million metric tonnes reported in 2022 [16]. Its extensive cultivation among households and its significant role in sustaining rural livelihoods highlight its socio-economic relevance [29]. Cassava's ability to flourish in various soil types, including those with low fertility and high acidity that are unsuitable for many other crops, is further enhanced by its climate resilience, tolerance to drought, and resistance to pests and diseases [10]. Furthermore, its unique ability to store roots underground post-maturity has bolstered its popularity among smallholder farmers. With minimal fertilizer application and cultivation on small plots averaging 0.5–2.5 hectares, cassava remains central to Nigeria's predominantly small-scale agricultural system [2].

Citation: Temitope Olanrewaju Bello, Adegboyega Eyitayo Oguntade, Thomas Tope Afolayan (2025). Profitability and Efficiency of Cassava Production in Ekiti State, Nigeria *Agriculture Archives: an International Journal.*

Received on: November 30, 2024
Revised on: December 26, 2024
Accepted on: January 10, 2025

Corresponding author: **Temitope Olanrewaju Bello**
E-mail: **topebelo168@gmail.com**

However, cassava production in Nigeria faces significant post-harvest challenges, including rapid physiological degradation within 48 hours of harvest and the presence of cyanogenic compounds, which affect marketability and utilization [20]. Despite these constraints, cassava continues to dominate global root and tuber crop production. Africa accounted for 61% of global cassava output in 2018, with Nigeria contributing approximately 18% to global production and 35% to Africa's total [16]. The domestic and industrial demand for cassava-derived products, alongside government initiatives like the mandatory inclusion of cassava flour in food products, has further elevated its economic significance [20].

Cassava's economic contributions extend beyond food security to industrial applications such as biofuels, animal feed, and starch-based products. These multifaceted uses, coupled with low production costs, position cassava as a viable means of poverty alleviation for Nigeria's rural smallholder farmers [33]. Furthermore, cassava cultivation enhances household incomes through price stability and growing demand for processed cassava products, including garri, fufu, and industrial starch. Its low production cost and adaptability provide comparative advantages over other staples, further motivating its cultivation among resource-constrained farmers [3]. Despite its evident importance, the cassava sector in Nigeria faces structural inefficiencies that limit its full potential. Traditional farming methods, characterized by low mechanization and suboptimal resource utilization, result in low yields and limited profitability [4] [31]. Studies report that cassava yields and profitability remain below global averages, reflecting inefficiencies in input use, poor access to technology, and inadequate infrastructure [31].

The profitability of cassava farming is heavily influenced by fluctuating market prices, high production costs, and post-harvest losses.

Additionally, the lack of value-addition opportunities and limited access to credit and extension services exacerbate the challenges faced by smallholder farmers [7]. Addressing these barriers is crucial to improving farm incomes, ensuring economic sustainability, and fostering growth within the sector. Efficiency in cassava production is critical for maximizing yields and minimizing resource wastage. In Nigeria, resource-use efficiency remains a significant challenge, with estimates suggesting that output efficiency for most crops falls below 60% [4]. Resource inefficiencies span across land use, labor allocation, and input application, ultimately limiting productivity and economic returns [31].

The Nigerian government's agricultural policies and initiatives aim to address inefficiencies and promote cassava production. Programs such as microcredit schemes and the promotion of high-yielding, disease-resistant cassava varieties have been implemented to enhance productivity and profitability. However, funding constraints and suboptimal implementation of these programs remain significant hurdles. Nigeria's allocation to the agricultural sector has consistently fallen short of the 10% benchmark set by the Comprehensive Africa Agriculture Development Programme (CAADP), with current levels averaging just 1.32% [9] [11]. Enhancing cassava production requires a dual focus on improving profitability and efficiency. This involves understanding the socio-economic profiles of cassava farmers, adopting cost-efficient production methods, and addressing challenges related to market access. Ekiti State, known for its substantial potential in cassava production, provides a valuable case for exploring these dynamics. Against this backdrop, the study aims to assess the profitability and efficiency of cassava farming in Ekiti State, Nigeria. The specific objectives are to analyze the socio-economic characteristics of cassava farmers in the region, evaluate the costs and returns of cassava farming, estimate the technical and allocative efficiencies of cassava production, and identify key constraints faced by cassava farmers.

Cassava's role as a staple crop and its potential to contribute to economic development warrant comprehensive research into its production dynamics. This study provides critical insights into the factors influencing cassava profitability and efficiency, offering practical recommendations for farmers, policymakers, and stakeholders in the agricultural sector. By addressing inefficiencies and promoting best practices, the findings can enhance cassava's role in food security, rural livelihoods, and sustainable development.

