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Original Research Article

Determinants of Cassava Production among Smallholder Farmers in Edo State, Nigeria

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Abstract: This study analyzed the determinants of cassava production among smallholder farmers in Edo State, Nigeria. Specifically, it estimated the profitability of cassava production, identified the factors affecting cassava output, and assessed the level of technical efficiency among the farmers. A multistage sampling technique was used to select 160 respondents, and data were collected using well-structured questionnaires. Analytical tools employed include descriptive statistics, the Cobb-Douglas production function, and the stochastic frontier production function. Results showed that 56% of the cassava farmers were male, with an average age of 45 years and an average farm size of 3 hectares. The total variable cost per hectare was ₦174,346.00, while total revenue was ₦990,826.67, yielding a gross margin of ₦816,480.67, a gross margin ratio of 0.82, and a rate of return on investment of 3.68. Cobb-Douglas analysis revealed that cassava cuttings, fertilizer, sex, age, household size, education, farm size and income significantly influenced cassava output (P<0.01). The stochastic frontier estimates also showed that planting material, fertilizer, herbicides, labour, and farm size significantly influenced production efficiency. However, inefficiency was significantly associated with age, sex, marital status, household size, extension contact, and access to credit. The average technical efficiency was 0.762, indicating a 24% efficiency shortfall. Major constraints faced by farmers included limited land access, weak land policies, insufficient finance, pest and disease infestations, and high labor costs. The study recommends the provision of subsidized inputs, access to credit, and greater inclusion of female farmers in cassava production in the study region.

Keywords: Cassava, determinants, farmers, efficiency, Cobb-Douglas, subsidized

1.0 INTRODUCTION

Cassava (*Manihot esculenta*) is one of the most important staple crops cultivated in the tropics, ranking fourth globally after rice, wheat, and sugarcane, with nearly a billion consumers worldwide (FAOSTAT, 2010). Originally domesticated in Brazil and introduced into Africa by Portuguese traders (Osun, Ogundiju and Bolariwa, 2014), cassava has become a staple food and industrial raw material in many sub-Saharan African countries, including Nigeria. Two major varieties, *Manihot palmata* (sweet) and *Manihot utilisima* (bitter), are widely cultivated in West Africa. While the sweet variety contains less than 100 mg/kg of cyanogenic compounds, the bitter variety exceeds this threshold and poses health risks if improperly processed (McKey *et al.*, 2010). Despite this, cassava remains a highly versatile crop, used for human food (e.g., gari, fufu, flour), animal feed, starch, ethanol, and industrial derivatives (Eguono, 2015).

Cassava is well-known for its year-round availability, climate resilience, and ability to thrive in poor soils (Asante-Pok, 2013). In Nigeria, it is a staple food for over 70% of the population and serves as a critical income source for agrarian households (Eke-Okoro and Njuko, 2012; Sanusi *et al.,* 2020). Nigeria remains the world's largest producer of cassava, with an output of 36.8 million metric tons annually (Brodrick and Sanzudur, 2016). However, the current national average yield is around 12.3 mt/ha, far below the potential yield of 28–40 mt/ha recorded under research conditions (Nkonya *et al.*, 2010; Eke-Okoro and Njuko, 2012). The discrepancy between actual and potential yields has been attributed to a range of production constraints including inadequate access to improved planting materials, high labor and input costs, pest and disease infestations, poor road infrastructure, and limited access to credit and extension services (IITA, 2017; Esheya, 2019).

The persistent gap between cassava supply and rising domestic demand, driven by population growth, urbanization, and industrial applications, underscores the urgent need to enhance productivity and efficiency in cassava production (Olutosin and Barbara, 2019). Despite its critical role in food security and economic resilience, cassava production remains suboptimal due to systemic challenges such as land tenure issues, low levels of mechanization, market volatility, and weak policy support (Aditya, Barbara and Oliver, 2017). These constraints are exacerbated in specific local contexts where agricultural potential is high but underutilized due to socioeconomic and institutional barriers. Although several studies have examined cassava production in Nigeria (Angba and Itom, 2020; Akerele *et al.,* 2018; Oladoyin *et al.,* 2022), there remains a dearth of localized evidence, particularly on the determinants of cassava production in Ovia North East and Ovia South West Local Government Areas of Edo State. This lack of disaggregated data limits targeted interventions by policymakers, extension agents, and development practitioners.

