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CONTENTS:

ECONOMIC EFFICIENCY OF SMALL HOLDER CASSAVA-BASED PRODUCERS IN CROSS RIVER STATE, NIGERIA.

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ABSTRACT

Improving farmers' resource use efficiency could be a cost effective method in enhancing agricultural productivity. This study determined the economic efficiency of cassava producers in Cross River State, Nigeria. The study adopted a multi stage random sampling technique in selecting two hundred (200) cassava producers from Calabar and Ikom Agricultural zones in State. Data were obtained primarily through the use of questionnaires and those on the socio-economic variables of the farmers were analyzed using descriptive statistics such as means, standard deviation, percentages and frequency counts. The neo-classical self-dual stochastic production function, using the Maximum Likelihood Estimating (MLE) techniques was used in estimating the producer's economic efficiency and their determinants. The mean economic efficiency of the cassava producers was 42%. The result of the generalized likelihood Ratio (LR) tests shows that cassava producers were economically inefficient in the area. Family size had a significant and negative influence on the producers economic efficiency, while educational level (years of schooling) had positive and significant influence on producers economic efficiency. Government policy should be geared towards encouraging educated producers (especially women) to continue in cassava production.

Keywords: Cassava, economic efficiency, maximum likelihood, producers, small holder, stochastic production function.

Introduction

Nigeria's agriculture is dominated by the small-scale farmers who produce the bulk of the food consumed and often times exported. Of this number about eighty (80) per cent of them live in the rural areas, rely on agriculture for their employment and spend a higher proportion of their income on food (1). Among the crops cultivated by farmers, cassava is a major energy of the rural and urban dwellers in Nigeria generally, and Cross River State in particular (2).

The crop not only serves as food crop, it is also a major source of income and employment for rural dwellers in Nigeria. Its relevance in bridging the food demand and supply gap in Nigeria cannot be over-emphasized and it's known for being a hardy crop producing economic yields under drought conditions, low fertility, locust attack, poor husbandry and other adverse production conditions (3,4&5). The crop is also available all the year round, making it preferable to other crops for food security.

Due to these characteristics, it has assumed a place of prominence among other staple food crops in Nigeria.

Nigeria is currently the largest cassava producer in the world with an estimated annual production of 49 million tons (6). Presently, the crop had gained an export status because of the increasing demand for cassava as industrial raw material abroad and the prospects for enhanced foreign exchange earnings from its export is becoming significantly high.

Given the various agricultural programmes and policies of government implemented over the years to raise farmers' productivity, it appears, little have been achieved, it is therefore imperative to empirically determine farmer's current levels of efficiency with a view to suggesting relevant policy options to adopt in order to raise their levels of efficiency. This is because there is a direct relationship between efficiency of production and the overall productivity of the agricultural sector. For Nigeria, raising productivity per area of land is the key to effectively addressing the challenges of achieving food security as most cultivable, physical and technological constraints prevent large scale conversion of potentially cultivable land (Ajibefun, 2002).

Edimetta (1987), Enun (1990), Abang et al., (2001), Aji (2002) and Abang & Agom (2004) using the Ordinary Least Squares (OLS) estimating technique reported allocative inefficiency among cassava farmers in Cross River State. Given that OLS provides average estimate of efficiency, they were not able to capture the inefficiencies of individual farmers. The use of the Stochastic Frontier Analysis (SFA) in determining efficiency, have overcome this shortcoming of the OLS. Although some authors have used the SFA, in their studies for cassava and other crops in Cross River State specifically, emphasis had been on determination of technical efficiency (Udoh and Akintola , 2001). Although, Idiong (2006) went beyond technical efficiency in his study but it was on rice. Presently there is seemingly no published information on the determination of economic efficiencies of cassava-based farmers in Cross River State, Nigeria using the stochastic frontier analytical methods.

The objective of this study is to determine the economic efficiency of cassava based producers in Cross River State by estimating the production and cost functions as well as determining the factors that influence their economic efficiency levels using the Stochastic Frontier Analysis.

