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# Technical efficiency of cassava farmers in Ekiti State, Nigeria

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## Abstract

This study measured the technical efficiency of cassava farmers in Ekiti State, Nigeria. A multi-stage sampling technique was employed to select 120 respondents for the study. Primary data were collected from the randomly selected respondents through a well-structured and self-administered questionnaire. The results of the study indicated that more than half (52.5%) of the cassava farmers were older than 50 years of age and had household sizes within the range of 6-10 persons. About 51.6 percent of the respondents had more than a primary school education. No difference existed between those with tertiary education and those without formal education regarding the cultivated farm size (4.00 ha). Combined labour (family and hired labour) was prevalent among the farmers, as submitted by 65.8 percent of the cassava farmers. Results from the Stochastic Frontier Production Function (SFPF) model indicated that herbicide and pesticide, depreciation value of tools, cost of fertiliser used, and farm size significantly differed from zero and were important in cassava production. Also, the year of formal education, farming experience and marital status were the major socioeconomic characteristics affecting the technical inefficiency of the cassava farmers. Essentially, the technical efficiency of cassava farmers ranges between 0.334 and 0.972, with a mean value of 0.790. This shows that, on average, farmers could obtain about 80% of potential output from a given set of inputs. For technical efficiency to be improved in the study area, the year of formal education and farming experience should be considered by policymakers.

**Keywords:** Cassava farmers; Technical efficiency; Ekiti State; Stochastic Frontier

## 1. Introduction

Before the significant shift to oil exploration, agriculture was the backbone of Nigeria's economy (Imiti & Odjebor, 2022). Agriculture contributed at least 57 percent to the GDP and 64.5 percent to export earnings between 1960 and 1969. (Abubakar & Ibrahim, 2019). However, the sector's contribution to the nation's economy declined steadily from 1970 to the late 2000s (National Bureau of Statistics, 2016). From 2011 to 2014, the sector contributed an average of 23.5 percent of GDP and 5.1 percent of export earnings to Nigeria's economy. And in 2016, agriculture accounted for 24,4 percent of the gross domestic product and 4.8 percent of foreign earnings (PWC, 2016).

Observing this declining trend in agriculture's contribution to the nation's economy (Michael, 2017) and the recent global decline in crude oil prices (Solaymani, 2019), resulting in a decline in crude oil's contribution to export earnings, the Federal Government and other stakeholders have initiated discussions about the significant role agriculture has to play in expanding and reviving Nigeria's economy. To make significant progress in this sector, crop production, which accounts for 90 percent of total agricultural output, must be the primary focus (Odetola & Etumnu, 2013). Nigeria has a minimum of 82.0 million hectares of arable land out of a total land mass of 92.4 million hectares, endowing its vast agricultural potential (Adeoye & Iwegbu, 2020). Only 34 million hectares of these arable hectares are currently cultivated.

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There are only two ways to achieve the desired growth in agriculture: an increase in yield per hectare and an expansion of land for production (Fugile & Rada, 2013). Until now, land expansion has been Nigeria's primary driver of agricultural growth. Due to insufficient and insufficient agricultural inputs, including seedlings, fertilisers, and pesticides, yield per hectare has been generally and persistently low (Price Water Coopers, 2016).

Cassava, one of the top five agricultural products in Nigeria and the subject of this study, has experienced persistently low output despite an increase in the number of hectares devoted to its production (Oluwafemi, Omonona & Adepoju, 2019). In 2014, the nation's cassava yield was lower than the global average yield for producing nations (Akinwumiju, Adelodun, & Orimoogunje, 2020). This necessitates considering what may be impeding cassava production in the country. This study examined the technical efficiency of cassava farmers in Ekiti State, Nigeria. To determine this, the study focused on:

- identifying the socioeconomic characteristics of the farmers;
- examining the technologies available to the farmers in the study area;
- estimating the technical efficiency of the cassava farmers; and
- analysing the factors that influence the technical efficiency of cassava farmers.

## 2. Methodology

The study focused on farmers in Ekiti State who cultivate cassava. The respondents for the study were selected using a multi-stage sampling technique. In the initial phase, four Local Government Areas were selected at random. The second step involved randomly selecting three local communities from each Local Government Area. The final phase involved randomly selecting 10 farmers from each of the 12 local communities for a total of 120 participants. It is essential to emphasise that personal administration and collection of pertinent information were carried out in order to collect essential and authentic data. In this instance, oral interviews, personal observation, and estimates were also utilised, and comments and other contextual events were recorded.

The socioeconomic characteristics of the cassava farmers, the technologies available to the farmers, and the factors inhibiting cassava production in the study area were described using descriptive statistical tools such as frequency counts, percentages, tables, and mean. While stochastic production frontier was utilised to estimate the technical efficiency and determinants of the cassava farmers' technical efficiency.