2. Materials and Methods

The research was conducted in Ekiti State, Nigeria, a predominantly rural region where subsistence farming forms the foundation of the local economy. Agriculture is central to the socio-economic fabric of the state, with cassava cultivation being a major agricultural activity due to the region's favorable environmental conditions. Ekiti State experiences a bimodal rainfall pattern, with annual precipitation ranging from 1,200 to 1,500 mm, and daily temperatures varying between 20°C and 35°C, creating ideal conditions for cassava farming. The fertile soils further enhance agricultural productivity. Geographically, the state lies between longitudes 4°05'11" and 5°04'51" East and latitudes 7°15'11" and 8°05'11" North [12]. It shares borders with Kwara, Kogi, Osun, Edo, and Ondo States. Culturally, the state exhibits linguistic and social homogeneity, with the majority of residents speaking the Ekiti dialect of Yoruba. According to population data, Ekiti State had approximately 2.7 million inhabitants in 2006 [23], which increased to an estimated 3.6 million by 2022 [35]. This combination of favorable climate, fertile land, and a predominantly agricultural population makes Ekiti State an ideal setting for cassava production and a valuable area for agricultural research aimed at improving practices and livelihoods.

A multi-stage sampling technique was employed to select respondents, ensuring a representative sample of cassava farmers within the state. The selection process involved four distinct stages. First, three Local Government Areas (LGAs) were randomly selected from the sixteen LGAs in Ekiti State [23]. This step ensured a broad and unbiased representation of the state's agricultural practices and socio-economic conditions. In the second stage, five villages were randomly chosen from each selected LGA, focusing on communities where cassava farming is prevalent. In the third stage, a purposive sampling method was applied to select two wards from each of the fifteen villages, resulting in a total of 30 wards. These wards were chosen based on their high levels of cassava production, ensuring the sample reflected areas of significant agricultural activity. Finally, 240 cassava farmers were randomly selected from these wards. The study relied on primary data, which were collected using a structured questionnaire designed to address the study's objectives. The data included information on farmers' socio-economic characteristics, inputs and outputs of cassava farming, input costs, and output prices of cassava tubers. Several analytical tools were employed to achieve the study's objectives, including descriptive statistics, budgetary analysis, and a stochastic frontier production model.

Analytical Tools and Model Specifications

Descriptive statistics such as means, standard deviations, frequency tables, percentages, minimum, and maximum values were utilized to analyze the socio-economic characteristics of cassava farmers and the main constraints they faced. Budgetary analysis was applied to evaluate the profitability of cassava farming, including the calculation of gross margin (GM) and net farm income (NFI). The gross margin analysis was computed using the following equations:

$$GM = TR - TVC \quad (1)$$

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

$$NFI = TR - TC \quad (3)$$

$$NROI = NFI/TC \quad (4)$$

Where:

TR = Total revenue, TVC = Total variable cost, TC = Total cost (in Naira),

TFC = Total fixed cost (depreciation on fixed assets), and NROI = Net return on investment.

The Stochastic Frontier Production (SFP) model was employed to estimate the technical efficiency of cassava farmers, utilizing the Battese and Coelli inefficiency model [6]. This model addresses the limitations of deterministic production functions used in earlier studies, which relied on mathematical programming techniques that inadequately characterized error terms and limited statistical inference. Unlike deterministic methods, the SFP model incorporates stochastic error terms to account for random variations in production, providing more robust and reliable estimates of technical efficiency. This approach effectively separates inefficiency from random errors, offering a clearer understanding of the factors influencing cassava production efficiency in the study area. The stochastic frontier model is specified as follows:

$OPY_i = f\ (X_i \beta_i)\ \exp(V_i - U_i)\ , i = 1, 2 \ldots n$ ....(5)

Where

OPY_i = output of the ITH farm

X_i = vector of input quantities for the i[th] farm

β_i = vector of unknown parameters

$f(X_i \beta_i)$ = the production frontier

V_i= symmetric error which accounts for random variation in output due to factors beyond the control of the farmer e.g. weather, disease outbreaks

U_i = deviation from maximum potential output attributable to technical inefficiency

The random error term (Vi) is modeled as independent and identically distributed random variables following a normal distribution, N(0,σv2), and is assumed to be independent of Ui term represents non-negative truncations of the N(0,σv2) distribution, commonly referred to as the half-normal distribution, or it may follow an exponential distribution [32]. The technical efficiency (TE) of an individual farmer is defined as the ratio between the observed output and the corresponding frontier output, given the available technology.