MATERIALS AND METHODS
Study Area

Cross River State is located in the Niger Delta region and the South-South geopolitical zone of Nigeria. The state lies within latitude $40^0 4"$, South and $60^0 30"$, North and between longitude $8^0 9^0 00"$ East of the equator. .

It is bounded in the North by Benue State, in the south by Atlantic Ocean, in the East by Cameroun Republic and on the west by Akwa Ibom , Abia and Ebonyi States. The State has three distinct ecological zones, i.e. the mangrove forest in the south, the tropical rainforest in the middle and the Guinea savanna in the north. The annual rainfall ranges between 1500mm and 2000mm.

The area is agrarian and well suited for the production of permanent and arable crops. Permanent crops such as cocoa, rubber, oil palm, oranges, bush mango etc, and arable crops such as maize, yam, rice and cassava are common in the area due to favourable climatic conditions. Cassava is a popular crop among the people of Cross River State. The tubers are processed into garri, (a staple food requirement of the people) and other forms for home consution and commerce.

SAMPLING TECHNIQUES

A multistage random sampling technique was adopted for this study. The first stage involved a random sampling of four (4) Local Government Areas (two each from Calabar and Ikom Agricultural zones). Yakurr and Obubra were selected from Ikom zone, while Odukpani and Akamkpa were selected from Calabar zone. In the second stage, five (5) villages were randomly selected from each of the four LGAs, giving a total of twenty (20) villages. Ugep, Idomi, Ekori, Nko and Assiga were selected from Yakurr, while Onyenokpono, Ochon, Ogada, Ofombogha and Ofodua were selected from Obubra. In Akamkpa, Awi, Akamkpa town, Okomita, Ojo and Iwuru were selected, while Okoyong, Creek town, Obomitiat, Ndongwong and Odukpani central were selected from Odukpani LGA. A random but proportionate sample, of 220 cassava producers, was then selected for the study.

DATA COLLECTION

Data were obtained mainly from primary sources. Information on socio-economic variables of cassava producers, output per producer and their price values, farm size and rents paid per size of land, labour and wage paid, quality of cassava stems and cost were also collected with the aid of structures questionnaires.

MODEL SPECIFICATION

The stochastic frontier production function can be expressed as

$$Y = f(X_i \beta) \exp(V_i - U_i), \quad i = 1,2 \quad \dots\dots\dots\dots (1)$$

Where;

Y: is the output of ith enterprise (farm)

X: is the vector input quantities used by the ith enterprise

β: is a vector of unknown parameters to be estimated

$f(\ )$: represents an appropriate function (e.g Cobb-Douglas, translog, etc)

Vi: is a symmetric error which accounts for random variation in output due to factors beyond the control of the farmer.

Ui: is a non-negative random variable representing inefficiency in production relative to the stochastic frontier.

Given that the functional form is self dual i.e. Cobb–Douglas, the cost frontier can be derived as;

$$C = f(P,Y;y) \quad \dots\dots\dots\dots\dots\dots (2)$$

Where,

C = minimum cost associated with cassava production.

P = Vector of input prices;

Y = output of cassava

y = vector of parameters

Using Sheppard's lemma, we obtain,

$$\frac{\delta c}{\delta P_i} = X_i(P,Y,y) \quad \dots\dots\dots\dots\dots (3)$$

This function is the system of minimum cost input demand equation (Bravo-Ureta and Pinheiro, 1997 and Xu and Jeffrey, 1995). Farmer's input prices and quantity of output when substituted in equation (3) will yield the economically efficient input vector Xe. Given the levels of observed output, the corresponding economically efficient costs of production will be equal to Xie, while the actual operating input combination of the farm is Xi.P. The computation of economic efficiency (EE) indices would be done using the three cost measures as follows;

$$EE = (Xie.P)/(Xi.P) \quad \dots\dots\dots\dots\dots (4)$$

Efficiency can then be measured using the adjusted output as follows;

$$Y^* = f(Xi; \beta) - U \quad \dots\dots\dots\dots\dots (5)$$

The production and cost functions (Cobb-Douglas functional form) is suitable for this study because it meets the requirement of being self-dual that is, allowing for the examination of economic efficiency (Bravo-Ureta and Pinheiro, 1997).