For this study, the model used was assumed to be of the Cobb Douglas form following Battese & Coeli (1995).

### 2.1. Model Specification

The implicit form is given as

$$Y = F(X1 \dots \dots \dots . . Xn, Ui) \dots \dots \dots \dots . (1)$$

$Where$
$Y = \ value\ of\ cassava\ output\ (₦)$
$Ui = error\ term$
$Xi - Xn = variables$

$The\ above\ will\ be\ utilized\ explicitly\ as$

$$InY1 = \beta0 + \beta1InX1 + \beta2InX2 + \beta3InX3 + \beta4InX4 + \beta5InX5 + \beta6InX6 \dots \dots \dots \dots (2)$$

$Where$
$Y1 = value\ of\ cassava\ output\ (₦)$
$X1 = Planting\ material\ used\ (₦)$
$X2 = \ Labour\ used\ (Man - days)$
$X3 = Fertilizer\ used\ (₦)$
$X4 = Herbicides\ and\ pesticide\ used\ (₦)$
$X5 = Farm\ size(Hectares)$
$X6 = Depreciation\ value\ of\ tools\ (₦)$
$\beta1 - \beta6 = Parameters\ to\ be\ estimated$

$Also\ inefficiency\ model\ (Ui) is\ shown\ as$

$$Ui = \delta 0 + \delta 1Z1 + \delta 2Z2 + \delta 3Z3 + \delta 4Z4 + \delta 5Z5 + \delta 6Z6$$

$Where,$
$ui = technical\ efficiency\ of\ the\ ith\ farmers$
$\delta's = Unknown\ scalar\ parameters\ to\ be\ estimated$
$Z1 = Extension\ visit\ (numbers)$
$Z2 = Age (years)$
$Z3 = Educational\ status\ (years)$
$Z4 = Farming\ experience\ (years)$
$Z5 = Marital\ status\ (married = 1, and\ 0\ otherwise$
$Z6 = Household\ size$

## 3. Results and discussion

Table 1 displays the distribution of cassava farmers according to their socioeconomic characteristics. According to the findings, 91.7% of cassava farmers were married, and 52.5% of respondents were aged 51 or older, with a mean age of 53. This indicates that farmers are still in their productive years, which is anticipated to increase productivity. More than half of the respondents (54,2 percent) had families with six to ten members, with an average of six members. Most cassava farmers (84,2 percent) were literate, while only 15.8 percent were illiterate, according to their educational background. This indicates that farmers in the study area are more enlightened and better understand how to acquire land, which is expected to result in greater productivity. Most farmers (55.8 percent) had more than ten years of farming experience, with a mean of fifteen years. About eighty percent of cassava farmers engaged in mixed cropping, while only twenty percent engaged in single cropping. The table also revealed that 62.5% of landowners inherited their property. This was anticipated to reduce production costs as less money would be spent on land acquisition. The average farm size was 4.8 hectares, and 51.7% of farmers had access to land larger than 4.0 hectares. 35.8 percent of the farmers planted a combination of local and improved cassava varieties on their farmland. In contrast, 30.8% of the farmers planted improved varieties, and 33.3% continued cultivating the local variety, although its yield was lower than that of the improved varieties. A minimum of 47.5% of farmers obtained their planting materials from Agricultural Development Programme (ADP) Zones. This was because the ADP Zones are located near the rural farmers in their various localities, which has increased the extension agents' contacts with a large proportion of the local farmers as they held biweekly meetings with them. In the meantime, none of the farmers obtained their planting materials from the research station due to the enormous knowledge gap between local farmers and the research station.

**Table 1** Socioeconomic Characteristics of the Respondents

| Variables | Frequency | Percentage | Mean |
|---|---|---|---|
| Marital Status | | | |
| Single | 10 | 8.3 | |
| Married | 110 | 91.7 | |
| Class of Age (Years) | | | |
| 20-30 | 4 | 3.3 | |
| 31-40 | 23 | 19.2 | 53 years |
| 41-50 | 30 | 25.0 | |
| > 51 | 63 | 52.5 | |
| Class of Family Size | | | |
| 5 or less | 53 | 44.1 | |
| 6-10 | 65 | 54.2 | 6 persons |
| 11 or more | 2 | 1.7 | |

