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Research Paper

Technical Efficiency of Cassava Producers in Ikom Agricultural Zone of Cross River State- Nigeria.

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ABSTRACT:-This study was carried out to economically analyze cassava production in the Ikom Agricultural Zone of Cross River State, Nigeria. A multi-stage and proportionate sampling of 40% of the total number of registered cassava producers for each of the 20 communities gave a total of 120 respondents which constituted the sample size for the study. This was done to ensure homogeneity, unbiased and representativeness of the sample and also to ensure more accurate result for the study. The result of the Maximum Likelihood Estimates (MLEs) of the Cobb-Douglas stochastic production frontier function showed that the coefficient of farm size (X_1), labor (X_3), contact with extension agent (X_4), cassava cuttings (X_5) and fertilizer use ((X_6) were positive and significant at 1 and 5% levels. This implied that an increase in any of these inputs will results in a further increase in output of cassava producers. The coefficient of farming experience (Z_1), educational level (Z_3), household size (Z_5), and association membership (Z_6) was positive and significant at 1 and 5% levels. The study recommends that the negative effect of age on technical efficiency levels of cassava producers in the area can be addressed by the formulation and implementation of policies that would encourage the younger ones to be interested and continue in cassava production. Also, policies that would encourage cassava producers to acquire some form of formal education done by strengthening the capacity of adult and continuing education centers should be formulated and implemented since their educational levels and contact with extension positively and significantly influence their technical efficiency. In addition, labor reducing technologies should be introduced to the farmers to reduce the drudgery associated with farming.

Keywords:-Cassava, technical efficiency, maximum likelihood estimates.

I. INTRODUCTION

Cassava (*Manihot esculenta crantz*) is a perennial woody shrub of the Euphorbiaceae family. It is grown principally for its tuberous root but its leaves are also eaten in some parts of Africa and used as animal feed in parts of Asia. In terms of its nutritive value, "cassava roots contain about 60% of water and are rich in carbohydrate. The roots are low in protein and lipids but reasonably rich in Calcium and vitamin C. Products from cassava when consumed with some energy dense protein and nutrient rich supplementary foods such as beans and oil seeds, pulses and fishes provide energy in adequate diet" [1].

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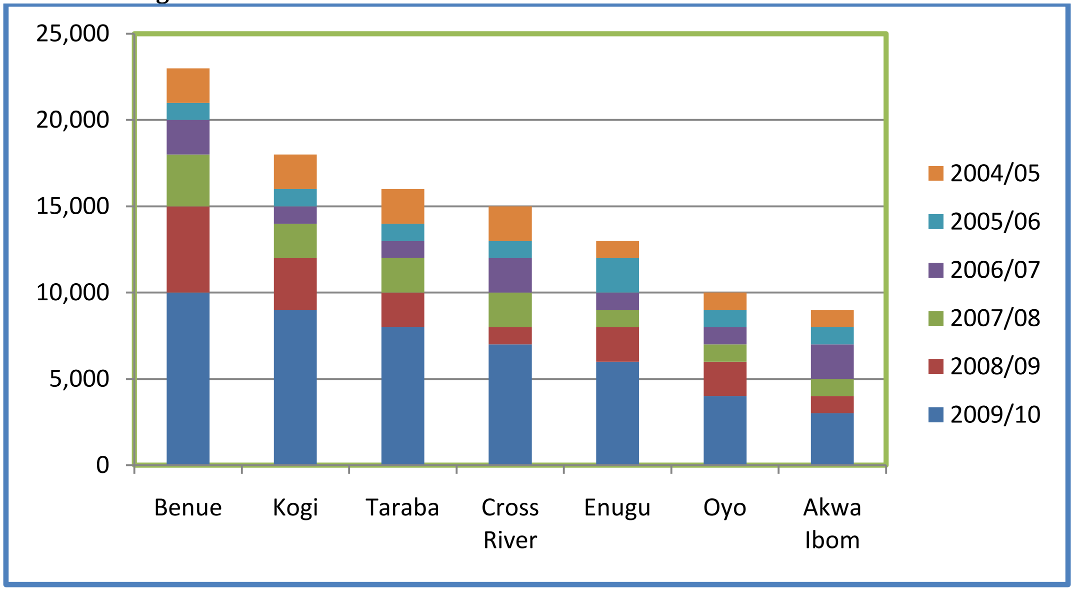
Fig 1: TOP CASSAVA PRODUCING STATES 2004/2005-2009/2010



Source: [2].