The specified cassava production function is as follows;

$$Ln\ Y = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \epsilon_i \quad \dots\dots\dots\dots (6)$$

Where;

Ln represents the natural logarithm

Y = Output of cassava in tons

X_1 = Farm size (hectares)

X_2 = labour input (Man-day)

X_3 = Capital investment (naira)

X_4 = Cassava cuttings (bundle)

β_0 = Y – Intercept

β_1 to β_4 are coefficients to be estimated.

V_i and U_i are as defined in (1)

While the Stochastic frontier cost function is specified as follows;

$$Ln\ C = Ln\varphi_0 + \varphi_1 Ln\ P_1 + \varphi_2 Ln\ P_2 + \varphi_3 LnP_3 + \varphi_4 LnP_4 + \varphi_5 LnP_5 + \varphi6 LnP6 + \varphi6 Ln\ Y^* + \epsilon_i \ \dots (7)$$

Where;

C = Cost of cassava production per producer (Naira)

P_1 = Average daily wage rate for labour (₦man-day^{-1})

P_2 = Rental value of land (₦ha^{-1})

P_3 = Price of fertilizer (₦kg^{-1})

P_4 = Cost per unit of capital (₦)

P_5 = Price of cassava stems (₦ bundle^{-1})

Y^* = output of harvested cassava in kg adjusted for statistical noise

φ_1 to φ_6 are parameters to be estimated.

φ_0 = the Y – intercept

ϵ_i = the composed error term defined as V-U in equation (1)

The efficiency model is specified as;

$$EE = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + e \ \dots\dots\dots (8)$$

Where;

EE = economic efficiency of the *ith* cassava producer

Z_1 = producers' age (years)

Z_2 = farming (years of schooling)

Z_3 = Education (years of formal schooling)

Z_4 = farm size (hectares)

Z_5 = family size (number of persons)
Z_6 = gender (1 = male, female = 0)
δ_1 to δ_6 are coefficients to be estimated
δ_o is the Y- intercept.

ANALYTICAL TECHNIQUES

Data analyses were done by the use of both descriptive and inferential statistics. The descriptives that included means, percentages and frequency count were used in analyzing the socio-economic variables of cassava producers, while the stochastic frontier production and cost functions where used in analyzing the economic efficiency and the influence of some socio-economic variables on the producer's economic efficiency.

RESULTS AND DISCUSSION
Socio economic profile of Cassava-based Producers in Cross River State, Nigeria.

The result shows that 64 per cent of the cassava producers were males which constitute the majority (Table 1). Most of the producers (72 per cent) were within the 24 to 40 years age bracket indicating that cassava production in the area is dominated by persons who were in their most economically active age bracket. Nwaru (2004) had asserted that a farmer's risk bearing ability, innovativeness and carrying out manual tasks on the farm is a function of his or her age and that these attributes decrease with age.

Ninety two (92) per cent of the respondents had attained one level of formal education or the other an indication that the producers would find it easy to acquire and use information that would enhance their efficiency and productivity. Farmers who had family sizes of between 5 and 10 persons constitute 51.5 per cent (majority), while the mean family size was 10 persons. Implication is that that more family labour will be available for cassava production. Effiong (2005) had reported that a relatively large household size enhances the availability of family labour which reduces constraints on labour cost in agricultural production.

Majority (87 per cent) of the producers had put in between five (5) and above twenty (20) years of experience in cassava production with a mean of 15 years. Since a good number of the farmers are experienced there is the likelihood that they will have higher economic efficiency.

Table 1: Distribution of cassava-based farmers according to their sex, age, level of formal education, family size and farming experience.

