GLOBAL JOURNAL OF BIOLOGY, AGRICULTURE & HEALTH SCIENCES
(**Published By**: Global Institute for Research & Education)
www.gifre.org

Technical Efficiency Analysis of Mechanized Cassava Farmers in Afijio Local Government Area of Oyo State, Nigeria

Durojaiye A. M[1]. & Ogunjinmi O. O[2].
[1,2]department of Agricultural Education, Emmanuel Alayande College of Education Oyo,
Pmb 1010, Oyo State, Nigeria.

Abstract

This paper examined the technical efficiency of mechanized cassava farmers in Afijio Local Government Area of Oyo State. Random sampling technique was employed to collect data from randomly selected 50 mechanized cassava farmers used for the study. Primary data were collected using a well structured questionnaire. Data collected were analyzed using descriptive statistics and Stochastic Frontier production function. The result of the study revealed that the technical efficiency of the farmers ranges from 58 – 92% with a mean of 78%. This indicates ample opportunity for the farmers to increase their productivity through improvement in their technical efficiency. Farm size, labour, fertilizer and planting materials were found to be statistically significant and positively related to farmers output while educational level, household size and farming experience of the mechanized cassava farmers negatively influenced farmers' technical inefficiency. The farmers therefore need to increase their output through more intensive use of land, planting material, labour and fertilizer input.

Keywords: *Mechanized cassava farmers, Technical efficiency, Stochastic Frontier Production Function, Socio – economic variables, Nigeria.*

Introduction

Cassava is Africa's second most important staple food after maize in terms of calories consumed. In the early 1960s, Africa accounted for 42% of world cassava production; thirty years later, Africa produced half of world cassava output, primarily because Nigeria and Ghana increased their production four fold. In the process, Nigeria replaced Brazil as the world's leading cassava producer (Nweke 2004). In Nigeria, traditionally, cassava is produced on small –scale family farms. As noted by Nweke (2004), the roots are processed and prepared as a subsistence crop for home consumption and for sale in the village markets and transported to urban centres. Cassava is an important staple food in Nigeria and has the potential to become a cash crop in many African countries (Qirschot *et al.*, 2004). It has spread to all parts of Nigeria, Sokoto, Kano, Benue, Kabba and Ilorin areas of Northern Nigeria. Smaller quantities are grown in Borno, Katsina, Bauchi, Niger, Adamawa, plateau and Zaria provinces. It is rapidly displacing yam (the indigenous tuber crop) which can be grown only in areas of well supplied moisture, it can grow in almost frost- free, humid or and tropical areas and does not stand cold weather (Olukotun and Akinrinde2001).

Cassava ranks high as a major staple food crop particularly for the low income earners and resource-poor farmers in the developing economics of sub Saharan Africa (Hahn *et al.*, 1989). However, in the recent times, cassava is progressively gaining a strategic position in the global trade as a result of the efforts by various research and development stakeholders in developing value-added cassava-based products for human consumption and industrial uses (Onyeka *et al*., 2005). It is estimated that 250 million people in Sub-Saharan Africa derive half of their daily calories from cassava being the second most important food staple and supplier of calories after maize (Nweke, 2004; FAO, 2005; Anyaegbunam *et al*., 2010). Recently, production figures ranked Nigeria as the leading producer of cassava in the world (FAO, 2004, Yakasi, 2010) and put ready money and food in the very vulnerable segments of the society in the country.

In Nigeria the economic importance of cassava can never be over- emphasized as it cuts across different spheres of human consumption, industrial materials, feed supplements for animals and source of employment and income to farmers. As a human consumption item, the sweet varieties are boiled but in the case of the bitter varieties the cassava is prepared in various ways to make "Gaari, "Atieke" "Laafun", "Fufu", "flour" consumed by majority of Nigerians. Cassava starch is widely used in Nigeria in various industries such as food processing, textile and paper production industries; it is also used in the production of certain chemicals such as acetone, alcohol and acetic acid. Also, the cassava peelings or various forms of dried cassava chips or meal are used in feeding livestock. According to Olukotun and Akinrinde (2001), the fresh or boiled tuber can be fed to domestic livestock for consumption for conversion into animal products (milk, meat and eggs). While the cassava peels is richer in protein, ether extract and minerals than the edible portion.