Cross River State is the fourth highest cassava producing States in Nigeria, with an annual output of 15,000 tons. The following states record the highest figures in terms of per ha of land cultivated and tons produced: Benue (403,000ha), Kogi (395,000ha), Taraba (355,000ha) followed by Cross River State (345,000ha), Enugu (242,000ha) [2]. Pelletized cassava for export is a good investment option in Cross River State especially with abundant raw materials and a seaport.

Nigeria is the largest producer of cassava tuber in the world with production of about 37.5 million metric tons of the world‘s production of 242 million metric tons in 2010. Comparing the output of various crops in Nigeria, cassava production ranked first, followed by yam at 27 million tons, sorghum at 7 million tones, millets at 6 million tones and rice at 5 million tones [3].

The agricultural sector used to be the dominant contributor to the Nigeria's Gross Domestic Product (about 40%) in 2010, but this has been diluted as other sectors such as finance, construction, entertainment and other sectors have braced up their contribution to the economy, hence, a decline in the country's agricultural gross domestic product. Only 50% of the 82million hectares of arable land in Nigeria have been cultivated. The overall agricultural situation deteriorated creating a wide gap between the supply and demand for food. Revenue from agricultural sector dwindled and the government is facing mounting food import bills. At the same time, industries continue to import agricultural raw materials, thus putting considerable stress on Nigeria's foreign exchange earnings. This is exemplified by the currently released rebased GDP figure, which shows that the agricultural sector's contribution is only 21.97% or ₦17.635trillion of the total ₦80.22trillion [2].

The presidential initiative on cassava is set to mobilize Nigerians to fully and profitably tap into the potentials of cassava, which had hitherto remained unharnessed. This makes it imperative to determine the factors that influence output of cassava as well as the technical efficiency of cassava producers in the area to ensure sufficient food availability, employment, and growth.

The study set out to:

- assess the factors that determine output of cassava producers
- determine the technical efficiencies of cassava producers and
- Assess the determinants of technical efficiencies of cassava producers in the study area.

II. METHODOLOGY

3.1 STUDY AREA

This study was carried out in selected communities in Ikom Agricultural Zone of Cross River State. For this study, five (5) communities from each of the four (4) LGAs randomly selected were used. According to [4], Ikom Agricultural Zone of Cross River State shares an international boundary with the republic of Cameroon to the East, Obanliku and Obudu to the North, Ebonyi state to the West, and Biase and Akamkpa to the south. It covers an approximate land mass of 16,280.02km^2 and lies at latitude 5^{0}32N and 4^{0}27N and between longitude 7^0 50^{0}E and9^{0}28 ^{0}E. The area is on approximately 25m above sea level, with annual temperature range of 27^{0}C-33^{0}C, while rainfall varies between 1500mm-2000mm per annum.The study area is found in the tropical rainforest zone of the country.

3.2 POPULATION OF STUDY

The population of this study comprises all the cassava producers in the study area. The total number of cassava producers in the Ikom agricultural zone, Cross River State is estimated to be 545,535

3.3 SAMPLE SIZE AND SAMPLING TECHNIQUE

The sample of the study was drawn from the study population. A multi-stage random sampling procedure was used.

Stage I - Random selection of four (4) LGAs to be used for the study.

Stage II - Random selection of five (5) communities from each of the LGAs.

Stage III - Random selection of cassava producers from each village sampled.

Using proportionate sampling, 40% of the total number of registered cassava producers from each of the 20 communities was used for the study. This gave a total of 120 respondents. This was done to ensure homogeneity, unbiased and representativeness of the sample and also to ensure more accurate result for the study.

3.4 SOURCES OF DATA COLLECTION

The data used for the study were obtained from a cross section of cassava producers through the use of validated structured questionnaires.

3.5 DATA ANALYSIS

The stochastic frontier production function which accommodates two error terms that account for random effects and exogenous shocks as well as technical inefficiency was adopted to estimate the variables of the production function. This is in line with [5] and [6].