$\mathrm{TE} = \frac{OPY_i}{OPY_i^*}$ ....(6)

Where,

OPY_i = observed value of dependent variable (output)

OPY_i^* = Frontier value of dependent variable (output)

$\mathrm{TE} = \frac{f\ (X_i \beta_i)\ \exp(V_i - U_i)}{f\ (X_{i;}\ \beta_i)\ \exp(V_i)}$ ....(7)

= exp (-U_i)

So that 0 < TE < 1,

$U_i > 0$. OPYi achieved its maximum feasible value of $(X_{i;}\ \beta_i)\ \exp(V_i)$ If and only if TE=1, otherwise TE<1 provides a measure of the shortfall of the observed output from the maximum feasible output.

The empirical model that was used to determine the technical efficiency of cassava farmers is defined as:

$$Ln\ OPY = \beta_0 + \beta_1 lnLX_1 + \beta_2 lnFX_2 + \beta_3 lnCX_3 + \beta_4 lnAX_4 + V_i - U \text{ ....(8)}$$

Where:

Ln = denote natural logarithm.

OPY = Cassava output (kg)

LX_1 = labor (man days)

FX_2= Farm size (hectares)

CX_3 = Quantity of cassava cuttings planted (bundles)

AX_4= Quantity of agrochemicals used in liters

V_i = random variability in the production that cannot be influenced by the farmer;

U_i= deviation from maximum potential output attributable to technical inefficiency.

β_0 = intercept

β = vector of production function parameters

This study utilized the Cobb-Douglas functional form of the stochastic production function to evaluate the allocative efficiency of cassava farmers in the study area. Known for its simplicity and self-dual properties, the Cobb-Douglas model is extensively applied in agricultural production analyses, especially in developing regions [8] [30]. In this context, the Cobb-Douglas function served as the cost frontier, forming the basis for assessing how effectively resources are allocated by cassava farmers. Adopting the methodological framework described by [6], the model incorporated a deterministic component within the cost frontier function to account for inefficiency behavior. Parameters were estimated using a one-step maximum likelihood estimation procedure, as recommended by [27]. This approach enabled a comprehensive analysis of both allocative and technical efficiencies, offering valuable insights into the farmers' production techniques and resource utilization.

The cost frontier production function is expressed in its implicit form as follows:

$\mathrm{InPC} = \alpha_0 + \alpha\mathrm{InWP}_1 + \alpha\mathrm{InRP}_2 + \alpha\mathrm{InPP}_3 + \alpha\mathrm{InCP}_4 + \alpha\mathrm{InY}_i + V_i + U_i$ .... (9)

Where:

PC = total cost of production (₦)

WP_1 = wage rate of labor (₦)

RP_2 = rent on land (₦)

PP_3 = cost of planting materials (stem cutting) (₦)

CP_4 = cost of agro-chemicals (₦)

OPY_i = cassava output (kg)

$\alpha_0 - \alpha_4$ = estimated parameters

The cost efficiency (CE) of individual producers is quantified by comparing their observed total cost (Ci) against the minimum total cost achievable at the frontier (C_i*).

The cost efficiency of the producer is expressed as:

$CE = \frac{C_i}{C_i^*}$.............................. (10)

Where Ci is the observed total cost and Ci* is the frontier cost. The CE ranges from 1 to ∞ i.e 1 ≤ CE ≥ ∞.

Economic efficiency (EE) is determined as the product of technical efficiency (TE) and allocative efficiency (AE), mathematically represented as EE=TE×AE. The resulting values of EE typically fall within a range of 0 to 1.

Allocative efficiency (AE) measures the ability to use available inputs in optimal proportions based on their relative costs and the prevailing production technology. In this framework, technical efficiency (TE) reflects a farmer's capability to achieve the maximum possible production output. AE also captures a farmer's ability to generate a specific level of output by utilizing input combinations that minimize costs. Economic efficiency (EE), in turn, represents the farmer's ability to produce a given quantity of output at the lowest possible cost while leveraging existing technology [27] [30] [18].

Therefore, $AE = \frac{EE}{TE}$ .... (11)

The determination of Allocative Efficiency for production inputs involved estimating an average response model through ordinary least squares (OLS). This model regressed the score against the inefficiency component, which encapsulates various socioeconomic factors. This approach follows the methodology outlined [24].