Concept of Technical Efficiency

Technical efficiency has been defined by Heady (1982) as the measure of a firm's success in producing maximum output from a given set of inputs. Also, Yao and Liu (2008) defined technical efficiency as the ability to produce maximum output from a given set of inputs, given the available technology. Efficiency measurement is an important issue in agricultural venture because it allows the comparison of productivity and efficiency between farming enterprises. Efficiency is a very crucial factor of productivity growth especially in developing agricultural economics, where resources are meagre and opportunities for developing and adopting new technologies have continued to dwindle.

Methodology

The study was conducted in Afijio Local Government Area of Oyo State, Nigeria. The area occupies a land mass of

685.085 sq km and a population size of 152,193 using a growth rate of 3.2% from 2006 census figures. The population density of the area is 222 persons per square kilometre. The Yorubas mainly dominate Afijio Local Government Area. The indigenes are mostly farmers who had taken the advantage of vast agricultural land that favours the cultivation of food crops such as cassava, maize, guinea corn, yam, cowpea, soya beans, fruit plantain, banana and tree crops.

A random sampling technique was employed to select 50 mechanized cassava farmers from six communities in the council Area through the administration of questionnaire and interview. Primary data collected focused on socio economic characteristics of mechanized cassava farmers, inputs used, cassava output and their prices. The data were subjected to descriptive statistics such as frequency distribution and percentages. These were used to describe the relevant socio-economic characteristics of the respondents.

The stochastic frontier model was also used to determine the technical efficiency of the mechanized cassava farmers. The stochastic frontier production function model is specified in the implicit form as follows:

$Yi = f(X_i,\beta) + (V_i - U_i)$

Where: Y_i is the output of the i^{th} farm

X_i is a K Xl vector of input quantities of the i^{th} farm

β is a vector of unknown parameters estimated, V_i are random variables which are assumed to be normally distributed N (O, S,^{2}) and independent of the U_i. It is assumed to account for measurement error and other factors not under the control of the farmers. U_i are non-negative random variable called technical inefficiency effects (Aigner *et al.*, 1977).

A Cobb–Douglas Production form of the frontier used for this study is presented as follows:

$$\ln Y = \beta_0+\beta_1 \ln X_1+\beta_2 \ln X_2+\beta_3 \ln X_3+\beta_4 \ln X_4+\beta_5 \ln X_5+\beta_6 \ln X_6+\beta_7 \ln X_7+V_1-U_1$$

Where Y = crop output of cassava (kg)

X_1 = Farm size (hectares)

X_2 = Family Labour (man-day)

X_3 = Hired labour (man-day)

X_4 = Quantity of fertilizer used (kg)

X_5 = Quantity of Herbicides (litre)

X_6 = Quantity of tractor used

$\beta_0, \beta_1 \ldots\ldots\ldots\ldots \beta_7$ = Estimated parameters

The inefficiency model is represented by

$$U_1 = d_0 + d_1z_1 + d_2z_2 + d_3z_3 + d_4z_4 + d_5 + z_5 + d_6 + z_6 + \ldots\ldots\ldots\ldots\ldots\ldots d_nz_n \quad (2)$$

U_i = Technical inefficiency

z_1 = Age of farmers (years)

z_2 = Marital Status (single 1, 0 = others)

z_3 = Sex (dummy variable. 1 if male, 0 = others)

z_4 = Level of education (years)

z_5 = Household size (number)

z_6 = Farming experience (years)

$d_0, d_1 \ldots\ldots\ldots d_6$ = Estimated parameters

Results and Discussion

The distribution of the socio-economic characteristics of respondents in Table 1 reveals that the mean age of the farmer is 50years. The result implies that the cassava farmers were in their active age and as such will respond positively to any intervention aimed at improving their level of production because of their expected capacity and strength to farm. This is supported by the findings of Clark and Akinbode (1998) and FAO (2001) that farmers in this age category are more willing to bear risk and more responsive to new agricultural packages. Also the mechanized cassava farmers had a household size of between 5 and 7. This suggests that household labour could serve as a cheap source of farm labour at least or no cost.