Despite Nigeria's status as the leading global producer of cassava, the productivity levels in many cassava-producing areas, including Edo State, remain significantly below potential. Smallholder farmers, who constitute the bulk of producers, face numerous challenges such as inadequate access to improved inputs, limited extension support, poor market infrastructure, and inefficient production practices. Furthermore, socioeconomic factors such as age, education, household size, and access to credit likely influence production outcomes, but their specific impacts within Edo State's context are not well-documented. The absence of empirical data on these determinants within Ovia North East and South West LGAs creates a significant gap in both academic literature and practical policy design. Thus, this study seeks to examine the determinants of cassava production among smallholder farmers in Edo State, with the aim of providing actionable insights for enhancing productivity and rural livelihoods. To accomplish this, the following specific objectives were formulated:

i. describe the socio-economic characteristics of cassava farmers in the study area;
ii. estimate the profit of smallholder cassava farmers in the study area;
iii. determine the factors influencing Cassava production among smallholder farmers;
iv. examine the level of technical efficiency of Cassava production among small holder farmers and
v. identify the constraints faced by smallholder cassava farmers in the study area.

2.0 MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Edo State, Nigeria. It is located in the southern region of the country between latitude of 6.5047° N and a longitude of 5.6037° E. Edo State was created in 1991 from the former Bendel State. Edo state has an estimated population of 4,235,595 inhabitants in 2016 (National Bureau of Statistics, 2017). The state's capital, Benin City, is the fourth largest city in Nigeria, and the Centre of the country's rubber industry. Ovia North-East is a Local Government Area of Edo State, Nigeria. Its headquarters is Okada. It has an area of 2,301 km² and a population of 180,223. Ovia South West Local Government Area of Edo State, Nigeria. It shares borders with Ovia North East Local Government Area and Ondo State. The geographical coordinates are within latitudes 6º10"0"N - 6º50"00"N and longitudes 5º0"0"E -5º40"0"E of the equator. The vegetation is a rainforest vegetation found in Tropical regions of the world.

Agriculture practice predominate the productive lives of the inhabitants of Edo State due to availability of fertile and productive soil. The predominant crops grown in the State include trees such as rubber, cocoa and oil palm. Other arable crops are also produced. These include cassava, yam, plantain, banana and assorted varieties of leafy vegetable crops. Animal husbandry is also a common practice with goat and chicken predominating livestock rearing.

2.2 Sampling Procedure and Sample Size

In this study, a multistage sampling method was employed. Because cassava producers predominate in the study region, Edo State was purposefully chosen for the initial stage. Due to the prominence of cassava cultivation, two Local Government Areas (LGAs), Ovia North East and Ovia South West, were also purposefully chosen for the second stage. In the third stage, four wards from each LGA were randomly chosen, and 20 farmers were then selected from those four wards. Oghede, Okada east, Okada west, and Oluku are the chosen wards from the Ovia North East LGA. A total of 160 farmers were chosen from the four wards of Usen, Ara, Udo, and Iguobazuwa in the Ovia South West LGA. Only 150 respondents were used for analysis because ten (10) copies of the questionnaire could not be obtained from the farmers. In order to estimate the sample size in relation to the number of cassava farmers present in the chosen wards, this study used the formula proposed by Yamane, (1967). The sample size was calculated using a total of 2,356 sample frames. The formula reads as follows:

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

Where,

n= Desired Sample Size
N= Finite Size of the Population
e= Maximum Acceptable Margin of Error as Determined by the Researcher

2.3 Data Collection and Analysis

Data were collected primarily through the use of well-structured questionnaires and interview schedules. The research instrument was organized into major sections, which addressed: the socioeconomic characteristics of the farmers; profit of smallholder cassava farmers, factors influencing cassava production, level of technical efficiency in cassava production and constraints faced by smallholder cassava farmers. The instrument was validated through a pre-test and expert review by professionals in the Department of Agricultural Economics to ensure both face and content validity. To determine the reliability of the instrument, the test-retest method was employed. In this process, 20 questionnaires were administered twice to respondents selected from the sample population. The test-retest reliability method directly assesses the consistency of test scores across two different administrations. Data collected analyzed using descriptive statistics (frequencies, percentages, mean), Gross Profit Margin Analysis, Cobb-Douglas Production Function and Stochastic Production Frontier.