Variable	frequency	percentage
Sex		
Male	128	64
Female	72	36
Total	200	100
Age		
24 – 29	29	14.5
30 – 35	76	38.0
36 – 35	39	19.5
41 – 45	21	10.5
46 – 50	19	9.5
>50	16	8.0
Total	200	100
Mean	36.60 (9.93)	
Education (years of schooling)		
0	16	8.0
6	78	39.0
12	52	26.0
14	21	10.5
16	33	16.5
Total	200	100
Mean	9.26 (3.28)	
Family size		
2 - 4	40	20.0
5 – 7	66	33.0
8 - 10	37	18.5
11 – 13	8	4.0
14 – 16	19	9.5
>16	30	15.0
Total	200	100
Mean	10 (6.0)	
Farming experience		
< 6	26	13
6 – 10	61	30.5
11 – 15	30	15.0
16 - 20	25	12.5
>20	58	29
Total	200	100
Mean	14.68 (6.8)	

Source: field survey data 2013/2014
Note: Values in parentheses are standard errors.

Stochastic production and cost functions estimates for cassava-based producers in Cross River State, Nigeria.

The summary statistics of the production variables obtained from cassava producers in the study area (Table 2) shows that the mean output of cassava per farmer was 1.309 tons, while output/ha was about 4.22 tons which is lower than the national average of 10-15 tons per hectare. The mean man-days of labour and farm size were 160.71 and 0.31 hectares respectively.

Table 2: Summary statistics of input and output of cassava-based producers in Cross River State, Nigeria

Variable	Unit	Mean	Standard error
Output(Y)	Kg	1309.71	56.75
Farm size (X_1)	Ha	0.31	0.017
Labour (X_2)	Mandays	160.71	4.47
Capital (X_3)	₦	2639.18	113.85
Cassava cutting (X_4)	Bundles	13	2.55
Total cost/farmer (C)	₦ ha^{-1}	42874.68	3180.42
Land rent (P_1)	₦ ha^{-1}	6896.55	132.07
Labour wage (P_2)	₦manday^{-1}	565.45	43.27
Capital (P_3)	₦	2639.18	113.85
Price of cuttings (P_4)	₦bundle^{-1}	200	15.35

Source: Derived from field survey data 2013/14

The producers' farm sizes clearly show the preponderance of small sized cassava farms in the State. The cassava producers used an average of N2,639.19 of capital, which is an indication of low external input use in small-scale cassava production in the State. Total cost of cassava production per hectare per farmer was N42,874.68 and the average labour wage paid per man-day was N565.45.

The result of the Maximum Likelihood Estimates (MLEs) (Table 3) shows that all the production variables (farm size, labour, capital and cassava cuttings) had positive signs and were significant at 1 per cent (except cassava cuttings which was significant at 5 per cent), implying that an increase in these variables will lead to corresponding increases in output of cassava.

Table 3: Maximum Likelihood Estimates (MLEs) of the stochastic production frontier function for cassava-based producers in Cross River State, Nigeria

Variable	Unit	Mean	Standard error
Output(Y)	Kg	1309.71	56.75
Farm size (X_1)	Ha	0.31	0.017
Labour (X_2)	Mandays	160.71	4.47
Capital (X_3)	₦	2639.18	113.85
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Table 3: Maximum Likelihood Estimates (MLEs) of the stochastic production frontier function for cassava-based producers in Cross River State, Nigeria

Variables	Coefficients	Standard errors	t-ratio
Constant	3.212	0.3094	10.38**
Farm size (X_1)	0.4756	0.1019	4.67***
Labour (X_2)	0.3989	0.0987	4.04***
Capital (X_3)	0.0429	0.0097	4.42***
Cassava cuttings (X_4)	0.1946	0.0864	2.25**
Returns to scale (RTS)	1.112		
Gamma (ϒ)	0.9999	0.085	11.76**
Sigma square ($δ^2$)	0.62	0.085	7.29***
Log likelihood Function	61.72		
LR test	28.13		

Note: *** Significant at 1%, ** Significant at 5% level.