It was specified as; $Y = f(X_i ; \alpha) + \varepsilon_i$ (1)

Where,

Y = Output of Cassava

X_i = Actual input vectors

α = Vector of unknown parameters to be estimated

ε_i= Composite error term defined as V-U (2)

Where,

V = Random error term that accounts for factors beyond the farmers control. It is independently and identically distributed $(N(O\delta^2_v)$

U = Non-negative one-sided error term that accounts for technical inefficiency and assumed to be independently distributed as truncated of the normal or half normal distribution, i.e.

$\delta^2_u (|N (U_i\ \delta^2_u)|)^2$ and $U_i = A_i\ \delta$ (3)

Where,

A_i is a 1 × e vector of farmers/farm characteristic that will influence inefficiency while, δ is vector of parameters to be estimated with the variance parameters expressed as:

$\delta^2 = \delta^2_v = \delta^2_u$ (4)

$$\gamma = \frac{\delta^2_v}{\delta^2_u}$$

To fulfill the objectives of the study, the stochastic frontier model for cassava production was specified as a Cobb-Douglas function as follows;

$Ln\ Q = Ln\alpha_0 + \alpha_1 LnX_1 + \alpha_2 LnX_2 + \alpha_3 LnX_3 + \alpha_4 LnX_4 + \alpha_5 LnX_5 + \alpha_6 LnX_6 + \varepsilon_i$ (5)

Where,

Q = Output of cassava produced (kg)

X_1= Farm size (ha)

X_2 = Access to credit (Dummy) 0 = No Access, 1= Access

X_3 = Labor (Man-days)

X_4= Contact with extension agent (number of times)

X_5 = Cassava Cuttings (Bundles)

X_6 = Fertilizer use (kg)

Ln = Natural logarithm

α_0 = Intercept

α_1-α_6= Coefficients to be estimated

ε_i =Composite error term as earlier defined in equation (1)

The stochastic frontier model for cassava producers characteristics was incorporated into the model with belief that they have direct influence on efficiency [7].

The specification is shown below:

$Y = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \varepsilon_i$ (6)

Where,

Y = Technical efficiency of the cassava producers

Z_1 = Farming experience (Years)
Z_2 = Age of farmer (Years)
Z_3 = Educational level (Years)
Z_4 = Gender (Dummy) 0 = Male, 1 = Female
Z_5 = Size of household (Number)
Z_6 = Membership of Organization (Dummy) 0 = Member, 1= Non-member
α_0 = Intercept
$\alpha_1 - \alpha_6$ = Coefficient to be estimated

III. RESULTS AND DISCUSSION

4.1 Factors that influence output of cassava producers in the area.

The maximum likelihood estimates (MLEs) of the Cobb-Douglas stochastic production frontier function of cassava producers in selected communities in Ikom zone of CRS are presented in Table 4.1. The result showed that the coefficient of farm size (X_1), was positive (as expected) and significant at five percent level. This implies that an increase in farm size will result in a further increase in output of cassava producers in the area. Hectarage change from small farm sizes to larger sizes could create economies of size which would benefit producers. This is in line with the study conducted by [8]. The coefficient of access to credit (X_2)had no significant coefficient although it carried a positive sign on priori basis. The coefficient of labor (X_3) also had a positive sign and was significant at 5 percent implying that increasing labor will cause increases in output. It should be noted that cassava production is labor intensive and the producers resort to the use of family labor in order to cut cost of hiring labor. However, increase use of family labor can result in labor saturation and lower returns on labor use and inefficiency. Also, the coefficients of contact with extension agent (X_4), cassava cuttings (X_5) and fertilizer use ((X_6) were positive and significant at one and five percent levels respectively. Hence, an increase in the use of fertilizer will result in an increase in the output of cassava especially where producers are constrained by land availability to allow for fallow or rotation. Also, increase in extension contact for technology transfer and extension education will increase output of cassava producers. Similarly, increasing the quantity of cassava cuttings used per hectare and number of nodes in cassava cuttings will also determine the quality and quantity cassava output. This conforms with similar findings by [9], [10], [11]and [12] in their separate studies.

Table 4.1 Maximum likelihood estimate of the stochastic production frontier function for cassava producers in Ikom Agricultural zone ofCross River State.