The table revealed that 92% of mechanized cassava farmers were male while 8% were female, 16% of them had at most primary school education as compared to 40% of farmers with tertiary education. This implies that the farmers would find it difficult to understand and adopt technological innovations on method of production because education will predispose farmers to be innovative and put them in a better position to cope with the challenges of new factor and product that the adoption of new technologies introduces to them. The description of the socio-economic characteristics variables further shows that majority of the cassava farmers (60%) had more than 10 years experience in cassava cultivation, while 64% acquired their land for cassava production through inheritance and the remaining 36% acquired theirs by leasing and renting.

Table 1: Socio-economic Profile of the respondents

Variable Description	Frequency	Percentage (%)
Age group (years)		
31 – 40	05	10
41 – 50	15	30
51 – 60	25	50
Above 60	05	10
House size		
2 – 4	10	20
5 – 7	35	70
8 – 10	05	10
Sex		
Male	46	92
Female	04	08
Educational level		
Primary school	08	16
Secondary school	22	44
Tertiary	20	40
Farming experience (years)		
10 or less	12	24
10 – 19	26	52
20 – 29	04	08
Above 30	08	16
Method of land acquisition		
Inheritance	32	64
Lease	14	28
Rental	04	08

Source: Field Survey, 2013

The technical efficiency indices of the mechanized cassava farmers are presented in Table 2. The result showed that the technical efficiency of the sampled farmers ranges between 0 and 1. The sampled farmers were less than a unity (less than 100%), implying that all the mechanized cassava farmers were producing below the maximum efficiency frontier. The distribution of the technical efficiency score of the respondents show that 02 farmers had efficiency rate of 3% – 39% while 1 and 4 farmers had technical efficiency score of 49% – 59%. Also, 10 and 15 farmers had efficiency index of 80% – 90% and 90% – 100% respectively. It is obvious from the result that 30% could be said to be technically efficient.

This clearly shows that the mechanized cassava farmers in the study area were technically efficient. The most efficient farmers operated at 0.92 efficiency levels, while the least efficient farmers were found to operate at 0.58 efficiency levels. The mean efficiency of 0.78 implies that although farmers were efficient, they still had room to increase the efficiency in their farming by 22% through better use of available resources given the current state of technology (Asogwa *et al.*, 2005).

Table 2: Distribution of Technical Efficiency Indices of Mechanized Cassava farmers.

Efficiency Class	Frequency	Percentage
Index		
0.30 – 0.39	02	04
0.40 – 0.49	01	02
0.50 – 0.59	04	08
0.60 – 0.69	06	12
0.70 – 0.79	12	24
0.80 – 0.89	10	20
0.90 – 1.00	16	30
Total	**50**	**100**
Mean	**0.78**	
Maximum value	**0.92**	
Minimum value	**0.58**	

Source: Field Survey, 2013

Estimated OLS and MLE of Mechanized Cassava Farmers in Afijio Local Government Area of Oyo State

The estimated result of the Ordinary Least Square (OLS) and maximum Likelihood estimate (MLE) of the production function parameter of mechanized cassava farmers in Afijio Local Government Area of Oyo State is presented in Table 3. The sigma square (δ^2_s) value of 2.820 which was positive and significantly different from zero indicated a good fit and the correctness of the distributional assumption specified. The variance ration (γ) which measures the effect of technical inefficiency on the observed output have a value of 0.882. This implies that 88% of the variation in the output of cassava was attributed to technical inefficiency. The ratio of log likelihood test was also significant, implying the major presence of technical inefficiency among the farmers.

The maximum likelihood coefficient for farm size, (0.524), hired and family labour is (0.364) and (0.231) respectively. Fertilizer (0.048) and planting materials (0.540) were also positive and statistically significant. This suggests that more output of cassava would be obtained from the use of additional quantities of these variables *ceteris paribus*. The significance of these variables could be attributed to their importance in crop production in the sense that the shortage would have direct negative effect on production. This is in line with the findings of Musa *et al.*, (2010) and

Shehu *et al.,* (2010) that had positive coefficients for labour, planting materials and land resources, and they were significant and directly affect farm output in their various study areas.

However, for the OLS function, only the coefficients of fertilizer, farm size and Labour were positive and statistically significant at 1% and 5% level respectively.

