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Full Length Research Paper

Analysis of factors affecting technical efficiency of cassava producers in Delta State, Nigeria

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This study analyzed factors affecting technical efficiency among cassava producers in Delta State Nigeria. The stratified random sampling technique was used in selecting 350 producers adopting the proportionate sampling method. The study data were collected by questionnaires and personal interview schedules. Statistical tools such as simple descriptive statistics (table, frequency, percentage and mean) and a stochastic production frontier based on the Cobb-Douglas production function were used to examine the data. The results indicate that the mean age of cassava producers was 38 years with mean years of schooling at 10. The mean farming experience was 12 years and mean household size of 8 persons. The empirical result also revealed that the most critical production factors were land, labour, planting material, and capital while age, level of education, household size, farm experience, and credit are the major determinants of technical efficiency in the study area. The mean efficiency of 0.52 indicates that cassava output can still be increased with available innovative technologies. Based on the findings it was therefore recommended that those variables that affect production efficiency positively should be studied and developed for optimum output towards sustainable agricultural and rural development.

Keywords: Analysis, technical efficiency, cassava and producers

INTRODUCTION

The cassava production enterprise in Nigeria and Delta State specifically apart from been characterized by small-scale farmers; is also bedeviled by inefficiency in resource use and the economic characteristics of the farmers. Effiong, (2006) revealed that access to advanced technology which is necessary for achieving high level of efficiency is another factor that strongly influences cassava production and to increase the productivity of cassava production; will therefore require efficient use of new technology.

It is obvious that the production especially of food is an economic and political issue in Nigeria; today the current problems associated with high costs of food cannot be separated from the general health of the economy because of its adverse effects. These problems are of interest not only to the government who will prefer a moderate increase in food prices but they are also of great concern to the consumers whose earnings are being eroded by the high prices of food (Central Bank of Nigeria, 2003).

Since independence in 1960; government agricultural policy has emphasized increasing the participation of Nigerians in economic activities more generally and in improving the productivity of small-scale farmers and this has greatly increased the quantity of cassava production (Ojo, 2005). The allocation of public resources to the agricultural sector has been subject of complaint among agricultural policy makers for decades. The irony of the situation is that all government including military regime has placed agriculture on top of their priorities. Ironically over the years; the allocation to the entire agricultural sector including the river basin schemes has never exceeded10% of the capital appropriations (Taha, 2003). However cassava production is with the climate for private investment is sometimes being improved by subsidies of various sorts and by facilitating access to credit and profitability.

Nigeria grows more cassava than any other country in the world. Its production is currently put at about34million metric tons a year and total area harvested of the crop in 2002 was 31 million hectares with an average yield of about 11 tons per hectare (CBN, 2003). Apart from food; cassava can be processed into starch; ethanol; chips and flour for industrial use.

With increasing population; there is the tendency for increase in demand for cassava products. To meet this demand there is need for farmers to increase their productivity through the use of improved technology and or efficient use of resources. However; where the adoption and use of improve technology is low; it will be expedient for farmers to improve their efficiency as cost-saving measure especially on the short run (Belbase and Grabowski, 1985). This study is therefore carried out to determine the efficiency of cassava producers using the stochastic frontier analytical technique with regards to the technical inefficiencies and low productivity faced by the producers in the study area.

Objectives of the study

This study's broader objective is to determine stochastically technical efficiency among cassava producers in Delta State; Nigeria. The specific objectives include:

(i) Describe socio-economic profile of cassava producers in the study area;
(ii) Determine the level of technical efficiency of cassava production in the area and
(iii) Quantify the factors affecting technical efficiency in cassava production.

The study's hypothesis

The study was guided by the following hypothesis:
(a) No significant relationship exists between the selected socio-economic/production variables of cassava producers and the cassava output and technical efficiency.

