Ethiopian Journal of Environmental Studies & Management 8(3): 342 – 350, 2015.
ISSN:1998-0507 doi: http://dx.doi.org/10.4314/ejesm.v8i3.11
Submitted: January 28, 2015 Accepted: April 07, 2015

TECHNICAL EFFICIENCY AMONG CASSAVA FARMERS IN IKENNE LOCAL GOVERNMENT AREA OF OGUN STATE, NIGERIA

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Abstract

Cassava has played and continues to play a remarkable role on the agricultural stage of Nigeria. The inability of the country meeting existing demand has been traced to resource use efficiency of the farmers. The study evaluates the technical efficiency among cassava farmers in Ikenne Local Government Area of Ogun State, Nigeria. Primary data employed in the study were obtained from 155 cassava farmers selected through a 2-Stage sampling technique. Data were analyzed using descriptive statistics and stochastic frontier model. Results showed that the return to scale was 1.814. Cassava stem cuttings (0.484), quantity of fertilizer used (0.614) and the farm size (0.427) significantly ($p \leq 0.05$) affected cassava production. Age and farming experience contributed to technical inefficiency while cassava stem cuttings, quantity of fertilizer used and the farm size enhanced technical efficiency. Efficiency of cassava growers ranged between 35.1 and 97.0 with a mean of 68.5. It was concluded that cassava production was highly profitable and farmers operated with maximum efficiency given the current technology. The study recommends increased area under cultivation and improved cassava varieties coupled with other inputs to boost to productivity of farmers.

Key Words: *Technical efficiency, Cassava farmers, Demand, Farm size, Profitable*

Introduction

Agriculture continues to be a strategic sector in the development of most countries in sub-Sahara Africa. It employs about 40% of the active labor force globally (World Bank, 2002). In Nigeria, agriculture provides food for the teeming population and contributes about 33% to the Gross Domestic Product (GDP) of the nation (Bureau of African Affairs, 2010). The sector employs about one-third of the total labor force and provides a livelihood for the bulk of the rural populace (FMARD, 2006). The performance of small holding farms in Nigeria is observed to be unsatisfactory. The agricultural sector of Nigeria has failed to keep pace with the demand of households and industries for farm produce as food or raw materials (Nwaiwu *et al*., 2010).

Food is one of the basic needs of man but its provision is not always adequate for all nations especially in developing countries. This insufficiency of food had led man to better ways of producing it. Nigeria is now diversifying its economic resources and efforts are being intensified to revamp the agricultural sector once again in order to achieve sustainable economic development through policies aimed at increasing agricultural production for instance cassava products for both local use and export trade. (RMRDC, 2004). Nigeria is the world's largest producer of cassava,

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with about 54.0 million metric tonnes and ranks 2nd after yam in extent of production among the root and tuber crops of economic value in Nigeria (FAOSTAT, 2013).

According to Food and Agriculture Organization of the United Nations database (FAOSTAT, 2013), Nigeria is the largest producer of the crop with 36.8, 42.5, 52.4 and 54.0 million metric tonnes in 2009, 2010, 2011 and 2012 respectively. About 90% of Nigeria's cassava production is however, consumed locally as food (Awoyinka, 2009). Nigeria needs yet to fully harness the economic potentials of cassava which would translate to higher ranking next to petroleum as major contributor to the Gross Domestic Product (GDP). For this to be achieve cassava farmers production efficiency and profit margins needs to be improved.

Cassava (*Manihot esculenta* Crantz) is one of the most important crops in Nigeria as well as in Africa because it serves as a major source of carbohydrate (Nweke *et al.*, 1994; Nandi *et al.*, 2011). Cassava can be grown and stored in the field in all seasons because it is relatively less sensitive than most crops to environmental changes (IITA, 1999). The significance of cassava cannot be undermined as cassava is a crop which serves both as food and feed (Chukwuji, 2006). The cassava cultivation has been neglected for a long time in Nigeria, but now it has become a key food security crop because it's many comparative advantages over others cultivations like cereals. It is highly adaptable to marginal soils and erratic rainfall conditions. It is rich in carbohydrate allowing for multiplicity of use, it is highly resistant to pests and diseases and it can maintain constant supply throughout the year. (Nwaiwu *et al.*, 2004). It is an important food and cash crop in several tropical African countries, especially Nigeria where it plays a principal role in the food economy (Agwu, 2007). Simonyan *et al*. (2010) stated that Nigerians are poor and hungry despite efforts made by various governments in improving agricultural productivity and efficiency of the rural farmers who are the major stakeholders of agricultural production. This effort is geared towards programs that will result to effective production. One of such programs is the Root and Tuber Expansion Program, aimed at increasing root and tuber crops production. Specifically, in the area of Cassava, a Presidential Initiative on Cassava Production and Export was unfolded by Nigerian government in 2002. The initiative was aimed at using Cassava production as the engine of economic growth for the nation. Based on this, in 2005, the Federal Government of Nigeria promulgated a law, making it mandatory for bakers to use composite flour of 10% Cassava and 90% wheat for bread production. The initiative seeks to generate about US$5 billion as export revenue in 2007. Since then, the demand for Cassava products globally increased which has led to an increase in its cultivation, but not enough to curb demand, thereby, putting a lot of pressure on production of Cassava. Olukosi (1999) suggested that access to adequate food by all members of the household and the entire nation at large at all times, for the maintenance of a healthy and active life is one of the major ways of fighting food insecurity in everywhere on the world. Despite the involvement of many rural farmers in the agricultural production, several odds however still work against their efforts to produce abundant food for the nation and live a better life.