2.4 Model specification

This study employed various analytical models to estimate profitability, identify production determinants, assess technical efficiency, and examine production constraints among smallholder cassava farmers in the study area.

2.4.1 Gross Profit Margin Analysis

Farm budgeting techniques, specifically Gross Profit Margin (GPM) analysis, were used to estimate the profitability of cassava production. This approach follows the method adopted by Omotayo and Oladejo (2018). Profitability was calculated as the difference between Total Revenue (TR) and Total Variable Cost (TVC), while Net Profit (NP) was obtained by subtracting Total Fixed Cost (TFC) from Gross Profit (GP). The model is specified as follows:

$$\text{GProfit (GP)} \sum GP = \sum TR - \sum TVC \qquad (2)$$

$$\sum GPM = \frac{\sum GP}{\sum TR} \times \frac{100}{1} \qquad (3)$$

$$\sum NP = \sum GP - \sum TFC \qquad (4)$$

Where:

GPGP=Gross profit
TRTR=Total Revenue
TVCTVC=Total Variable Cost
TFCTFC=Total Fixed Cost
GPMGPM=Gross Profit Margin
NPNP = Net Profit

2.4.2 Regression Analysis (Ordinary Least Squares)

To determine the factors influencing cassava production, an Ordinary Least Squares (OLS) multiple regression model was employed. The general form of the model is:

$$Y = bo + b_1X_1 + b_2X_2 + \ldots\ldots\ldots\ldots + b_{11}X_{11} + U \qquad (5)$$

Where:

Y = Cassava output (kg)
X_1 = Stem cuttings (Number)
X_2 = Fertilizer (kg)
X_3 = Herbicides (Litres)
X_4 = Labour (Man-days)
X_5 = Age (Years)
X_6 = Sex (1 = Male, 0 = Female)
X_7 = Household size (Number of persons)
X_8 = Education (Years of schooling)
X_9 = Farming experience (Years)
X_{10} = Farm size (Hectares)
X_{11} = Annual income (₦)
b_0............b_{11} = Regression coefficients
U = Error term

2.4.3 Stochastic Frontier Production Function

The level of technical efficiency among cassava farmers was estimated using the Cobb-

Douglas functional form of the Stochastic Frontier Production Function (SFPF), as specified by Battese and Coelli (1995). The model simultaneously estimates both the production frontier and inefficiency effects:

$$Y= \beta_0+ \beta_1X_1+ \beta_2X_2+ \beta_3X_3+ \beta_4X_4 + \beta_5X_5 + V_i-U_i \quad (6)$$

Where:

Y = Output of cassava (kg)
X_1 = Planting material (Stem cuttings)
X_2 = Fertilizer (kg)
X_3 = Farm size (ha)
X_4 = Labour input (Man-days)
X_5 = Herbicide quantity (Litres)
β_0.....β_5 = Parameters to be estimated
V_i = Random error term
U_i = Non-negative technical inefficiency term

The inefficiency effects model is specified as:

$$Ui =\alpha 0 + \alpha 1\ Z1+ \alpha 2\ Z2+ \alpha 3\ Z3+ \alpha 4\ Z4+ \alpha 5Z5+ \alpha 6\ Z6+ \alpha 7Z7+ \alpha 8Z8 \quad (7)$$

Where:

1 = Age (Years)
Z2 = Sex (1 = Male, 0 = Otherwise)
Z3 = Marital Status (1 = Married, 0 = Otherwise)
Z4 = Educational Level (Years)
Z5 = Household Size
Z6 = Farming Experience (Years)
Z7 = Extension Contact (1 = Access, 0 = Otherwise)
Z8 = Access to Credit (1 = Access, 0 = Otherwise)
α0…α8 = Inefficiency parameters

3.0 RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics of the Sampled Cassava Farmers in the Study Area

Table 1 presents the socio-economic characteristics of cassava farmers, including their sex, age, marital status, household size, years of schooling, farming experience, farm size, source of finance, access to credit and extension services. The results show that 56.0% of the cassava farmers were female, while 44.0% were male. This indicates that women are more actively involved in cassava production in the study area. This finding contrasts with the general expectation that cassava farming is typically male-dominated, as reported by Otekunrin *et al.,* (2022). The higher female participation observed in this study may be attributed to the role of cassava in household food security and its compatibility with domestic responsibilities traditionally undertaken by women.