METHODOLOGY

Study area

This study focused on the analysis of factors affecting technical efficiency of cassava producers in Delta State of Nigeria. Delta State is located in the South-South of Nigeria and one of the 36 States constituting the Nigeria Federation. The State was created in August 27, 1991 out of the former Bendel State. The State comprises Twenty-five (25) Local Government Areas (LGAs). Delta State is located between longitude $5° 00^1$ and $6° 45^1$ East and latitude $5° 00^1$ and $6° 30^1$ North. It is bounded on the North by Edo State, on the Northwest by Ondo State, Anambra State on the East and Bayelsa State on the South East. On the Southern flank is the Bight of Benin, which covers approximately 160 kilometers of the State's coastline (FOS, 1996). The 2006 population census puts the population of Delta State at 4,098,391 made up of 2,074,306 males and 2,024,085 females, with a land area of 17,011sq kilometres (NPC, 2006). The State has a tropical climate marked by two distinct seasons: the dry and rainy seasons. The dry season occurs between November and April, while the raining season begins in April and last till October. There exist a brief dry spell in August commonly referred to as 'August break'. The average annual rainfall is about 2667 mm in the coastal areas and 1905 mm in the Northern areas. Rainfall is heaviest in July. Delta State has a high temperature ranging between 29°C and 44°C with an average of 30°C (Delta State main fact, 2018). The vegetation consists of the mangrove swamp along the coastal areas and their thick rain forest in the middle and the Savannah in the North. The soil is basically sandy loam, which favours a wide variety of agricultural activities including crop and livestock production. Common crops and livestock raised include cassava, plantain, banana, vegetables and fruits, poultry, piggery, cattle rearing. It is also suitable for wildlife conservation and fish farming.

Sampling procedure, data collection and analysis

The stratified random sampling technique was used to select respondents. The study area was divided into three strata based on the ADP zoning structure and in each strata; a random sampling technique was used to select the farmers. A total of three hundred fifty (350) cassava farmers were selected using the proportionate sampling method on each stratum. The study was both primary and secondary data. Primary data was collected using well-structured questionnaire complimented by oral interview to elicit information on farmers' socio-economic characteristics; value of inputs and outputs used and their prices; while secondary data were sourced from relevant materials published and unpublished. Data collected were analyzed using both descriptive and inferential statistical tools such as table; percentages; frequency; mean and stochastic frontier model analytical technique.

The empirical model

The production function of cassava farmers in Delta State; Nigeria is specified by fitting a Cobb-Douglas frontier production function which is as follows: model for estimating technical efficiency.

$LnY = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + Vi - Ui$

Where

Ln = logarithm to base e.
β_0 = constant
$\beta i \ldots \beta n$ = parameters to be estimated
Y = is output of cassava in (kg)
X_1 = farm size in (ha)
X_2 = labour input in (man day)
X_3 = quantity of cassava cuttings in (bundles)
X_4 = quantity of fertilizers used in (kg)
X_5 = capital expressed as the value of all implements used in (naira)
Vi and Ui are symmetric error term and non-negative random variables.

Technical efficiency model

A determinant of technical efficiency (inefficiency effects) is a function of socio-economic factors as stated below.

$TE = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8$

Where

TE = the technical efficiency of the i^{th} farmer
$\delta_0 - \delta_8$ = parameters to be estimated
Z_1 = farmers age in years
Z_2 = farming experience in years
Z_3 = level of education in years
Z_4 = farm size in hectares
Z_5 = access to credit in dummy (1 = yes and 0 = no)
Z_6 = extension contact in the production year in numbers of visit
Z_7 = sex of farmer in dummy (1 = male and 0 = female)
Z_8 = household size in number of persons in the house.

The values of unknown coefficients are jointly estimated by maximizing the likelihood function (Yin, 2000; Udoh and Akintola, 2001). Stochastic frontier function is estimated using the computer programme frontier version 4.1 by Coelli, (1994).

RESULTS AND DISCUSSION

Socio-economic profile of the sampled cassava farmers

Majority of the respondents 80.5% were within the age range of 20-50 years. This is an indication that cassava producers are within the active and productive age as shown in (Table 1). This has a positive implications for increased productivity vis-à-vis efficiency since persons within this age bracket can be innovative and ready to take risk by adopting improved cassava production technology. Based on educational attainment; 43% of the producers had secondary education while 35% and 22% had primary and tertiary education. Majority of the producers 53% had farming experience ranging between 11-20 years while 29% and 17% of the producers had between 1-10 years and above 20 years farming experience. The result revealed that 61% of the producers had a household size ranging between 5-10 persons. Household size is a principal determinant of labour availability especially in small-scale farm production given the relative high cost of hired labour. A good number of the producers 58% did not have access to credit. Credit has the ability of removing the constraint to timely acquisition and utilization of inputs used in production while majority 73% of the cassava producers did not have access to extension services.