Variables	Coefficients	Standard Errors	t-ratios
Intercept	3.125	0.5093	6.12***
Farm size (X_1)	0.245	0.0936	2.704**
Access to credit (X_2)	0.083	0.0776	1.06
Labor (X_3)	0.835	0.2886	2.88***
Contact with extension agent (X_4)	0.125	0.0422	2.98***
Cassava cuttings (X_5)	0.235	0.2472	2.66**
Fertilizer use ((X_6)	0.188	0.0763	2.46**
Returns to Scale (RTS)	1.711		
Gamma (γ)	0.898	0.256	3.51***
Sigma square (δ^2)	0.731	0.212	3.46***
Log Likelihood function (LLF)	98.54		
Log Likelihood Ratio (LLR)	33.32		

Note: * Significant at 1%, ** Significant at 5%, * Significant at 10%**
Source: Computed from field survey data, 2014 using frontier 4.1 by Coelli (1994).

The elasticity of production with respect to farm size, access to credit, labor, contact with extension agent, cassava cuttings and manure use indicated that a one percent increase or decrease in these variables will lead to 0.245, 0.083, 0.835, 0.125, 0.235 and 0.188 percent increase or decrease in output of cassava respectively. Returns to scale measures the sum of all the elasticities of production with respect to all the inputs or the proportionate change in output if all the inputs are change simultaneously by one percent [13]. The various forms of returns to scale are: increasing (Ep>1), constant (Ep = 1) and decreasing returns to scales (Ep<1). The sum of elasticities of production with respect to explanatory variables in the study area was 1.711 indicating that cassava farmers are operating in increasing return to scale region (Ep>1). That is, they are operating in the 'irrational stage' of production. This is an indication that producers are producing in stage 1 of the production surface [14].In stage 1, cassava producers are inefficient in the use of their resources. This agrees with findings carried out by [15].

The sigma square (0.731) is statistically significant and different from zero at 0.01. This gives an indication of the goodness of fit and the correctness of the specified distribution assumption of the composite error term. The gamma (γ) estimated to be 89 percent suggests systematic influences that are unexplained by the production function as the dominant sources of random errors. Putting it differently, the presence of technical inefficiency among cassava producers explains 89 percent variation in the output level of the cassava cultivated. The presence of one-sided error component in the specified model is thus confirmed implying that the ordinary least square estimation would be inadequate representation of the data. The generalized likelihood ratio (98.54) was highly significant which implies the presence of one-sided error component. The results of the diagnostic analysis therefore confirm the relevance of stochastic parametric production function and maximum likelihood estimation. This findings conforms with studies carried out by [15], and [16].

4.2 Estimates Of Technical Efficiency

The distribution of efficiencies of cassava producers in the study area are presented in table 4.2. The distribution shows that majority (36.7%) of the producers were within the 81 to 90 percent efficiency class and only about 14.7% were those with efficiency that is above 90 percent. The mean efficiency of the cassava producers was 70 percent implying that production can still be increased by 30 percent using available technology. Findings emphasize the need for appropriate policy intervention that will curb farmers' technical inefficiency in production among cassava producers.

Table 4.2 Technical Efficiency Distribution of cassava producers in Ikom Agricultural zone of Cross River State.

Efficiency class	Frequency	Percentage
less than 51	10	12.0
51 – 60	8	6.67
61 – 70	19	15.83
71 – 80	32	26.67
81 – 90	44	36.67
91-100	17	14.7
Total	120	100
Mean	0.70	
Standard deviation	31.43	
Minimum	0.48	
Maximum	0.99	

Source: Field survey data, 2014.

The relative high levels of technical efficiency of cassava producers is a suggestion that only a small fraction of the losses in output of the producers can actually be attributed to resource wastage. The result further showed that, for the average cassava producer to achieve the level of the most technically efficient producer, he/she would realize about 29.29 (1 – 70/99) percent cost savings. Similarly, the least technical efficient cassava producer would realize a cost saving of about 51.52 (1 – 48/99) percent, to achieve the level of the most technically efficient producer in the sample. These estimates are similar to findings conducted by [17] in his study on the technical efficiency of cassava farmers in south eastern Nigeria.

4.3 Determinants of Technical Efficiency

The result in table 4.3 shows the maximum likelihood estimates of the determinant of technical efficiency of cassava producers in Ikom Agricultural zone of Cross River State. The result indicates that the coefficient of farming experience (Z_1) was positive and significant at the one percent level. It indicates that cassava producers with many years of production had higher levels of technical efficiency than those with fewer years of experience. [18]had reported that farmers sometimes count on their experience in their bid to efficiently utilize their scarce resources. The finding supports the findings of [19]; [20]; [21]; [22] in their separate studies. They indicated that farmers with more experiencehave better knowledge of situations in the market thus, runs a more efficient and profitable enterprise. Similar findings were reported earlier by[23],[24], [9], [10] [24] and [22] stated that previous experience in farm business management enables farmers to allocate, combine and utilize resources efficiently, set realistic time and identify production risks.