The passion for cassava production has increased over the years rapidly as a result of the awareness of the importance of this practice to individuals and the economy at large, as well as the advantages attached to it. Based on this nexus, this study examines technical efficiency among cassava farmers in Ikenne Local Government area of Ogun

State, Nigeria by answering the following questions: what are the factors determining technical efficiency of cassava farmers and their level of technical efficiency in the study area. The main objective of the study is to examine the technical efficiency among cassava farmers in Ikenne Local Government Area of Ogun State, Nigeria. The specific objectives are to determine the socio-economic characteristic of cassava farmers and to know the determinants of technical efficiency of the cassava farmers in the study area.

Materials and Methods

Study Area

The study was conducted in Ikenne Local Government Area (LGA) of Ogun State, which has it's headquarter at Ikenne Remo. The Local Government Area is bounded 4km to the East by Odogbolu Local Government Area (LGA), 5km to the South by Ayepe, 10km to the North east by Irolu, 4km to the North by Ilara, 2km to the East by Ilishan and 7km to the West by Sagamu. The local government is located along the transitional forest zone of southern Nigeria and Guinea savannah. It is situated 235.2 meters above sea level, has an annual rainfall of 1200mm, 65% mean relative humidity and 21.4° mean temperature. Figure 1 shows the map of Ikenne local Government Area in Ogun state, Nigeria.

Figure 1: Map of Ogun state showing Ikenne local Government Area

Sampling Procedure

Data for this study were mainly primary data which were collected with the aid of questionnaires applied to cassava farmers in the study area. A two stage random sampling technique was adopted for this study. In the first stage were randomly selected five towns from the Local Government Area (LGA). The next stage of the sampling involved the random selection of 31 farmers from each of the selected towns in the Local Government Area (LGA), to give a total of 155 farmers which were used for the analysis. Analytical tools used in the study were: descriptive statistics and stochastic frontier model

i) Descriptive Statistics

Descriptive statistics such as mean, percentage and frequency

ii) Stochastic Frontier Production Function

The model of the stochastic frontier production for the estimation of technical efficiency is specified as:

$Y= f(X_{ij}\ \beta) + e_i$ 1

$e_i = V_i - U_i$

Where Y is output of the farmer 1, X_i is input, β is a vector of parameters to be estimated (including the efficiency parameter). The disturbance term *i e* consist of two components V_i and U_i.

Where $V_i - N(O, \sigma^2)$ and Ui is a one-sided error term. The two errors V_i and U_i are assumed to be independently distributed. The term V_i is the symmetric component and permits random variation of the production function across farms; while it also captures factors outside the control of the farmer. A one-sided component (U_i>0) reflects technical efficiency relative to the stochastic frontier. If U_i = 0, production lies on the stochastic frontier, while if U_i □□□, production lies below the frontier and is inefficient

The error term is assumed to follow one of three possible distributions (Bauer, 1990)

i) half-normal as U/ N $(O, \sigma u^2)$

ii) exponential as $EXP\ (\mu u, \sigma u^2)$

iii) truncated normal at zero $N{\sim}(\mu u, \sigma u^2)$

It follows;

$$\sigma^2 = \sigma_{v^2} + \sigma_{u^2} \quad \text{.................................} \ 2$$

where

$$\sigma = [\ \sigma_{v^2} + \sigma_{u^2}]\ ^1/_2$$

In accordance with Jondrow *et al.* (1982), the Technical Efficiency (TE) of the individual farmer is calculated as the expected values of Vi conditional on $\varepsilon ii = V_i - U_i$ that is:

Following Jondrow *et al.* (1982), the Technical Efficiency (TE) of the individual farmer is calculated as the expected values of V_i conditional on $\varepsilon ii = V_i - U_i$ that is:

$$E(u_i/\varepsilon_i) = \frac{\sigma_x - \sigma_y}{\sigma}\left[\frac{f\left({\varepsilon_i}^{\lambda}/_{\sigma}\right)}{1-F\left({\varepsilon_i}^{\lambda}/_{\sigma}\right)} - \frac{{\varepsilon_i}^{\lambda}}{\sigma}\right] \text{.........} \ 3$$

Where E is the expectation of the farm operator, F* and f* are the values of the standard normal density and distribution functions respectively. Measures of technical efficiency (TE), technical efficiency is then calculated as:

So that 0 ≤ TE ≤ 1.

