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Cassava production and technical efficiency in ayedaade local government area of osun state, Nigeria

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ABSTRACT

This study analysed the efficiency of resource use in cassava production in Ayedaade Local Government Area of Osun State, Nigeria. It focused on the socio-economic characteristics of cassava farmers, input-output relationship and the efficiency of resource use in cassava production. Data were collected from a random sampling of 120 cassava farmers using pre-tested questionnaire. The data were analysed using descriptive statistics, regression technique and stochastic frontier analysis (SFA). Result showed that the average age of the respondents was 49 years;average year of schooling was 7 and average households' size consistsof 7 members. The result further revealed that the average farm size of the respondents was 4.59 hectares. The double-Log function of the multiple regression analysis gave best fit with R^2 of 92.3% and it indicated that farm size, hired labour used, quantity of herbicides and fertilizer used significantly influenced cassava output. For the efficiency analysis, farm size (ha), cost of factor input and chemicals (fertilizers and herbicides) used per hectares were the major determinants of farm level efficiency among the cassava farm households in the study area.

Introduction

Cassava is a major food crop produce in Nigeria, its combined abilities to thrive on less fertile soil, produce high yield under poor conditions and store harvestable portion underground makes cassava a classic food security crop. Cassava provides about 40% of daily food requirement for rural households in Sub Saharan Africa (SSA) and 70% of the daily calorie intake for over 50million Nigerians (FAO, 2003). Nigeria is the leading producer of cassava in the world, harvesting from 3.81 million hectares to produce 45.72 million tonnes in 2006 (FAOSTAT, 2008). Nigerian Agricultural sector reflects the picture of many developing countries, where 70-80% of the total population doesnot only live in the rural area, but also derive their livelihood from Agriculture (Ijere, 1986). In spite of the peasantry nature of the agricultural sector in Nigeria, cassava production continues to play its traditional role of not only providing food for both man and livestock consumption, raw materials for industries, employment and revenue generation, but also contributes significantly to both the total export earnings and gross domestic product (GDP) of the country (Gusau, 1989). However, cassava production in Nigeria is still largely based on traditional production technologies which, to a large extent, affect the farm level efficiency. Generally, agricultural productivity depends on resource allocation which is also associated with the management decisions of the farmers. The objectives of the study are to identify some socio-economic factors which influence cassava production; analyse input-output relationship of cassava production and estimate farm-level technical efficiencies for cassava producers in Ayedaade Local Government area in Osun State.

Technical efficiency in production is defined as the physical ratio of output to the factor input, while economic efficiency on the other hand occurs, when a firm chooses resources and enterprises in such a way that a given resources has its marginal value product (MPV) is equal to its marginal factor cost (MFC) (Adegeye&Dittoh, 1985). Studies (Iheanacho et al., 2000; O'Donnel*et al*., 2008) have used production function analysis to estimate efficiency of resource-use in crop production systems and determined the optimal resource allocation for appropriate adjustment. They suggested that efficient resources allocation was necessary to achieve equality between marginal value products and marginal factor costs of inputs within any farm enterprise.

***Experimental Study Area*:** The study was conducted in Ayedaade Local Government Area which is one of the local government areas in Osun, Nigeria. The major occupation of the people in the area is agriculture which provides employment and income for over 80% of the population. The Local Government Area is one of the major producers of Cassava in the State. This study area was chosen because their populations are predominantly farmers growing cassava as the major food crop.

***Methods of data collection and analysis*:**The methodology used in this research includes the use of structured questionnaires to obtain information from 120 respondents within the study area. These questionnaires were administered in different areas and small communities numbering about twelve (12) villages of the Local Government area. Multistage Sampling Techniques was used to select respondents. The selection of the State, the Local Government Areas and the Villages was purposive; while the selection of farmers was on the basis of simple random sampling. Data were collected on farmers' socio-economic characteristics such as age, gender, years of formal education, marital status, farm size, as well as on quantities and prices of various inputs used and outputs produced.

Data analytical technique: Descriptive statistics was used to describe the socio-economic characteristics of the farmers.

Regression model: was used to examine input-output relationship and implicit form of the model is given by:

Y = f (x1, x 2, x3,x4,x5,x6,x7,x8,ui)................(1)

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Linear exponential and Semi-log forms of the production function were fitted to the data. The double-log function gave the best fit and was chosen as the lead equation on the basis of the number of significant variables, magnitude of R^2, F-statistics, standard error and the signs of co-efficient. The explicit form of the lead equation is given as:

$InY=Inb_0 + b_1InX_1 + b_2InX_2 + b_3In X_3- b_4In X_4 + b_5In X_5 + b_6In X_6 + b_7In X_7 + b_8In X_8 + U_i$ …..(2)

Where: Y = Output in kilogram (kg).