Table 4.3Determinants of technical efficiency of cassava producers in Ikom Agricultural Zone- CRS.

Variables	Coefficients	Standard errors	t-ratios
Constant	-0.5323	0.5331	-0.997
Farming experience (Z_1)	0.9866	0.1646	2.51**
Age (Z_2)	-0.4130	0.3322	2.98***
Educational level (Z_3)	0.2544	0.0622	4.07***
Gender (Z_4)	0.2114	0.1058	1.98
Household size (Z_5)	0.5672	0.1898	2.96***
Membership of organization (Z_6)	0.3545	0.1446	2.48**

Note: ****Significant at 1% level, **Significant at 5% level*.
Source: Computed from the Field Survey Data, 2014.

The coefficient of age (Z_2), has negative sign and is significant at five percent level. This implies that the age of the cassava producers inversely influences his/her technical efficiency. That is, the older the cassava producer, the less technically efficient he/she would be. In other words, older cassava producers are less efficient than the younger ones.This conforms to studies conducted by [25], [21] and [24]. They showed that younger farmers are innovative, able and willing to take risk and physically strong to do the manual farm work typical of subsistence agriculture unlike the older farmers. In the same vein, [25], asserted that older farmers are conservative and less likely to have extension contacts and therefore are less willing to adopt improved technology that would enhance their technical efficiency.

The coefficient of educational level (Z_3) was positive and significant at the one percent level, showing that the level of technical efficiency of cassava producers will increase with his or her level of education. Thus, the farmer's level of education determines his managerial competence. A farmer who has a higher level of education has the capacity to understand and adopt improved technology resulting in shifting upwards of his production frontier. Education affects efficiency via improved quality of labor and improved ability to process information, select inputs and allocate them across competing uses. This result agrees with that reported by [19]; [21] that higher level of education determines the quality of skills of farmers. Other similar findings were that of[10], [26], [24], [9] [10], and [17]. However, the result of[8], was contradicting, as he reported a non-significant effect of education on farmers efficiency and concluded that education surely increases efficiency but lower levels of education, seldom does.

The coefficient of gender (Z_4) was positive but not significant at 5 percent level. This conforms with studies carried out by [8], [2], but the findings of [23] on the efficiency of agricultural production in the Central region of Thailand was at variance with that obtained for this study.

The significance of the coefficients of household size (Z_5) was positive and significant at one percent. This implies that, farmers with larger sizes have higher levels of technical efficiency, due to the fact that increasing household size results in family labor availability. Cassava production and sales often requires a lot of hands and therefore, increases in household size makes labor readily available given the high cost of hired labor in the study area. This result corroborates with studies carried out by [21]. However, [26] and [24] obtained a negative and insignificant relationship, with an assertion that labor availability through large household sizes depends on the age structure of members of the household.

Finally, the coefficient of association membership (Z_6) was positive and significant as expected at 5 percent. Association membership affords the cassava producers the opportunity to exchange information on improved technology as a result of interaction with other producers. Credit facilities are also passed to members by government to expand and improve their farms. This also corroborates with similar findings by [10] and [17].[23]in their separate studies. Thus, an increase in cassava producers membership in cooperatives or farmers organization, will lead to an increase in technical efficiency. However, [16] stated that farmers that are members of any association can be valuable for small scale operation because apart from the provision of secure market for their crops and technical assistance, it facilitates access to markets and increases income and employment.

IV. CONCLUSION

1. Policies that would encourage cassava producers to acquire some form of formal and informal education should be formulated and implemented. This can be done by strengthening the capacity of adult and continuing education centres available in the area, since their educational levels and contact with extension positively and significantly influence their technical efficiency.
2. Labor reducing technologies should be introduced to the farmers. This will reduce the drudgery associated with farming.

3. The negative effect of age on technical efficiency levels of cassava producers in the area can be addressed by the formulation and implementation of policies that would encourage the younger persons to go into cassava production. School to farm programmes should be resuscitated.
4. More farmers should be encouraged to become members of cooperatives.

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