TE = exp (-E$\langle u_i/\varepsilon_i \rangle$; i=1......................... 4

The empirical model of the stochastic production frontier is specified as

Yi = β_0 + β_1InX_1 + β_2InX_2 + β_3InX_3 + β_4InX_4 + β_5 InX_5 + β_6InX_6 + Vi- Ui ……. 5

Y = Output of the farmers in kg.

X_1 = Hire Labour input use in production in man-day

X_2 = Farm Size in (ha).

X_3 = Family Labour in (Man-day)

X_4= Fertilizer in (kg)

X_6 = Cassava stem in (cuttings)

In's = Parameters to be estimated.

Ln's = Natural Logarithms

Vi = The symmetric component that captures random error associated with

random factor under the control of cassava farmers.
Ui = The asymmetric error component represents the deviation from the frontier production (the technical inefficiency).
The efficiency model:

$$Ui = \alpha_0 + \alpha_1 Z_1i + \alpha_2 Z_2i + \alpha_3 Z_3i + \alpha_4 Z_4i + \alpha_5 + Z_5i \quad \ldots \quad 6$$

Where:
U_i = Technical efficiency of the cassava farmers
Z_1 = Age of farmers (years).
Z_2 = Household size
Z_3 = Farming experience (years).
Z_4 = Years spent in school (years).
Z_5 = Extension contacts (Yes=1, No=0)
α_i's = Parameters to be estimated.

Results and Discussion

The socioeconomic characteristic of the cassava farmers in the study area is presented in Table 1. The result shows that most the farmers (58.7%) were male while the remaining was female. The result indicated that male dominated cassava production in the study area. The result disagrees with Adebisi *et al*. (2012) and Owombo (2012) female farmers dominated food crop production in south-western Nigeria. The reason for this might be due to the less involvement of the female farmers in cash crop production than women and the greater concern of the women for household consumption. The distribution of the farmers by age shows that 31.6% of the cassava farmers were less than 30 years while 3.8% were above 61 years. Majority (64.6%) of the farmers were in age range 30-60 years while the mean age of farmers was 39.8 years. This is the active productive age. This is an indication that majority of the farmers in the study area are still in their working age. Most operations in cassava cultivation, such as land clearing, tilling, weeding and harvesting, require a lot of strength and energy. Thus, only those farmers within the productive age group are likely to possess the necessary strength to carry out these operations. The result indicates that 69.7% of cassava farmers in the study area cultivated less than one hactare of land. This implies that majority of cassava farmers in the area operate on small to medium scale. This corroborates the findings of (Akatugba-Ogisi,1994; Ogisi *et al*., 2013) that farm sizes in Nigeria are small and in most cases fragmented. The mean average size of 6.0 observed among the cassava farmers is below the acclaimed average household size of about 8 which is more common in rural communities in Nigeria. About 20.6% of the farmers had farming experience of less than 6 years. Those with farming experience of 6 years and above comprise 79.4%. This implies that cassava farming is not only an occupation but a way of life of the people in the study area. The farmers have sufficient agricultural experience, which could explain the high level of technical efficiency of farmers. The result collaborates Nandi *et al*. (2011) that most cassava farmers in Nigeria have been cultivating cassava for years. Most of cassava farmers are married and were educated enough to be able read and write. The literacy level here implies that it may be easier for them to adopt and practice innovations in farming. The distribution of farmers by extension contact revealed that 12.9% of the respondents had contact with extension agent.