X_1 = Age of respondent (yrs).

X_2 = Years of formal education (yrs).

X_3 = Farm size in (ha).

X_4 = Households size (#)

X_5 = Quantity of herbicides used (lit/ha.).

X_6 = Hired labour (man-days).

X_7 = Family labour (man-days).

X_8 = Fertilizer in kilogram (kg/ha).

Ui = Error term.

b_0 = Constant.

b_1- b_8 = Regression co-efficient.

Stochastic frontier analysis (SFA): A stochastic production function comprises of a production function of the usual regression type with a composite disturbance term equal to the sum of two error components (Aigner and Van de Broeck, 1977; Meeusen and Van de Broeck,1977). One error component represents the effect of statistical noise (e.g. weather, topography, distribution of supplies, measurement error, etc.). The other error component captures systematic influences that are unexplained by the production function and are attributed to the effects of technical inefficiency.This study used a variant of the stochastic frontier production function proposed by Battese and Coelli (1995) which builds hypothesized efficiency determinants into inefficiency error component so that it will be easy to identify focal points for action to bring efficiency to higher levels among cassava farmers in the study area. The general form of the model is as expressed in equation (3):

$Q_i = \beta_0 + \beta iX_i + (V_i – U_i)$…………… (3)

Where; Q_i is the production (on the logarithm of the production) of the ith firm,$X_i$is a KX_i vector of (transformations of the) input quantities of the ith firm, [X_i: X_1-X_4] and β is a vector of unknown parameters;

Where:X_1 = Labour used (mandays)

X_2 = Cost of inputs (N/ha)

X_3 = Farm size (ha)

X_4 = Chemical (fertilize & herbicides) (N/ha)

The V_i are random variables which are assumed to be lid $N(0,\delta v^2)$ and independent of U_i which are non-negative random variables assumed to account for technical inefficiency in production and are often assumed to be lid $N(0,\delta u^2)$. It is further assumed that the average level of technical inefficiency, measured by the mode of the truncated normal distribution (i.e. U_i) is a function of factors believed to affect technical inefficiency as shown in equation (4):

$U_i = \delta_0 + \delta_iZ_i$……………………………. (4)

Where; Z_i is a column vector of hypothesized efficiency determinants and δ_0 and δ_i are unknown parameter to be estimated.It is clear that if U_i does not exist in equation (3) or $U_i = \delta u^2 = 0$, the stochastic frontier analysis is reduces to a traditional production function. In that case, the observed units are equally efficient and residual output is solely explained by unsystematic influences. The distributional parameters, U_i and δu^2 are hence inefficiency indicators, the former indicating the average level of technical inefficiency and the later the dispersion of the inefficiency level across the farmers.

Given functional and distributional assumptions, the values of unknown coefficients (3) and (4), i.e. βs, δs, δu^2 and δv^2 can be obtained jointly using the maximum likelihood method (ML). An estimated value of technical efficiency for each observation can be calculated using equation (5) which expressed as:

TE_i = exp (-Ui)……………………… (5)

The unobservable value of V_i may be obtained from its conditional expectation given the observable value of (Vi – Ui) (Yao and Liu, 1998).

Results and discussion

Socio-economic characteristics of farmers: Table I presents the socio-economic characteristics of cassava farmers at Ayedaade Local Government area. The socioeconomic distribution showed that the average age of the respondents is 49 years which imply that farmers in the area are very young and are still within the active working age. The level of education showed that an average year of schooling is 7. This indicates that farmers in the area were educated and as such, they should be able to carefully analyse the advantages and disadvantages of various farming and/or technological options which eventually will affect their level of farm efficiency. The distribution of farmers according to their level of access to various services such as farm credit, membership of association and extension services showed that 60%, an average of 3.7 and 5% of the farmers had access to the services respectively.

Households' size distribution showed that average cassava farm households had at least 7 members. This reflected the level of households' access to family labour. Faming experience revealed that an average farmer had spent more than 17 years in cassava production. Distribution by areas of land cultivated showed that average farmer had access to 4.59 hectares of land in the area. This indicated that most of the farmers had limited access to farm land, hence the need to efficiently allocate their limited resources for optimal production.

