TECHNICAL EFFICIENCY OF SMALL HOLDER CASSAVA PRODUCTION IN ANAMBRA STATE, NIGERIA: A COBB-DOUGLAS STOCHASTIC FRONTIER PRODUCTION APPROACH

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Abstract
This study was carried out to analyse the level of input utilization efficiency of cassava farmers in Anambra State. A multistage sampling technique was employed to select a total of 150 respondents for the study. Data collected were analysed using frequency distribution, means and percentages. A Stochastic Frontier Production Function (SFPF) which incorporated inefficiency causes were estimated using Maximum Likelihood Estimation (MLE) technique. The result obtained indicated that the farmers were operating below the production frontier with a mean technical efficiency of 73%. This shows that they are operating below the frontier. With appropriate technology using hybrid planting materials and credit, production can still be increased by 27%. It is recommended among others that credit and hybrid planting materials should be made readily available to the farmers to enhance resource use efficiency.

Keywords: Resource use, stochastic, hybrid, input, efficiency and cassava

Introduction

Cassava production and areas of arable land cultivated to cassava in Nigeria has been on steady increase. This has been as a result of the adoption of high yielding varieties. The predominance of improved varieties has been occasioned by Nigeria's climate which is basically favourable to cassava production, farmers' level of technology and their socio-economic situation (Simonyan and Ibelegbu, 2012).

Cassava cultivation according to Sang (1992) was adopted and integrated into the traditional farming and food system of Africa because of its low input resource requirement and relative ease of cultivation and processing. Cassava which is usually consumed in processed forms, serves not only as food but also as raw material for several industrial products and animal feed processors. Nigeria, being the largest producing country (FAO, 2004), had an approximately 34 million tones estimate in 2002 with the North Central zone having the highest per capita production of 72 tonnes per person followed by South East Zone – 56 tonnes per person. Expansion of production has been relatively steady since the 1980s (FAO 2006)

Poverty reduction according to IITA (2004) can be attained in sub-Saharan Africa by improving the technical and economic efficiencies of food production in crops such as cassava. IFAD (2004) in Ogumbameru and Okeowo (2013), noted that the growing demand for cassava which will spur rural industrial development and contribute to the economic development of producing, processing and trading communities and well-being of numerous disadvantaged people in the world, has prompted the development of the Global Cassava Development Strategy(GCDS). The strategy suggested that industry analysis in cassava producing countries should be undertaken to indicate current status, strengths, weaknesses and issues for attention and action needed to resolve pressing constraints and take advantage of markets and business opportunities and to encompass finding of committed national experts.

It is significant to note the importance of cassava in the Nigerian food chain and poverty reduction and hence necessary to determine the inefficiency level in resource utilization among the individual farmers. Efficiency in cassava resource utilization will lead to reduction in input expenditure hence reduced production cost, and increased productivity. The issue of resource use efficiency and profitability of farms have taken centre stage on farm productivity, how to combine and apply the available resource input to achieve maximum output. In their study on efficiency measurements, Rios and Shively (2005) stated that the economic literature on production efficiency typically distinguishes two types of efficiency technical and allocative efficiency. The later includes component cost minimization, revenue maximization, and profit maximization. A firm that is both technically and allocatively efficient is said to be economically efficient (Papades and Dahl, 1991). The study will delve into the technical efficiency and production technologies in cassava. Therefore, the general objective of the study is to determine the input utilization efficiency in cassava production. Specifically, the study will also determine: (i) the socio economic characteristics of the practicing farmers (ii) the level of input utilization (iii) input utilization efficiency and inefficiency.

Methodology

The study was carried out in Anambra State. The state has arable land relatively good for cassava cultivation. The climate is humid with substantial rainfall of 1500-2000mm per annum, spread between April to October, and a mean temperature of 87^oF (SEED, 2006)

Sampling Techniques

Multistage sampling technique was employed in this study. In the first stage, ten local government areas were randomly selected. These are Anambra East, Anambra West, Ayamelum, Oyi, Anaocha, Idemili South, Njikoka, Orumba South, Ihiala, and Ogbaru LGAs. The second stage involves the random selection of three towns from each of these LGAs. In the final stage is another random selection of five farming households from each of these towns to give a total of 150 respondents for the study. Data were collected using structured questionnaire.