Furthermore, the mean age of the cassava farmers was 45.4 years, with nearly half (47.3%) aged between 41 and 50 years. This indicates that cassava farming is largely managed by middle-aged individuals, who are likely to be physically active and inclined to adopt innovations. This trend aligns with Olanrewaju *et al,*. (2022), who found that farmers in this age bracket tend to be more productive and open to new agricultural technologies, which can improve farm output and efficiency. In addition, 50.0% of the respondents were married, 31.3% were single, while the remaining were either widowed or divorced. This finding supports the assertions by Angba and Iton (2020) and Enimu *et al.,* (2016) that married individuals dominate cassava farming. This suggests that married farmers are more likely to have access to family labor, which can significantly reduce dependence on hired labor and lower production costs.

The study also revealed that the average household size was 5.8 members, with 61.4% of the respondents having between 1 and 5 members. Although fewer farmers had larger households, those with more members potentially benefit from greater availability of family labor. As emphasized by Angba and Iton (2020), large household sizes contribute to on-farm labor supply and reduce operational costs.

In terms of education, farmers reported an average of 7.1 years of schooling. Half (50.0%) had between 1–6 years of education, and 40.0% had between 7–12 years. This implies that a significant portion of farmers had completed primary or some secondary education, which is essential for interpreting extension information and adopting improved farming techniques. This finding is consistent with Aboajah *et al.,* (2018), who emphasized that education facilitates access to agricultural innovations. Similarly, the farmers had an average of 15 years of farming experience. Notably, 39.3% had between 1–10 years of experience, while 38.0% had between 11–20 years. Such levels of experience suggest that most cassava farmers have been in the sector long enough to gain practical knowledge, which can enhance their adaptability and risk management. According to Aboajah *et al.,* (2018), this depth of experience positively influences the adoption of improved practices and technologies.

Additionally, the mean farm size was 3.2 hectares, with the majority (71.3%) cultivating between 2–4 hectares. This indicates a predominance of smallholder farming, which is typical in cassava production systems in Nigeria. This finding corresponds with Esheya (2019), who observed that most cassava farmers operate on relatively small plots of land, possibly due to land constraints or resource limitations. Regarding financial resources, 42.7% of the farmers relied on personal savings, and 30.0% sourced finance from cooperatives. Only 23.3% accessed funds from formal financial institutions. This limited access to formal credit may be due to collateral requirements and high-interest rates. As Oguejiofor *et al.,* (2021) noted, such institutional barriers restrict the financial inclusion of smallholder farmers, thereby limiting their investment capacity and potential productivity.

Moreover, the study found that only 42.0% of the farmers had access to extension visits, leaving 58.0% without such support. Limited access to extension services may hinder the transfer of critical agricultural information and practices, leading to suboptimal farming outcomes. This highlights the necessity for expanded extension outreach programs tailored to cassava farmers' needs. Finally, while 59.3% of respondents reported having access to credit, most accessed these funds through informal sources like cooperatives and friends. This suggests that structural challenges, including lack of collateral and restrictive lending conditions, continue to inhibit access to formal credit channels. As supported by Oguejiofor *et al.,* (2021), such constraints may limit the ability of farmers to invest in quality inputs and improved technologies.

Table 1: Socio-economic Characteristics of the Cassava Farmers in Study Area.