Table 2 shows the results of stochastic frontier model of cassava farmer. The maximum likelihood estimate of the Cobb-Douglas production function shows that the Lambda and Gamma values were 5.226 and 0.328 respectively significant at 5% level. The values are significantly different from zero suggesting that the model is a good fit. The return to scale of 1.8143 implies an increasing return to scale. Any additional input will lead to more than proportionate change in the output. This shows that the farmers are in stage 1 of production function. The results indicated that three significant variables in this model are cassava stem cuttings, quantity of fertilizer used and the farm size ($p < 0.05$). The coefficient of cassava stem cuttings (0.484) is positive and inelastic. This implies that increasing the cassava stem cuttings by one kilogram will bring about 48.7% increases in output of the cassava growers in the area. Similarly, the quantity of fertilizer used by farmer (0.614) has positive relationship with technical efficiency. This implies that increasing the quantity of fertilizer used will increase output by 61.4%. In the case of land size, the coefficient is also positive and inelastic. The result shows one hectare increase in farm size grown to cassava increased technical efficiency cassava farmer by 42.7%. For farm specific characteristics, the only significant variables are age ($p < 0.10$) and farming experience ($p < 0.05$). Only age is positive meaning that they contribute to technical inefficiency in cassava production in the area. This might be as farmers become older his willingness to adopt improved technology that can enhance their efficiency will decrease. In case of farming experience, past bad experience may also make farmer to be skeptical about adoption new improved technology that can increase their efficiency. It is shown in Table 3 that efficiency of the cassava growers ranged between 35 and 97% with a mean of 68.5%. Thus, they are all operating at low levels of efficiency given the cassava production technology available to them. This may be a contributing factor to the low level of cassava production in the area. The mean technical efficiency estimated was TE= 0.685 in Table 3, indicating that the realized output could be increased by about 31.5% by adopting the practices of the best cassava farmers.

Conclusion and Recommendations

Majority of the cassava farmers were married with age between 41 to 50 years. The farmers were educated with household size 6 persons. Few of the farmers had access to extension agent and most of them had been in cassava production business for over 6 years. The results of the maximum likelihood estimates of the parameters in the Cobb-Douglas production function for the efficiency of the sampled cassava farmers revealed that the cassava cuttings, quantity of fertilizer used and the farm size significantly determined cassava farmer's technical efficiency. The results of this study showed that majority of cassava farmers were technically efficient, given the technology they use. The result revealed that age of the cassava farmers and farming experience were the inefficiency variables significantly determined farmer's technical efficiency. The study recommends policies that facilitate access to fertilizer and improved cassava cuttings will go a long way to improve the technical efficiency levels of farmers in the area.

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Table 1: Socio-economic Characteristics of Cassava farmers

Variables	Frequency	Percent
1. Sex		
Male	91	58.7
Female	64	41.3
Total	155	100.0
2. Age (years)		
<30	49	31.6
31-40	39	25.2
41-50	37	23.9
51-60	24	15.5
>60	6	3.8
Total	155	100.0
Mean=39.8, SD=2.8		
3. Farm Size (ha.)		
< 0.6	69	44.5
0.6-1.0	39	25.2
1.1-1.5	2	1.3
1.6-2.0	10	6.5
>2.0	35	22.5
Total	155	100.0
Mean= 0.73ha; SD=0.11ha		
4. Household Size		
1- 4	41	26.5
5- 6	79	51.0
≥ 7	35	22.5
Total	155	100.0
Mean=6.0; SD=0.01		
5. Farming experience (Years)		
< 6	32	20.6
6 – 10	47	30.3
>10	76	49.1
Total	155	100
Mean=9.1, SD=1.8		
6. Marital Status		
Married	117	75.5
Single	38	24.5
Total	155	100
7. Training on cassava farming		
Yes	41	26.5
No	114	73.5
Total	155	100
8. Educational Level		
No formal education	33	21.3
Primary	40	25.8
Secondary	48	31.0
Tertiary	34	21.9
Total	155	100
9. Contact with extension agent		
Yes	20	12.9
No	135	87.1
Total	155	100

Table 2: Result of stochastic frontier model of cassava farmers

Variable	Coefficient	Standard Error	t value
Constant	0.3075	0.1140	2.6974**
Qty of cuttings	0.4837	0.1304	3.7094**
Qty of fert.	0.6139	0.1579	3.8879**
Farm Size	0.4272	0.1339	3.1904**
Labour	-0.4621	0.3474	-1.3301NS
Man day	0.4441	0.3215	1.3814NS
Inefficiency			
Constant	0.1182	0.8761	0.1349
Age	0.8342	0.4223	1.9754*
Household size	0.5750	0.6370	0.0090NS
Farming Experience	-0.5819	0.1834	-3.1728**
Years spent in school	0.1982	0.9618	0.2061NS
Extension contact	-0.2419	0.1621	-1.4922NS

Mean efficiency = 0.68538E+00

σ^2 = 0.5226E+01; (γ) = 0.3289E+00

Log-likelihood function= -0.7243E+02

**= 5% significant, *= 10% significant NS=Not significant

Table 3: Frequency Distribution of Technical Efficiency Indices

Technical Efficiency Range	Frequency	Percent
0.31 -0.40	10.0	6.5
0.41 – 0.50	17.0	10.9
0.51 – 0.60	22.0	14.2
0.61 – 0.70	40.0	25.8
0.71 – 0.80	28.0	18.1
0.81 – 0.90	30.0	19.4
0.91 – 1.00	8.0	5.1
Total	155.0	100
Min	0.35	
Max	0.97	
Mean efficiency = 0.685		