$\mathrm{Exp.}(-U_i) = \delta_0 + \delta_1 ZG_1 + \delta_2 ZA_2 + \delta_3 ZE_3 + \delta_4 ZX_4 + \delta_5 ZI_5 + \varepsilon_i$........... (12)

Where:

Exp. (-Ui) = AE of the i-th respondents,

Z_1-Z_5= inefficiency variables;
ε_i = the two-sided error term
δ_1-δ_5= vector of parameters.
ZG_1 = Gender (male =1 and female = 0)
ZA_2 = Age in years
ZE_3 = Education in years
ZX_4 = Experience in years
ZI_5 = Annual income in Naira (₦)

3. Results and Discussion

3.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics of the respondents are summarized in Table 1. The data show that 67.50% of the respondents were male, suggesting that men are more involved in cassava farming. This trend may be attributed to the labor-intensive nature of cassava cultivation. Regarding age distribution, 23.33% of the farmers were under 25 years, 52.50% were between 25 and 35 years, and 24.17% were above 35 years. The average age of respondents was 29.80 years, indicating that the majority of cassava farmers are relatively young, energetic, and likely to adopt innovative agricultural practices. This youthful demographic represents a significant advantage for productivity and the diffusion of new farming technologies. In terms of marital status, 27.50% of the respondents were single, 68.33% were married, and 4.17% were divorced. The high proportion of married individuals (68.33%) highlights the family-oriented nature of cassava farming, often involving collective family efforts. These findings are consistent with the results of [1], who noted that 91.70% of cassava farmers in Ekiti State were married. The respondents represented diverse religious backgrounds, demonstrating that religious beliefs did not hinder the adoption or diffusion of innovative technologies. This pragmatic approach suggests that practical outcomes, such as observing successful implementation by peers, are more influential than religious considerations in influencing technology adoption. Educational attainment among respondents varied widely. Approximately 19.58% of the farmers had no formal education, 52.08% had completed primary education, 24.17% had secondary education, and 4.17% had tertiary education. The dominance of primary school-level education (52.08%) reflects limited formal educational backgrounds, which may restrict the adoption of advanced agricultural technologies and adversely impact productivity. Income levels also showed variability among respondents. Annual income was categorized as follows: less than ₦50,000 (18.33%), ₦50,000–₦200,000 (12.08%), ₦200,000–₦350,000 (16.66%), and more than ₦350,000 (52.43%).

The mean annual income was ₦3,135,642, indicating that a substantial proportion of farmers earned relatively high incomes from cassava farming. Farm sizes were distributed as follows: 56.26% of farmers cultivated less than 1.0 hectare, 38.83% farmed between 1.00 and 2.00 hectares, and 7.92% operated farms larger than 2.0 hectares. The average farm size was 1.16 hectares, highlighting the predominance of smallholder farming among the respondents. These findings differ from those of [1], who reported a mean cassava farm size of 4.8 hectares in Ekiti State.

Table 1: Socio-economic characteristics of respondents

Characteristics	Frequency	Percentage
Gender		
Male	162	67.50
Female	78	32.50
Age (years)		
<25	56	23.33
25-35	126	52.50
>35	58	24.17
Mean = 29.80		
Marital Status		
Single	66	27.50
Married	164	68.33
Divorced	10	4.17
Religion		
Traditional	66	27.50
Christianity	144	60.00
Islam	30	12.50
Educational Status		
No Formal Education	47	19.58
Primary	125	52.08
Secondary	58	24.17
Tertiary	10	4.17
Annual Income (₦)		
<50,000.00	38	18.33
50,000.00 – 200,000.00	29	12.08
200,000.01-350,000.00	40	16.66
> 350,000.00	133	52.43
Mean = 3,135,642		
Cassava Farm (Hectares)		
< 1	135	56.25
1.00 – 2.00	86	35.83
> 2.00	19	7.92
Mean = 1.16		

3.2 Costs and returns to cassava farming

Table 2 provides an overview of the costs and returns associated with cassava production per hectare. The analysis revealed that the total revenue generated by cassava farmers was ₦595,203.37, with a gross margin of ₦483,387.97 and a net profit of ₦482,488.08. The Net Return on Investment (NROI) indicated that for every naira spent on cassava production, farmers earned ₦4.28 in return. This highlights the profitability of cassava farming, demonstrating that it offers substantial financial benefits to the farmers.