Variable	Frequency	Percentage	Mean
Sex			
Male	66	44.0	
Female	84	56.0	
Age (years)			45.4
31-40	41	27.3	
41-50	71	47.3	
51 and above	38	25.3	
Marital status			
Single	47	31.3	
Married	75	50.0	
Widowed	12	8.0	
Divorced	16	10.7	
Household size (members)			5.8
1-5	92	61.4	
6 -10	38	25.3	
11-15	15	10.0	
16 and above	5	3.3	
Years of schooling (years)			7.1
1- 6	75	50.0	
7-12	60	40.0	
13 and above	15	10.0	
Farm Experience (years)			15
1 - 10	59	39.3	
11 – 20	37	38.0	
21 – 30	20	13.3	
31 and above	14	9.4	
Farm Size (hectares)			3.2
1- 2	23	15.3	
2 - 4	107	71.3	
5 - 6	14	9.3	
7 and above	6	4.0	
Source of Finance			
Personal Savings	64	42.7	
Friends	6	4.0	
Cooperative	45	30.0	
Financial Institutions	35	23.3	
Extension Visits			
Yes	63	42.0	
No	87	58.0	
Access to Credit/Loan			
Yes	89	59.3	
No	61	40.7	

Source: Field Survey, 2022.

3.2 Costs and Returns of Cassava Production in the Study Area

The findings of the sampled respondents' assessments of the costs and returns associated with cassava cultivation are shown in Table 2. The analysis revealed that the average cost of cassava stems was ₦26,186.67, fertilizer ₦17,578.99, and herbicides ₦14,173.33. Labor constituted the largest portion of production costs, with an average expenditure of ₦108,533.34, representing 62% of the total production cost. This result aligns with the findings of Sanusi, Adedeji, Madaki and Udoh (2020), who also identified labor as the most significant cost component in cassava production. The total variable cost incurred by cassava farmers was ₦174,346.00, while the total revenue realized was ₦990,826.67. This resulted in a gross margin of ₦816,480.67, a gross margin ratio of 0.824, and a return on investment (ROI) of 4.68. These figures suggest that cassava production is a profitable venture in the study area. This finding is consistent with the study by Sanusi *et al.,* (2020), which reported that cassava production in Kwara State, Nigeria, was economically viable. It also supports the assertion by Esheya (2019) that cassava production is a lucrative enterprise capable of recovering investment costs by the end of each production cycle.

Table 2: Average Costs and Returns Involved in Cassava Production in the Study Area per Production Cycle

Cost items	Average Value/ha	Proportion	Percentage
A. Variable Cost			
Cost of Stem Cutting/bundles	26,186.67	0.150	15
Cost of Fertilizer	17,578.99	0.101	10.1
Cost of Herbicides	14,173.33	0.081	8.1
Cost of Labour	108,533.34	0.623	62.3
Cost of Pesticides	7,873.33		
Output/ton	7.5533		
Unit Price/ton	129,800.00		
B. Total Variable Cost	174,346.00		
C. Total Revenue	990,826.67		
Gross Profit	816,480.67		
Gross Profit Margin	0.824		
Rate of Return	3.683		

Source: Field Survey, 2022.

3.3 Factors Influencing the Total Output of Cassava Production in the Study Area

The factors affecting the output of cassava production in the study area are revealed in Table 3. The Cobb-Douglas production function analysis showed that the coefficient of stem cuttings positively influenced the total output of cassava production; the coefficient of stem cuttings was positive and statistically significant at 0.053. This suggested that an increase in stem cuttings (planting materials) by one unit would result in an increase in the amount of cassava harvested overall in the research area.

Conversely, fertilizer had a negative and statistically significant coefficient (-0.003), implying that a unit increase in the amount of fertilizer used in cassava production led to a decrease in overall yield. This result contradicts a priori expectations and is inconsistent with the findings of Sanusi *et al.,* (2020), who reported that fertilizer application increases cassava yield.

Herbicides also have a negative impact on the overall output of cassava as well; their statistically significant coefficient was -0.434. This meant that a unit increase in the amount of herbicides used by the cassava farmers would result in a drop in the overall output of cassava in the research area. Nevertheless, this finding is inconsistent with Sanusi *et al.,* (2020). This can be due to insufficient understanding of how to use the chemical. More so, labor had a positive impact on cassava production overall; the coefficient of labor was 0.114. This suggests that an increase in labor utilized per unit of cassava production will result in an increase in the overall amount of cassava produced by farmers in study area. Oladoyin, Akinbola, Aturam and Ilesanmi (2022) observed that this also showed that a unit increase in the hour of labor will lead to an increase in the output of cassava production in Ondo State, Nigeria, and their findings are consistent with this. This outcome is also consistent with the findings of Sanusi *et al.,* (2020), who discovered a favorable association between labor and cassava output.