Source: Computed from field survey data 2013/2014 using frontier 4.1 by Coelli (1994).

The value of the returns to scale (RTS) was 1.112 indicating that the farmers were operating in the region of increasing returns to scale. On the other hand, the cost frontier function estimates (Table 4) shows that only labour wage and rental value of land were positive and significant at 1 per cent level, indicating that labour wage and land value were important determinants of the farm cost structure.

Table 4: Maximum likelihood estimates of the stochastic cost frontier function for cassava-based producers in Cross River State, Nigeria

Variables	Coefficients	Standard errors	t-ratios
Intercept	4.8219	2.893	1.67
Labour wage (P_1)	2.145	0.224	9.57***
Rental value of land (P_2)	0.7746	0.114	6.76***
Capital (P_3)	0.0027	0.0064	1.61
Price of cutting (P_4)	0.0089	0.0864	1.39
Output (Y^*)	0.0279	0.0115	2.42**
Diagnostic statistics	0.99		
Gamma (ϒ)	0.71		
Sigma square ($δ^2$)	-246.512		
Log Likelihood Function	482.44		
LR test (ϒ)			

Note: ***significant at 1%, **significant at 5% level

Source: Computed from field survey data, 2013/2014 using frontier 4.1 by Coelli (1994).

Economic efficiencies of cassava-based producers in Cross River State, Nigeria
The economic efficiencies range from 20 to 64 per cent with a mean efficiency of 42 per cent (Table 5). The result further indicates that the average cassava farmer in the area will achieve a cost savings of about 34.38 per cent [1-(1-42/64)] if the farmer is to attain the efficiency level of the most economically efficient farmer in the area. The farmers were economically inefficient and could be attributed to their high levels of allocative inefficiency as reported by Idiong and Onyenweaku (2008).

Finally, farming experience and educational level of the farmers had significant relationship with economic efficiency (Table 6), implying that farmers with valuable experience and higher levels of education would understand production processes and aim to achieve higher levels of economic efficiency through attainment of higher allocative efficiency than their less experienced and less educated counterparts. The negative but significant value of the coefficient of family size indicates that farmer's economic efficiency decreases as family size increases. This implies that farmer's with smaller family sizes were more economically efficient than farmers with large family sizes. The larger family sizes may consists of predominantly dependent population, who may not be old enough to constitute labour force or may be too old to be involved in farming activities.

Table 5: Distribution of economic efficiency of cassava-based producers in Cross River State, Nigeria

Efficiency range	Frequency	Percentage
20-30	40	20
31-40	56	28
41-50	32	16
51-60	44	22
>60	28	14
Total	**200**	**100**
Mean	42	
Standard deviation	9.12	
Minimum	20	
Maximum	64	

Source: Derived from output of the computer programme, Frontier 4.1 by Coelli (1994).

Table 6: Maximum likelihood estimates of the determinants of economic efficiency of cassava producers in Cross River State.

Variables	Coefficients	Standard errors	t-ratios
Intercept	- 0.3578	0.9553	0.34
Age (Z_1)	-0.8974	0.6416	1.39
Farming experience (Z_2)	0.2217	0.0581	2.09**
Educational level (Z_3)	0.0635	0.0227	2.78**
Farm Size (Z_4)	0.1260	0.3366	0.37
Family size (Z_5)	-0.4280	0.1352	3.17**
Sex (Z_6)	- 0.2018	0.1342	1.61

Note: ** Significant at 5% level.

Source: Computed from field survey data 2013/2014 using frontier 4.1 by Coelli (1994).

Conclusion and Recommendations

This study estimated the economic efficiency of cassava producers in Cross River State. The study reveals that cassava producers were economically inefficient. Farmer's educational level, family size and farming experience were variables that had significant effects (positive and negative) on efficiency levels of the cassava producers. There is room for cassava producers to increase their economic efficiency since they were not fully economically efficient. Also, since farming experience and educational levels had significant effects on economic efficiency, policy variables should be targeted towards encouraging experience and educated farmers (especially women) to go into cassava production.

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