Table 2: Costs and returns of cassava production per hectare

Variable	Unit (Number of Hectare x Number of pick up x price per pick-up)	Amount (N)	Percentage of TC
Total Revenue	1.16 x 2.12 x N242,031.3	595,203.37	
Variable Cost			
Cost of Labour		1,166.66	1.03
Cost of Stem		782.75	0.69
Cost of Chemicals		446.26	4.29
Land rent		13,545.57	12.02
Cost of Machineries		91,474.16	81.16
Total Variable Cost (TVC)		111,815.40	99.20
Total Fixed Cost		899.89	0.80
(TFC) or Depreciation on fixed asset			
Total cost (TC = TVC + TFC)		112,715.29	100.00
Gross margin (GM = TR - TVC)		483,387.97	
Net Farm Income (NFI = TR - TC)		482,488.08	
Net return on investment (NROI = NFI/TC)		4.28	

3.3 Estimation of the Technical, Economic, and Allocative Efficiencies of Cassava Farmers in the Area

3.3.1 Estimation of the Stochastic Frontier Production Function

Table 3 presents the Maximum Likelihood Estimates (MLE) for the stochastic frontier production function for cassava farmers. The sigma-square (δ^2) value of 1.231 is both significant and substantial, confirming a strong model fit and validating the appropriateness of the assumed distribution for the composite error term. The gamma (γ) value of 0.891 indicates that approximately 89% of the variability in cassava output among farmers is due to technical inefficiency. This result highlights that most of the unexplained variations in output stem from inefficiencies in the production process, emphasizing the relevance of the one-sided error component in the model. Consequently, using Ordinary Least Squares (OLS) would not adequately capture the data's nuances. The Return to Scale (RTS) coefficient was calculated as 0.672, indicating positive but diminishing returns to scale. This finding is consistent with the RTS of 0.549 reported by [14] in Imo State, Nigeria, but contrasts with the higher RTS of 1.306 observed by [17] in Delta State, Nigeria. The generalized likelihood test value of -109.639 further supports the conclusion that cassava farmers do not achieve full technical efficiency. These findings align with studies by [25] [21] [22] [28] [14] [17], which also reported varying levels of technical inefficiency among cassava farmers. In the regression analysis, most variables, except for labor, showed positive impacts on cassava output, with several coefficients being statistically significant. Labor exhibited a negative coefficient that was significant at the 1% level, indicating that an increase in labor (measured in man-days) reduces output by approximately 80%, holding other variables constant. This result suggests that adopting mechanization could enhance productivity by reducing reliance on manual labor. This finding contrasts with studies by [14] [17], which reported a positive but nonsignificant relationship between labor and cassava output. The coefficient for farm size was positive and significant at the 1% level, showing that a unit increase in farm size leads to an 11.1% increase in output, controlling for other factors. This aligns with findings from studies by [27] [19] [5] [17], which demonstrated the positive impact of larger farm sizes on cassava production. Additionally, the coefficient for stem cuttings was significant at the 5% level, indicating that increasing the number of stem cuttings by one unit results in a 51.6% increase in output, all else being equal. This result is consistent with studies by [15] [14] [17], underscoring the critical role of planting materials in boosting cassava productivity.

Table 3: Maximum Likelihood Estimates of the Parameters of the Stochastic Frontier Production Function

Variable	Parameters	Coefficients	Standard error	t-value
Constant	β_0	3.667	13.033	0.281
Labor (man day)	β_1	-0.800***	0.072	4.167
Farm size (ha)	β_2	0.111***	0.009	12.333
Bundles of stem cuttings (kg)	β_3	0.516**	0.254	2.031
Agrochemical (litres)	β_4	0.845	0.686	1.232
Sigma squared	δ^2	1.231***	0.021	
Gamma	γ	0.891***	0.019	
Log Likelihood	LLF	-109.639		
RTS		0.672		

*Note: *,**, and *** mean significant at 10%, 5%, and 1% respectively.*

3.3.2 Estimation of Stochastic Frontier Cost Function Model

Table 4 presents the estimation results for the stochastic frontier cost function model. The gamma (γ) value of 0.795 indicates that approximately 79.5% of the variations in cassava production costs are due to economic inefficiency. The sigma square (δ^2) value of 6.80, significant at the 1% level, confirms the robustness of the model and validates the assumptions about the compound error term's distribution. The generalized likelihood test score of -104.46 further indicates that cassava farmers are not achieving full economic efficiency. These results are consistent with previous research on cassava and other staple crops in Southwest Nigeria, including studies by [19] [14] [5] [30]. The findings also show that coefficients for stem cuttings, agrochemicals, and output have positive effects on production costs, whereas wage rates and land rent exhibit negative relationships with production costs.