| | | | |
|---|---|---|---|
| Level of Education | | | |
| No formal education | 19 | 15.8 | |
| Primary level | 39 | 32.6 | |
| Secondary level | 55 | 45.8 | |
| Tertiary level | 7 | 5.8 | |
| Farming Experience | | | |
| 10 or less | 53 | 44.2 | |
| 11-20 | 34 | 28.3 | 15 years |
| 21-30 | 27 | 22.5 | |
| 31or more | 6 | 5.0 | |
| Cropping Pattern | | | |
| Mixed cropping | 96 | 80.0 | |
| Sole cropping | 24 | 20.0 | |
| Source of Land | | | |
| Leased | 13 | 10.8 | |
| Rent | 15 | 12.5 | |
| Inheritance | 75 | 62.5 | |
| Outright purchase | 15 | 12.2 | |
| Gift | 2 | 1.7 | |
| Farm Size(Ha) | | | |
| 0.1-1.0 | 26 | 21.7 | |
| 1.1-2.0 | 14 | 11.7 | |
| 2.1-3.0 | 9 | 7.5 | 4.8 Hectares |
| 3.1-4.0 | 9 | 7.5 | |
| 4.1 or more | 62 | 51.7 | |
| Variety planted | | | |
| Local Variety | 40 | 33.3 | |
| Improved Variety | 37 | 30.8 | |
| Both | 43 | 35.8 | |
| Source of planting materials | | | |
| Research Stations | 0 | 0 | |
| ADP | 57 | 47.5 | |
| Local Markets | 25 | 20.8 | |
| Others(previously cultivated) | 5 | 4.2 | |
| Farmlands, friends and relatives) | 33 | 27.5 | |

Source: Field Survey, 2019

Table 2 reveals that most farmers (91.7%) employed the traditional method, while 7.5% combined the use of tractors and other simple tools in their agricultural operations. According to the findings, farmers primarily utilised simple tools such as the cutlass, hoe, etc. This could be due to the high cost of mechanised farming in the region, or it could be due to a lack of knowledge regarding the benefits of mechanised farming. About 65.8 percent of farmers in the study area used both hired and family labour as manpower for their labour-intensive tasks such as ridging, weeding, and harvesting. However, only 20.0% of farmers used hired labor for all their farming activities.

Regarding the use of herbicides and pesticides, 81.7% of farmers did not use herbicides and pesticides, while 81.7% used them. This suggests that most farmers in the study area employed traditional methods. Moreover, the results demonstrated that most farmers (83.0 percent) did not use fertiliser.

**Table 2** Technology Available to the Farmers

| **Variables** | **Frequency** | **Percentages** |
|---|---|---|
| Farming Methods Used | | |
| Traditional Methods | 110 | 91.7 |
| Mechanical Methods | 1 | 0.8 |
| Both | 9 | 7.5 |
| Type of Labour Used | | |
| Family Labour | 17 | 14.2 |
| Hired Labour | 24 | 20.0 |
| Both | 79 | 65.8 |
| Herbicide and Pesticide Usage | | |
| Non Usage | 98 | 81.7 |
| Usage | 22 | 18.3 |
| Fertilizer Usage | | |
| No Fertilizer Use | 100 | 83.3 |
| Fertilizer Use | 20 | 16.7 |

### 3.1. Technical Efficiency Analysis

Table 3 displays the estimates of the Stochastic Frontier Production Function (SFPF) for cassava farms; at the 1% significance level, the sigma-square (δ2) value of 0.215 significantly differed from zero. The gamma (γ) value of 0.296, which was statistically significant at the 1% significance level, indicates a good fit of the model and the correctness of the specified distribution assumption of the composite error term ($U_i$). This implies that roughly 29 percent of the variation in the value of cassava output was primarily attributable to the difference in their technical efficiencies or technical inefficiencies. In comparison, the remaining 71 percent was attributable to random errors. The table displays the Maximum Likelihood Estimates (MLE) for each of the variables that contribute to the efficiency and inefficiency of the households, as well as the extent to which the farmers use these variables efficiently or inefficiently. According to Table 3, the estimated coefficients for the cost of fertiliser and the depreciated value of tools were significant at 5%. In comparison, those for herbicide and pesticide use and farm size were significant at 10% and 1%, respectively. This demonstrates that these four inputs significantly differed from zero and significant for cassava production in the study area.

To improve production efficiency, examining the factors that lead to inefficiency is necessary. The estimated coefficient of the inefficiency model explains the relative productivity levels among farmers. Table 3 shows that years of farming experience were significant at the 5% significance level, while marital status and years of formal education were significant at the 1% and 10% levels of significance, respectively. This suggests that these three variables are the most influential socioeconomic factors in the technical inefficiency of cassava farmers in the study area. Other variables such as age, extension visit, and household size did not differ significantly from zero at the 1%, 5%, or 10% significance levels. The estimated coefficients for years of farming experience and formal education negatively correlated with technical inefficiency. This implies that as these variables increase (decrease), technical inefficiency decreases (increases), and as a result, technical efficiency increases (decreases). Also, a positive sign for marital status indicates that married respondents are less productive.