The coefficient of sex of cassava farmers is 1.514. It is significant and positively related to cassava output. This implies that being a male cassava farmer in the study area will lead to increased production. This could be attributed to the land and labor requirements in cassava production, which may not be easily accessible to female farmers.

The age of the farmer influences the total output of cassava and it was statistically significant at (P<0.01) probability level. The coefficient of age is 0.189, implying that a unit increase in the age of a farmer will result in increased cassava output by 18.9%. As the farmer's age increases, they accumulate more experience in cassava farming and, as a result, they may have better technical know-how about cassava production.

Household size of cassava farmers influenced the total output of cassava positively and it was statistically significant at (P<0.01). The coefficient of household size (0.788) implied that a unit increase in the household size will result in an increase in cassava output. This is because of the provision of free labor for cassava production in the study area. This result is in line with the findings of Oladoyin *et al.,* (2022), who reported that household size influences cassava output positively in Okoko District, Ondo State.

The education level of farmers, measured in years spent in school, influenced cassava output negatively and it was statistically significant. The coefficient of years of schooling (-0.125) implies that a unit change in the number of years spent schooling by the farmer led to a decrease in the total output of cassava. This could be due to the fact that educated farmers might be engaged in other lucrative jobs rather than concentrating on farming activities, which could decrease the time allocated to farming.

Farm size influences total output of cassava in the study area positively and it was statistically significant (P<0.01). The coefficient of the farm size (1.23) implies that a unit change in the farm size will result in an increase in the total output of cassava by 1.23% in the study area. As the farm size increases, due to expansion, cassava output will also increase.

Income of the farmer also influences total output of cassava positively in the study area and it was statistically significant at (P<0.01). The coefficient of income was 3.867, signifying that a unit increase in the income of the farmer will result in an increase in the total output of cassava among cassava farmers in the study area. As the income of the farmer increases, their ability to acquire production inputs will also increase. This is in line with Sanusi *et al.*, (2020), who reported similar results in cassava production.

The value of the R-squared (0.969) showed that about 97% of the variation in the total output of cassava production was explained by the number of explanatory variables included in the model. The F-value (423.607) was positive, and it was highly significant at the P<0.01 probability level. This is consistent with the findings of Angba *et al.,* (2020), who recorded similar R-squared and F-values, respectively.

Table 3: Results of the Estimates of the Cobb Douglas Production Function: Factors Influencing Total Output of Cassava Production in the Study area

Variables	Coefficients	Standard Error	T-value
Constant	0.890	0.541	1.646
Seeds Planting Material	0.053	0.004	12.329*
Fertilizer	-0.003	0.000	-11.684*
Herbicides	-0.434	0.037	-11.616*
Labour	0.114	0.035	3.247*
Sex	1.514	0.215	7.034*
Age	0.189	0.013	14.260*
Household Size	-0.951	0.129	-7.396*
Years schooling	-0.125	0.018	-6.894*
Farming Experience	-0 .031	0.023	-1.348
Farm Size	1.223	0.190	6.440*
Income	3.867	0.000	22.399*
R Square	0.971		
Adjusted R Square	0.969		
F-value	423.607		

Source: Field Survey, 2022.
Note: * 1% level of significance, ** 5% level, * 10%.**

3.4 Estimates of the Factors Influencing Technical Efficiency of Cassava Production in the Study Area

The results in Table 4 show the Maximum Likelihood Estimates (MLE) of the stochastic frontier production function and inefficiency component for smallholder cassava farmers. The study found that smallholder cassava growers in the study area had an average technical efficiency of 76%, with a shortfall of 24%. This indicates that the farmers were able to obtain 76% of the potential output from a given mixture of cassava production inputs. The inefficiency, represented by the lambda estimate of 0.00905, suggests that technical inefficiencies accounted for 0.9% of the variation in cassava yield. The sigma square parameter, which represents the variance from the mean, was 11.4837.