Specifically, the wage rate coefficient is negative and significant at the 1% level, suggesting that a unit increase in wages results in a 24.1% reduction in total production costs, holding other factors constant. This result aligns with studies by [5] [17] conducted in Delta and Edo States, respectively, but contrasts with the findings of [14], who identified a positive and significant relationship between wages and production costs. The coefficient for stem cuttings is positive and significant at the 5% level, indicating that a unit increase in the cost of stem cuttings leads to an 18.9% increase in total production costs. This finding is supported by earlier research, including studies by [19] [28] [14] [17] which emphasized the substantial role of planting materials in determining production costs. Similarly, the coefficient for output is positive and significant at the 1% level, demonstrating that a unit increase in output corresponds to a 142% increase in total production costs, all else being equal. This relationship has been corroborated by several studies, such as those by [5] [14] [17] [30]. In contrast, the coefficients for land rent and agrochemical costs are not statistically significant at the 5% level. While increases in land rent appear to reduce total production costs and higher agrochemical costs are associated with increased production costs, these relationships lack statistical significance. These findings suggest that while land rent and agrochemical costs may influence production costs, their effects are less pronounced compared to other factors.

Table 4: Maximum Likelihood Estimates of Stochastic Cost Function

Variable	Parameter	Coefficient	Std. error	t-value
Constant	β_0	1.021	2.602	0.392
Rent on land (N)	β_2	-0.006	0.052	-0.122
Cost of stem cuttings (N)	β_1	0.189**	0.072	2.623
Wage rate (N)	β_3	-0.241***	0.050	-4.790
Cost of agrochemicals (N)	β_4	0.025	0.077	0.329
Output (kg)	β_7	1.420***	0.357	3.972
Sigma-squared	δ^2	6.800***	0.472	12.4
Gamma	γ	0.795***	0.033	23.979
LR Test	-104.458			

*Note: *,**, and *** mean significance at 10%, 5%, and 1% respectively.*

3.3.3 Allocative Efficiency Distribution of the Respondents

Table 5 summarizes the average technical, economic, and allocative efficiencies of cassava farmers in the study area, with values of 0.923, 0.433, and 0.434, respectively. These results indicate that, on average, farmers achieve about 92.3%, 43.3%, and 43.4% of their maximum potential output due to production efficiency, with the remaining gaps attributed to inefficiencies. The mean technical efficiency of 0.923 reflects a high proficiency in utilizing inputs, with only 7.7% of potential output lost to inefficiencies. Furthermore, the distribution of technical efficiency reveals that most farmers (79.2%) operate within an efficiency range of 0.81 to 1.00, suggesting significant opportunities for optimizing technical efficiency across the study area. In contrast, the economic efficiency findings show greater variability. Approximately 33.3% of farmers achieved economic efficiency levels between 0.81 and 1.00, while 7.08% fell within the 0.21 to 0.40 range. A standard deviation of 0.219, alongside a minimum value of 0.007 and a maximum of 0.982, highlights the disparities in economic efficiency across respondents. Allocative efficiency scores ranged from 0.007 to 0.925, with an average of 0.434. These findings indicate significant potential for improving allocative efficiency, which could result in substantial cost savings for farmers with lower efficiency levels. The study highlights the need for targeted interventions to enhance farmers' skills, knowledge, and awareness of best practices in cassava production. This could lead to improvements in both technical and allocative efficiencies. Previous research by [28] [14] [17] similarly identifies technical inefficiencies among cassava farmers at the household level, emphasizing the necessity of capacity-building initiatives. Training programs that focus on modern farming techniques and technologies are likely to improve allocative efficiency, enabling farmers to achieve higher productivity and cost-effectiveness. These findings align with recommendations from earlier studies, which advocate for educational interventions aimed at equipping farmers with the tools and knowledge needed for better resource allocation and production management.

Table 5: Technical, Economic, and Allocative Efficiencies of the Respondents

Efficiency Range	Technical		Economic		Allocative	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
< 0.20	7	2.92	53	22.08	50	20.83
0.21 – 0.40	10	4.17	17	7.08	27	11.25
0.41 – 0.60	20	8.33	33	13.75	40	16.67
0.61 – 0.80	13	5.42	57	23.75	43	17.92
0.81 – 1.00	190	79.17	80	33.33	80	33.33
Total	240	100.00	240	100.00	240	100.00
Mean	0.923		0.433		0.434	
SD	0.551		0.219		0.220	
Minimum	0.174		0.007		0.007	
Maximum	0.998		0.982		0.925	