Production input-output relationship: The estimated Cobb-Douglas production function is given in Table II. The lead equation is: $InY = 8.16 – 5.28X_1 + 8.09X_2 – 5.19X_3 + 6.63X_4 + 7.99X_5 + 8.93X_6 + 6.24X_7 – 1.56X_8$…..……….(6)

About 92.3% of the variation in output of cassava is explained by the factor inputs as indicated by the value of R^2. All the variables have positive co-efficient except years of schooling and family labour, which have negative relationship with output. However, they did not affect output significantly. The positive co-efficient implies that increase in the quantity of these input will result to increase in cassava output and for the significant factor inputs (such as farm size, hired labour used, quantity of herbicides and fertilizer used); it implies these inputs were the major determinants of cassava output.

Efficiency level in cassava production: The maximum likelihood estimates (MLE) of the parametric stochastic frontier analysis (SFA) were shown in Table III. The production function was estimated using stochastic frontier model of Battese and Coelli (1992). The inefficiency factors considered were age, farming experience, households' size, years of formal education, access to credit, membership of association, extension contact, off-farm employment, and rent paid on land. All the independents variables (except labour used) were significant at 5.00% level and the average technical efficiency score among the farmers was 73.4%. This implied that cassava farmers in the area were operating below the production frontier. They can still increase their efficiency level by 26.6%. Among the inefficiency factors considered, only years of formal education and access to extension contact were significant.

Table I. Socio-economic characteristics of cassava farmers

Variables	Farmers (N=120)	Standard Deviation
Age (yrs.)	49.51	13.60
Years of Schooling	7.21	4.89
Access to Credit (% yes)	0.60	0.49
Membership of Association (yrs.)	3.76	3.60
Extension Contact (% yes)	0.05	0.22
Household Size (#)	7.82	5.32
Farming Experience (yrs.)	17.86	9.01
Land Cultivated (Ha)	4.59	3.78

Table II: Estimated Cobb douglass production function for cassava

Function Forms	Dependent Variables	Constant (b_0)	Coefficient of Independent Variables								R^2	Standard Error	F-Values
			X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8			
Linear	Y	2757.94 (0.80)	588.09 (0.17)	3341.39 (-1.07)	9574.65 (2.15)*	683.89 (0.91)	2677.41 (1.97)*	7072.18 (10.02)*	4.68 (2.27)*	0.84 (0.50)	91.9	3005.19	43.08
Exponential	LY	9.09 (1.23)	7.26 (-0.69)	9.01 (-1.10)	7.83 (0.32)	7.86 (1.45)	8.80 (0.18)	8.01 (1.14)	5.81 (0.32)	0.97 (-0.17)	31.4	118.86	3.20
Double Log	LY	8.16 (-0.89)	5.28 (0.30)	8.09 (-1.01)	5.19 (2.06)*	6.63 (0.95)	7.99 (1.92)*	8.93 (3.50)*	6.24 (-0.23)	1.56 (2.08)*	92.3	3094.51	32.38
Semi-log	L	8501.43 (1.21)	1384.95 (-0.68)	8230.06 (-1.12)	2998.48 (0.39)	2618.50 (1.45)	8533.14 (0.23)	3618.00 (2.04)*	0.27 (0.12)	2033.11 (0.81)	31.6	118.10	3.59

Table III: Technical Efficiency (SFA)

Variables	Parameters	Coefficients	Standard Error
Constant	β_0	5.631*	5.782
$\ln X_1$	β_1	-0.962	-1.133
$\ln X_2$	β_2	1.271*	2.325
$\ln X_3$	β_3	-3.392*	-7.652
$\ln X_4$	β_4	-0.713*	-2.850
Inefficiency function			
Intercept	α_0	0.362**	1.797
Age	α_1	-0.028	-0.480
Family size	α_2	0.043	0.481
Farming experience	α_3	-0.002	-0.189
Years of education	α_4	-0.030*	-1.965
Access to credit	α_5	-0.088	-0.735
Farmers' association	α_6	-0.028	-0.208
Extension contact	α_7	0.543*	2.033
Off-farm employment	α_8	-0.044	-0.437
Land Rent	α_9	-0.00002	-0.393
Diagnosis statistics			
Sigma-square $\sigma^2 = \sigma_u^2 + \sigma_v^2$		0.302*	5.684
Gamma		0.070	0.198
Average TE		0.7344	

The gamma diagnostics further confirmed that 7% of the inefficiency observed among the farmers was as result of the inefficiency factors considered.

Conclusion

In conclusion, the result of this study has clearly shown that resources used such as farm size, hired labour used, quantity of herbicides and fertilizer used were the major determinants of output level among the farmers. The result further established that farm size (ha), cost of factor input and Chemical (fertilizers and herbicides) used per hectares were the major determinant of farm level efficiency among the cassava farm households in the study area. Therefore, the farmers can increase their farm level efficiency by using these resources more efficiently.

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