The factors influencing cassava output included stem cuttings, which positively affected output with a coefficient of 0.0388, statistically significant at P<0.01. A unit increase in stem cuttings resulted in a 3.9% increase in cassava yield. Fertilizer and herbicides, however, had a negative impact on output. Fertilizer had a coefficient of -0.002697, implying a 0.2% decrease in output for each unit change in its application, likely due to poor utilization. Herbicides had a coefficient of -0.5635, showing a 56.5% decrease in output, suggesting improper application or misuse. Labor positively influenced cassava production with a coefficient of 0.198, indicating a 19.8% increase in output for each unit change in labor used, statistically significant at P<0.1. Farm size also positively impacted cassava output with a coefficient of 1.381, signifying that a unit increase in farm size led to a 138% increase in cassava yield, statistically significant at P<0.05.

Moreover, the inefficiency component analysis revealed that six factors significantly influenced technical inefficiency among farmers. Age had a negative coefficient of -0.093, suggesting that as farmers age, their technical efficiency increases by 9.3%, likely due to accumulated experience. This is in line with findings by Etwire, Martey and Goldsmith (2021), which suggest older farmers are more efficient due to greater resource endowment. Sex had a coefficient of -1.772, indicating that male farmers were more technically efficient by 1.772% compared to females, which contrasts with Itam, Ajah, Ofem, and Abam (2015) study, which found female farmers to be more efficient. Marital status had a positive coefficient of 1.220, indicating that marital status decreases technical efficiency, statistically significant at P<0.01. Household size had a negative impact, with a coefficient of 0.7884, meaning each additional household member decreased technical efficiency by 78.8%, potentially due to diversion of resources.

Extension contact had a negative impact on technical efficiency, with a coefficient of -0.0515, suggesting that each unit increase in extension contact leads to a 5.15% increase in technical efficiency. This is supported by Ume, Ebe, Ochiaka and Ochiaka (2017), who found that extension services help farmers adopt new techniques and improve productivity. Access to credit was the most significant factor influencing inefficiency, with a negative coefficient of -2.57, indicating that each unit increase in credit access improved technical efficiency by 2.57%, helping farmers acquire better inputs and labor. This finding is consistent with Ebukiba, Akpeji and Anthony (2022), who reported that access to credit enhances productivity.

Table 4: Estimates of the Parameters of the Maximum Likelihood of the Stochastic Frontier Production Model; Technical Efficiency of the Cassava Farmers in the Study Area

Variables Frontier	Stochastic	Parameter	Coefficient	Standard Error	Z- value
Constant		B0	3.577977	3.770631	0.95
Stem cuttings		β1	0.0388014	0.0128254	3.03*
Fertilizer		β_2	-0.002697	0.0005324	-5.07*
Herbicides		β3	-0.563577	0.1298788	-4.34*
Pesticides		β_4	-0.0616832	0.0825903	-0.75
Labour		β5	0.1983763	0.1120599	1.77***
Farm Size		β_6	1.381389	0.6342497	2.18 **
Inefficiency Model					
Age		Z_1	-0.0930655	0.033171	-2.81*
Sex		Z_2	-1.772785	0.4516471	-3.93*
Marital Status		Z_3	1.220024	0.1952759	6.25*
Educational Level		Z_4	0.0270145	0.0392182	0.69
Household Size		Z_5	0.7884366	0.1953848	4.04*
Farming Experience		Z_6	0.0515197	0.0443322	1.16
Extension Contact		Z_5	-2.006433	-0.4990361	-4.02*
Access to Credit		Z_1	-2.57105	-0.4911182	-5.24*
Sigma^2		α^2	11.4837	1.337633	
Lambda		$^{\gamma}$	0.0090504	4.51056	
Log likelihood =		**-395.9065**			
Number of Observation		**N**	150		
Mean Tech efficiency		**TE**	0.76		

Source: Field Survey, 2022.