4.4 Factors Affecting Allocative Efficiency in the Study Area

Table 6 presents the results of the Ordinary Least Squares (OLS) regression analysis, which examines the factors affecting allocative efficiency among cassava farmers in the study area. The diagnostic tests confirm the model's robustness, with an R^2 value of 0.692, indicating that approximately 69.2% of the variance in allocative efficiency is explained by the independent variables. Furthermore, the F-value of 39.20, significant at the 1% level, demonstrates that the combined influence of the explanatory variables significantly affects allocative efficiency. Out of the five variables analyzed in the model, four were statistically significant and positively associated with allocative efficiency. These include gender, age, farming experience, and annual income. The coefficient for gender was positive and significant at the 10% level, showing that male cassava farmers achieve allocative efficiency levels that are about 11.6% higher than their female counterparts. This result aligns with the notion that gender roles and the physical demands of cassava farming contribute to disparities in efficiency, as highlighted by [15] [14]. Farming experience exhibited a positive and significant relationship with allocative efficiency at the 1% level. The results indicate that each additional year of farming experience enhances allocative efficiency by 1.4%. This finding is consistent with studies by [14] [17], which suggest that accumulated experience improves farmers' decision-making capabilities in resource management and allocation.

Annual income also had a positive and significant impact on allocative efficiency, significant at the 1% level. A 1% increase in annual income was associated with a 0.005% improvement in allocative efficiency, underscoring the importance of financial resources in optimizing input usage and production decisions among cassava farmers. Although education was positively related to allocative efficiency, the coefficient was not statistically significant at the 5% level. While the data suggest that each additional year of schooling could potentially increase allocative efficiency by 1.3%, this relationship was not strongly supported in this study.

Table 6: Determinants of Allocative Efficiency in the Study Area

Variable	Parameters	Coefficient	Std. Error	P-value
Gender (male = 1)	Z_1	0.116*	0.065	0.076
Age (years)	Z_2	-0.007**	0.004	0.042
Education (years)	Z_3	0.013	0.011	0.100
Experience (years)	Z_4	0.014***	0.004	0.000
Annual income	Z_5	0.005**	0.002	0.010
Constant	Z_0	0.371	0.352	0.222
R^2	0.692			
F-value	39.197***			

*Note: *,**, and *** mean significance at 10%, 5%, and 1% respectively.*

3.4 Major constraints faced by cassava farmers

In Table 7, the major constraints faced by cassava farmers are presented. The results of this study highlight the constraints that have impeded the profitability and efficiency of cassava farmers in Ekiti State. Among these, poor patronage emerged as the most widely perceived and significant challenge, with a substantial 53.8% of respondents strongly agreeing that it restricted their profitability. This constraint reflects the lack of consistent market demand for cassava products in Ekiti, where local markets are often unpredictable and, at times, saturated. This insufficient demand created income instability, making it difficult for farmers to plan financially, reinvest in their operations, or achieve a sustainable livelihood. Poor patronage as a major constraint for cassava farmers in Ekiti State is closely linked to the inherent characteristics of cassava itself. Cassava, while a staple crop with significant local and industrial demand, is a highly perishable root crop with a limited shelf life. Once harvested, cassava begins to deteriorate rapidly due to its high moisture content and lack of natural preservation mechanisms. This perishability makes timely sales and processing critical for farmers to avoid spoilage and loss of product quality.

In Ekiti state, the poor patronage issue is compounded by the difficulty in securing consistent and reliable markets for cassava. Unlike other cash crops with established supply chains and higher market stability, cassava demand can fluctuate, affected by both local consumption patterns and industrial demand, which are not always steady. Farmers in Ekiti may find it challenging to secure regular buyers who are willing to purchase their produce at fair prices, particularly when the market is saturated or when processing facilities are limited. In addition to poor patronage, transportation costs were another concern, with 32.08% of farmers agreeing that these costs severely impacted their operations. Ekiti State's underdeveloped rural infrastructure compounded this issue, as poor road networks made it costly and challenging to move cassava from farms to urban markets. These high transportation expenses directly reduced profit margins, especially for farmers located in more remote areas, thus constraining their ability to expand production and limiting the overall growth of the local cassava industry.

Another constraint identified was multiple taxation, with 28.75% of farmers strongly agreeing that it posed a substantial barrier. Farmers in Ekiti State often faced overlapping taxes from various government agencies, placing an undue financial burden on their limited resources. For small-scale cassava farmers, these tax obligations detracted from funds that could have been reinvested into farm productivity. The high tax pressure reduced profitability discouraged long-term investment and limited the sector's potential for growth.

High loan interest rates also presented a challenge, although the responses were mixed, with 47.08% of respondents disagreeing that it was a critical constraint. This suggests that while some farmers might have had access to alternative financing, smaller-scale farmers in particular likely struggled with limited access to affordable credit. For these farmers, high interest rates restricted their ability to secure necessary capital for improvements, such as modern inputs or mechanized equipment, thereby curtailing their yield potential and operational efficiency.