Estimation of the stochastic frontier production functions

The sigma square coefficient of 0.3954 in (Table 2) is statistically significant and different from zero at 1%. This indicates a good fit and the correctness of the specified distributed assumption of the composed error term. The gamma value (variance ratio) of 0.7807 is also significant and statistically different from zero at 1%; meaning that 78% variation in the output of cassava producers are attributed to the presence of technical inefficiency in the resource use during the production as confirmed by the generalized log likelihood function of -54.802. The log likelihood function implies that inefficiency exist in the data set. The log likelihood ratio maximizes the joint densities in the estimated model. Thus; the functional form that is Cobb-Douglas used in the estimation is an adequate representation of the data. Hence the occurrence of technical inefficiency among cassava producers in the pooled location is 54% of the variation in the output level of the crop grown. The diagnostic result therefore confirms the relevance of the stochastic production frontier and maximum likelihoods estimates. The estimated production frontier shows a not too perfect combination of resources in cassava production. All coefficients of explanatory variables (inputs) exhibits expected signs and magnitudes except for fertilizer; and all the variables are significant at 1%. Farm size; labour; planting materials and capital seem to be the most important inputs with elasticity of (0.5237; 0.8341; -0.6341 and 0.2103) respectively.

This implies that a unit percent increase in these inputs quantity will increase outputs by 0.5237; 0.8341; 0.6341 and 0.2103 respectively. The determinants of technical efficiency could be explained by estimation of the

Table 1. Distribution of cassava producers based on socio-economic characteristics.

Characteristics	Frequency	Percentage
Age of farmers		
Less than 20	32	9.1
20-29	73	20.9
30-39	120	34.3
40-49	92	26.3
50-59	21	6.0
More than 60	12	3.4
Mean	38	
Years of schooling		
Primary	122	34.9
Secondary	151	43.1
Tertiary	77	22.0
Mean	10	
Farming experience		
1– 10	103	29.4
11 – 20	187	53.4
Above 20	60	17.2
Mean	12	
Household size		
Less than 5	57	16.2
5 – 10	213	60.9
11 – 15	73	20.9
More than 15	7	2.0
Mean	8	
Credit assess		
Yes	148	42.3
No	202	57.7
Extension contact		
Yes	95	27.1
No	255	72.9
Total	350	100

Source: field survey data; 2018.

Table 2. Maximum likelihood estimates and inefficiency estimate result.

Variables	Coefficient	Standard error	T – ratios
Constant term	2.1343	0.8274	1.2983
Farm size	0.5237	0.9466	8.6371 [xxx]
Labour	0.8341	0.2561	4.3832 [xxx]
Planting material	-0.6341	0.3430	-2.7837 [xxx]
Fertilizer	0.4235	0.0734	0.3750
Capital	0.2103	0.8340	3.1024 [xxx]
Diagnosis statistics			
Sigma – square	0.3954	0.9720	0.7934
Gamma	0.7807	0.6835	0.9230
Log likelihood	-54.802		
Inefficiency models			
Intercept	0.3070	0.2517	214.5187 [xxx]
Sex	0.2041	0.4320	0.2310
Age	-0.3483	0.0371	5.8371 [xxx]
Educational status	-0.9730	0.4388	7.3482 [xxx]
Household size	0.4320	0.0037	6.0337 [xxx]
Farming experience	-0.3278	0.8315	9.4389 [xxx]
Access to credit	-0.2389	0.0327	3.8757 [xxx]
Extension contact	0.0247	0.6341	0.0394

[xxx; xx; x;] indicates significant at 1; 5 and 10% probability level respectively. Source: computation from field survey data; 2018.

Table 3. Cassava producer's specific resource use efficiency indices.