Note: * 1% level of significance, ** 5% level, * 10%.**

3.5 Distribution of Technical Efficiency Level Obtained by Smallholder Cassava Farmers in the Study Area

The results presented in Table 5 show that 8% of the sampled smallholder cassava farmers fell within the 0.0-0.2 range of technical efficiency, while 10% of the farmers were within the 0.21-0.4 and 0.41-0.6 technical efficiency ranges. Furthermore, with an average efficiency of 0.762 in the study area, approximately 9.33% of the sampled cassava farmers achieved a technical efficiency range of 0.61 to 0.8, and 62% of the farmers attained a technical efficiency level between 0.81 and 1.0. According to this study, smallholder cassava farmers achieved a technical efficiency level of 76%, which indicates a 24% inefficiency gap from the ideal level of perfection with the available technology. This finding is consistent with studies by Itam *et al.,* (2015) and Ebukiba *et al.*, (2022), which suggest that farmers can achieve optimal technical efficiency by adopting new innovations and cutting-edge technologies, even if they are currently technically inefficient to some extent.

Table 5: Distribution of Technically Efficiency Level among Smallholder Cassava Farmers

Technical Efficiency Score	Frequency	Percentage
0-0.2	12	8.00
0.21-0.4	16	10.67
0.41-0.6	15	10.00
0.61-0.8	14	9.33
0.81-1.0	93	62.00
Minimum	0.017	
Maximum	0.998	
Mean TE	0.762	

Source: Field Survey, 2022.

3.6 Constraints Faced by Sampled Smallholder Cassava Farmers in the Study Area

The results presented in Table 6 show the challenges encountered by the sampled smallholder cassava farmers in the study area. The study revealed that approximately 68.7% of the farmers experienced a shortage of land for cassava cultivation. A lack of land can lead to insufficient cassava production in the area, potentially resulting in scarcity and increased prices of cassava products. Furthermore, a majority (78%) of the farmers reported insufficient access to financing for cassava production. About 54% of respondents also identified government policies on land as a major challenge. Inconsistencies in land tenure policies may lead to the conversion of farmlands to other uses, thereby limiting land availability for cassava cultivation. This aligns with the findings of Oladoyin *et al.,* (2022), who noted that inadequate access to credit or financial support is a major constraint affecting agricultural productivity.

Moreover, approximately 59.3% of cassava farmers indicated that lack of access to loans hindered their ability to enhance production. Pests and diseases posed a significant challenge for 92.7% of the farmers, causing damage to cassava crops both before and after harvest. Another major constraint was the high cost of labor, as reported by 89.3% of the respondents. Rising labor expenses increase production costs and reduce the net income derived from cassava farming. The study also found that 38.7% of cassava farmers lacked access to quality stem cuttings, which are essential for improving cassava yield. These findings support Esheya (2019) assertion that limited access to improved stem cuttings and other inputs can negatively affect cassava productivity, while better access could significantly enhance production and overall output.

Table 6: Constraints Faced by Smallholder Cassava Farmers in the Study Area

Constraints	Frequency	Percentage
Lack of Land	103	68.7
Government Policies on Land	81	54.0
Inadequate Finance	117	78.0
No Access to Loan	89	59.3
Pests and Diseases	139	92.7
High Cost of Labour	134	89.3
No Access to Planting Stock	58	38.7

Source: Field Survey, 2022.

4.1 CONCLUSION AND RECOMMENDATIONS

The study indicates that cassava farmers in the area have favorable socioeconomic conditions for production, with high gross margins and efficient resource utilization, reflected in an average technical efficiency of 0.762. However, challenges such as land and funding shortages persist. Despite these challenges, cassava production remains a viable and beneficial enterprise in the region. Based on the findings of this study, it is recommended that farmers be encouraged to expand their cassava farming operations to increase profitability. Additionally, cassava processing into value-added products like chips and flour should be promoted to boost income. Access to subsidized inputs, such as improved planting materials, disease-resistant varieties, and credit, should be provided to enhance production. Special support for female farmers through subsidies, education, and dedicated funds will also be crucial to improving their participation in cassava production. Furthermore, the Agricultural Development Program (ADP) should be revitalized to offer training on efficient resource allocation. To help farmers transition to commercial farming, subsidies on production inputs like fertilizers, seeds, and chemicals, along with the provision of tractors, should be implemented. Finally, government and donor agencies should fund and disseminate crop breeding research findings to farmers to further enhance productivity.

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