Inadequate storage facilities emerged as another challenge, with many farmers lacking proper options for preserving their produce post-harvest. Given that cassava is a perishable crop, the absence of adequate storage forced farmers to sell it immediately after harvesting, often at lower prices.

This lack of storage not only limited their profit potential but also exposed them to exploitation, as buyers could offer reduced prices knowing farmers had limited alternatives.

For some farmers, the long distance to processing plants posed additional difficulties, particularly for those located in more remote areas of Ekiti State. While 34.58% of respondents disagreed that this was a major issue, those affected incurred extra transportation costs and experienced delays in processing, ultimately impacting the quality and market value of their cassava. With limited processing facilities available within Ekiti, farmers had to travel considerable distances to access them, adding to operational costs and reducing profitability for those who lacked convenient access. Price instability also affected cassava farmers, with 11.25% of respondents strongly agreeing that fluctuating prices created financial uncertainty. For these farmers, unpredictable market prices undermined their ability to plan, reinvest, and manage their finances effectively. This volatility discouraged long-term planning and investment, as farmers were left vulnerable to unfavorable market conditions that could result in significant financial losses.

Table 7: Constraints faced by cassava farmers

Constraints	SA	A	N	D	SD
High loan interest rate	0.00(0)	20.42(49)	4.17(10)	47.08(113)	28.33(68)
High cost of transportation	4.17(10)	32.08(77)	15.42(37)	19.58(47)	28.75(69)
Multiple taxation	28.75(69)	4.17(10)	11.67(28)	39.17(94)	16.25(39)
Poor patronage	53.8(129)	36.7(88)	3.75(9)	3.3(8)	2.5(6)
Inadequate storage facilities	12.50(30)	23.75(57)	11.67(28)	12.50(30)	39.58(95)
Long distance of processing plant	7.92(19)	4.17(10)	20.42(49)	34.58(83)	32.92(79)
Price instability	11.25(27)	16.25(39)	16.25(39)	40.00(96)	16.25(39)
Climate change	12.50(30)	23.75(57)	7.92(19)	12.50(30)	43.33(104)

SA = Strongly Agree, A = Agree, N = Neutral, SD = Strongly Disagree and D = Disagree

4. Conclusion and Recommendations

This study provides critical insights into the socio-economic dynamics, production efficiencies, and challenges faced by cassava farmers in Ekiti State, Nigeria. The findings demonstrate a predominantly young, male-dominated workforce with moderate educational attainment and a high prevalence of smallholder farming practices. Despite the constraints of small farm sizes and limited access to advanced technologies, cassava farming proved to be highly profitable, with a net return on investment of ₦4.28. However, inefficiencies in resource allocation and production practices were notable, limiting the full potential of cassava cultivation. Key production challenges, including poor market patronage, high transportation costs, inadequate infrastructure, and limited access to processing and storage facilities, further hindered the ability of farmers to sustain operations and maximize profitability. The analysis underscores the importance of addressing these structural and operational bottlenecks to improve efficiency and productivity. Furthermore, the economic and allocative efficiency metrics indicate significant room for improvement, emphasizing the need for interventions to optimize resource use and enhance farm management practices. Based on the findings, the following recommendations are proposed to improve cassava farming profitability and efficiency in the area.

I. Mechanization should be prioritized to address labor inefficiencies and enhance productivity. Government and private sector partnerships could facilitate the provision of affordable mechanized equipment tailored to smallholder farmers' needs.

II. Investments in rural road networks and transportation systems are critical to reducing the high costs of moving produce to markets. Establishing well-organized market hubs and expanding access to both local and international markets will help stabilize prices and boost market patronage.

III. Capacity-building initiatives focusing on modern agricultural techniques, efficient resource use, and financial management should be provided to farmers. These programs can address the limitations posed by the low educational profile of farmers and improve their adaptability to new technologies.

IV. Policies aimed at improving farmers' access to credit facilities, subsidized inputs, and quality planting materials will enable them to invest in higher productivity and efficiency. Tailored microfinance schemes should also be introduced to support smallholder farmers.

V. Research institutions should focus on developing high-yield, disease-resistant cassava varieties and disseminating these findings to farmers through robust extension services. Extension agents should also assist in adopting precision farming techniques to enhance efficiency.

VI. Policies should encourage greater participation of women and youth in cassava farming by addressing structural barriers and providing targeted support programs. This inclusion will harness the untapped potential of these demographic groups.

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