Efficiency	Frequency	Percentage
- 0.19	0	0
0.20 – 0.29	5	1.43
0.30 – 0.39	8	2.29
0.40 – 0.49	53	15.14
0.50 – 0.59	81	23.14
0.60 – 0.69	137	39.14
0.70 – 0.79	13	3.71
0.80 – 0.89	20	5.71
0.90 – 1.00	33	9.43
Mean	0.5237	
Total	350	100

Source: computation from field survey data; 2018.

inefficiency effect model and its results. Based on the factors that affects technical efficiency; the estimated coefficients of the inefficiency variables are highly significant. Age has negatively sign which implies that as the age of the producer's increases; their inefficiency in resource use decreases and their technical efficiency increases pushing them towards the production frontier; a unit increase in the age of the cassava farmers will increase technical efficiency by a magnitude of 0.348. Idiong, (2006) reported a positive relationship between age and technical efficiency of farmers.

Education was negatively related and statistically significant at 1% level of probability; this implies that a unit increase the farmers level of education will reduces the farmer's technical inefficiency by a magnitude of 0.973. This finding conform to *a priori* expectation and work by Ajibefun and Aderinola, (2003) who noted that the level of farmer's education is very important in determinants of technical efficiency and productivity. On other words, more educated farmers were more likely to have higher output due to their better skills; access to information and good farm management. This result was also consistent with Kebede, (2001); Ahmad and Chaudhry, (2000). However, Effiong, (2006) did not obtain a significant coefficient of this variable in his study of cassava producers in Akwa - Ibom State.

The estimated coefficient of producer's household size was positive at 1% probability level implying that the higher the numbers of individual staying in the same house; the lower the technical efficiency of cassava production. On other words; a unit increase in household size will leads to a decrease in magnitude of 0.432 of technical efficiency thereby encouraging inefficiency in cassava production. This result is in contrast with *a priori* expectations and work by Kebede, (2001); Idiong, (2006); Ahmad and Chaudhry, (2000).

Farm experience is negatively related and statistically significant at 1% probability level indicating that a unit increase in the number of years of experience of a cassava producer will increase the technical efficiency by a magnitude of 0.328. According Idiong, (2006) farming experience proxy for educational attainment is a vital determinant of technical efficiency of farmers. This finding conforms to *a priori* expectation. Access to credit have negative signs and is significant at 1% probability level. This indicates that as cassava producers have access to more credit; inefficiency of resource use decreases and technical efficiency increases. A unit increase in the amount of credit available to cassava producers will increase their technical efficiency by a magnitude of 0.239 and their output will be closer to the production frontier. This finding conform to *a priori* expectation and work by Kebede, (2001) who reported a similar relationship among rice producers in Mardi water-shed in the western development region of Nepal.

Technical efficiency analysis of cassava producers

The estimates of the farm level technical efficiency of cassava producers as presented in (Table 3) indicates a technical efficiency range from 14 – 96%. The mean technical efficiency obtained is 52%. This means that the cassava producers are producing at about 52% of the potentials frontier production levels given their current resources base and available technology and about 48% of their production capacity has remained untapped. The result further shows that for the average cassava farmers to reach the technical efficiency level of the most efficient farmer in the sampled; he/she would achieve a cost savings of about 24% on the other hand; the least efficient cassava farmer would achieve a cost savings of about 47% if he /she were to attain the level of the most efficient farmer in the study area.

Conclusion and recommendations

This study measures the technical efficiencies of cassava producers in Delta State; Nigeria through the application of the stochastic frontier production function. Cassava production in the rural area with its subsistence nature can

can be a good source of employment; income source and even a means to engineer other sector of economy for increase productivity if resources are efficiently utilized. The success of a farm enterprise as it indicates an ability of the farm to produce maximum output from a set of input mix and the position of the individual farm efficient resource use in the production frontier coupled with the ability to produce the greatest amount of output possible from a fixed amount of inputs can only be guaranteed if the input mix; socio-economic and marketing characteristics of the farmer is properly managed. Based on the findings of this research work; the following recommendations were proffered:

(i) Since credit is an important variable in cassava production efficiency; policy makers should formulates measures to provide sustained credit to the farmers and financial institutions should provide timely and targeted loans to cassava farmers.
(ii) Education is vital for improve efficiency of farmers therefore affordable and available educational system should be encourage and developed mostly in the rural areas.
(iii) Farming incentives such as hybrid and improved inputs should be provided to the farmers at subsidies rates.
(iv) Generally speaking, the variables that affects production efficiency positively should be studied and developed for optimum output; increase income towards sustainable agricultural development.

Authors' declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

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