Table 3: The Ordinary Least Square (OLS) and Maximum Likelihood Estimated (MLE) for Mechanized Cassava Farmers in Afijio Local Government Area of Oyo State

Variable	*Parameters*	*OLS*	*MLE*
Constant	b_0	3.974(2.642)	1.472 (1.843)
Farm Size (Ha)	b_1	0.684 (2.204*)*	0.525 (3.272)*
Labour (Monday) F	b_2	0.234 (2.685*)*	0.364 (5.474)*
Labour (Monday) H	b_3	0.062 (0.290)	0.2309 (2.212)**
Fertilizer (Kg)	b_4	0.079 (3.092*)	0.048 (2.222)**
Herbicides (Litres)	b_5	0.057 (0.482)	0.006 (0.284)
Tractor	b_6	0.018 (1.435)	0.013 (1.318)
Planting materials	b_7	0.123 (1.350)	0.540 (6.452)*
Diagnostic Statistics			
Sigma square	δ^2_s		2.820 (7.618)*
Gamma	γ		0.882 (10.186)*
Log likelihood ratio			30.34

Source: Field Survey, 2013

Figures in parenthesis are t–ratios

** Estimate is at 1% level of significance*

*** Estimate is at 5% level of significance.*

Determinants of technical inefficiency

The inefficiency variables were specified at those relating to farmers socio–economic characteristics. The results of the analysis of the determinants of technical inefficiency are presented in Table 4. The estimated coefficient of the inefficient function provides some explanation farmers. Since the dependent variable of the function represent inefficiency, a positive sign of an estimated parameter implies that the associated variable has a negative effect on efficiency and a negative sign indicates the reverse.

The coefficient for educational level of respondents (-0.374) was negative and significantly related to technical inefficiency at 1% level of significance. This implies that farmers with more years of education tend to be more technically efficient in cassava production. The reason may be that educated farmers are more receptive to improved farming techniques. This result is in line with the findings of Shehu *et al.,* (2010) and Oluwatosin (2011). The result affirmed that more years of formal education is imperative to better understanding and adoption of new technology.

The estimated coefficient for household size (-0.433) was negative and statistically significant at 1% level of significant, that has the effect of reducing the farmers' technical inefficiency. This means that farmers with large household size will be more technically efficient. Also as the household size increases, it will obviously increase his production efficiency, because agricultural production activities are labour intensive and large household can provide labour at reduced or no cost (Ajibefun and Daramola 2003).

Farming experience (-0.272) was found to be statistically significant at 1% level of significance and also contributed negatively to farmers' inefficiency. This implies that farmers with less farming experience are inefficient compared to their counterparts with more years of farming experience.

Table 4: Inefficiency Parameters of Mechanized Cassava Farmers in Afijio Local Government Area of Oyo State.

Variable	*Parameter*	*Coefficient*	*t-value*
Constant	z_0	- 2.383	- 1.85
Age	z_1	0.008	0.658
Marital Status	z_2	0.584	0.965
Sex	z_3	0.430	0.425
Educational level	z_4	- 0.374	- 3.442 *
Household Size	z_5	- 0.433	- 2.742 *
Farming experience	z_6	- 0.272	- 5.916 *

Source: Field Survey, 2013

**Estimate is at 1% level of significance.*

Conclusion and Recommendation

The study estimated the technical efficiency of mechanized cassava farmers in Oyo State. Results from the study indicated that the production input which could lead to increased production of cassava is farmland expansion, increase use of planting materials, fertilizer and labour. Educational level of mechanized cassava farmers, household size and farming experience were the socio economic characteristics that had significant and negative effect on the farmers' technical inefficiency. None of the sampled farmers operated at the maximum efficiency level indicating that there was efficiency gap hence there is still room for improvement in mechanized system of producing cassava in the study area.

From the result obtained in the study, it was observed that mechanized cassava farmers were efficient and more emphasis should be placed on the adequate resource utilization to sustain the efficiency level. Increase productivity and improvement in their technical efficiency can be achieved by addressing the factors responsible for the inefficiency. These include more intensive use of land, increase use of planting materials, fertilizer, labour input given the prevailing state of technology. The mechanized cassava farmers should also be encouraged to increase their cassava production by making available improved and disease free varieties of cassava stems at affordable price. Education was found to have a

significant effect on the efficiency of the farmers; therefore government should also assist by improving the educational status of the farmers.

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