**Table 3** Maximum –Likelihood Estimates of the Stochastic Cobb- Douglas Production Frontier for Ekiti-State Cassava Farmers

| **Functions** | **Parameters** | **Coefficient** | **t-value** |
|---|---|---|---|
| Production function | | | |
| Constant | $\beta_0$ | 12.927* | 0.450 |
| Planting material used(₦) | $\beta_1$ | -0.032** | 0.145 |
| Labour used (man/ days) | $\beta_2$- | 0.004 | 0.119 |
| Fertilizer used (₦) | $\beta_3$ | 0.032* | 0.012 |
| Herbicide and pesticide(₦) | $\beta_4$ | -0.027*** | 0.014 |
| Farm size(Hectares) | $\beta_5$ | 0.881* | 0.06 |
| Depreciation value of tools | $\beta_6$ | -0.131** | 0.052 |
| Inefficiency model | | | |
| Constant | $\delta_0$ | 0.050 | 1.356 |
| Extension visit (numbers) | $\delta_1$ | -1.602* | 0.267 |
| Age(years) | $\delta_2$ | 0.259 | 0.346 |
| Years of formal education | $\delta_3$ | -0.185*** | 0.106 |
| Farming experience (years) | $\delta_4$ | -0.539** | 0.221 |
| Marital status | $\delta_5$ | 0.772* | 0.258 |
| Household size | $\delta_6$ | -0.125 | 0.209 |
| Variance parameters | | | |
| Sigma-squared | $\delta^2$ | 0.215* | 0.028 |
| Gamma | $\gamma$ | 0.296* | 0.089 |
| Log-likelihood function L(H) | 65.595 | | |

SOURCE: Computed from Field Survey Data, 2020; *** t-values significant at 10%; ** t-values significant at 5%; * t-values significant at 1%

### 3.2. Cassava Farmer's Technical Efficiency Index

In Table 4, the frequency distribution of technical efficiency indexes reveals significant variations in technical efficiency among respondents. The distribution reveals that 7.5% of products have technical indexes between 0.91 and 1.00. Technical efficiencies (TE) of cassava farmers range from 0.334 to 0.972, with an average of 0.770. Approximately 56.7percent of cassava producers in the study area were deemed technically efficient.

The mean value of 0.790 indicates that farmers will operate at the production frontier if the technical efficiency of input usage is increased by 0.210 (1-0.790). This indicates that, on average, farmers could obtain approximately 80% of the potential yield from the inputs used in the production process. These findings also reveal the existence of technical inefficiencies, the elimination of which could increase the technical efficiency of cassava producers in Ekiti State.

**Table 4** Distribution of cassava producers' technical efficiency

| Efficiency Class Index | Frequency | Percentage |
|---|---|---|
| 0.31-0.40 | 4 | 3.3 |
| 0.41-0.50 | 8 | 6.7 |
| 0.51-0.60 | 11 | 9.2 |
| 0.61-0.70 | 16 | 13.3 |
| 0.71-0.80 | 13 | 10.8 |
| 0.81-0.90 | 11 | 9.2 |
| 0.91-1.00 | 57 | 47.5 |
| TOTAL | 120 | 100.0 |
| Mean TE | 0.790 | |
| Minimum | 0.334 | |
| Maximum | | 0.972 |

**SOURCE:** Field Survey Data, 2020

## 4. Conclusion

As indicated by the mean TE of 0.790, the farmers were inefficient in their cassava production. In addition, the study reveals the existence of technical inefficiency among the farmers, as indicated by the gamma ($\gamma$) coefficient of 0.296, which indicates that about 29 percent of the variation in the value of cassava output was attributable to differences in their technical efficiencies or inefficiencies. Five of the six variables were significantly different from zero and important for cassava production in the study area. In addition, the analysis of the technical inefficiency model revealed that years of formal education, marital status, and farming experience were the most influential socioeconomic factors in the technical inefficiency of cassava producers. In addition, approximately 57% of farmers had a technical efficiency index between 0.81 and 1.00. Technical efficiencies ranged from 0.333 to 0.972.

Recommendations

The following recommendations were made based on the findings:

- Cassava farmers must be educated on the utility and significance of mechanised farming.
- Improved inputs such as fertilisers and herbicides should be introduced to farmers to increase their productivity and reduce the production costs associated with conventional farming techniques.
- Modern farming equipment should be subsidised so farmers can afford and utilise modern farming techniques.

## Compliance with ethical standards


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All authors declare no conflict of interest to disclose.

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