Method of Data Analyses

The socio-economic characteristics of the farmers, input and output variables and distribution of inefficiency levels were analysed using frequency distribution, means and percentages. A stochastic Frontier Production Function (SFPF) which incorporated inefficiency causes were estimated using the maximum likelihood Estimation (MLE) technique to obtain the farm/farmer's specific levels of technical inefficiencies. Again, to ascertain the farmer's level of technical efficiency level, a generalized likelihood Ratio (LR) test was conducted.

Stochastic Frontier

The stochastic frontier model was used to determine the technical efficiency level of the cassava farmers in the study area. The model is expressed as

$$Y = F(X : \beta) \exp (V_i - U_i), i = 1, 2, \ldots\ldots, N \ldots\ldots (1)$$

Where:

Y = output of the ith farm

X = vector of input quantities of the ith farm

β = represent an appropriate function

V_i = assumed to account for factors beyond the farmers control-weather, diseases etc.

U_i = error due to technical inefficiency

The production technology of the farm was assumed to be specified by the Cobb-Douglass Production Function (CDPF).

Hence, $U_i = 0$ for any farms output lying on the frontier and, positive for any output below the frontier. The empirical stochastic production frontier model used was specified as:

$$\text{Ln } Y_i = \beta_0 + \beta_1 \text{Ln}X_{1i} + \beta_2 \text{Ln}X_{2i} + \beta_3 \text{Ln}X_{3i} + \beta_4 \text{Ln}X_{4i} + \ldots \beta_7 \text{Ln}X_{7i} + V_i - U_i \ldots (2)$$

Where:

Ln = denotes natural logarithm to base e

Y_1 = represents output of the ith farm (in kg)

β_0, β_1 ……….β_n are parameters to be estimated

Y_i = Output in tons

X_1 = Farm size in ha

X_2 = Cassava cuttings in bundles

X_3 = Family labour (mandays)

X_4 = Fertilizer used (kg)

X_5 = Hired labour used in production (mandays)

X_6 = Capital inputs depreciated (Naira)

X_7 = Herbicides in litres

V_i and U_i as in equ (1)

The inefficiency model is defined by $U_i = \sigma + \sigma_1 Z_1 + \sigma_2 Z_2 + \sigma_3 Z_3 + \ldots \sigma_8 Z_8$

Where U_1 = inefficiency effect

Z_1 = Age of the farmer in years

Z_2 = Sex of the farmer (dummy variable; 1=male, 0=female)

Z_3 = Education status (years)

Z_4 = Farming experience (years)

Z_5 = Household size (No. of persons)

Z_6 = Access to credit (dummy variable; 1=yes, 0=No)

Z_7 = Hybrid Variety use (dummy variable; 1=yes, 0=No)

Z_8 = Extension contact (dummy variable; 1=yes, 0=No)

Results and Discussion

Table 1 shows the socio-economic characteristics of the respondents. About 61 percent of the farmers are male and 65% are within the age range of 31-50 years which is the active age of production and reception of new innovation and proper utilization of inputs. The educational status of the sampled farmers shows that 44.67% had primary education, 20% had secondary education, and 25% had no formal education while 10% had tertiary education, an indication that a large number (74%) of the cassava farmers were literate, while 25% illiterate farmers will not be able to fully utilize new technologies appropriately. The result also indicate that majority (64%) of the respondents had farming experience of between 11 to 20 years and are expected to exhibit high level of efficiency in input utilization. This is in line with Nwaru (2004), who noted that experience has a positive effect on efficiency.

The household size of 6-10 persons for 50% of the farmers indicates more contribution of household labour to farm work. This is however dependent according to Idiong, (2006), on household age structure which determines whether the members are of school age hence engaged in school activities or, comprised of aged members hence, their labour availability cannot be guaranteed. The result further revealed that about 78 of the cassava farmers had no access to credit while only 21% had access to production credit. This entails a reduced operational scope for most of the farmers. The implication is that the farmers’ level of production will not allow them to experience the benefits of economics of scale. Also, they will not be able to adopt modern production techniques, employ the needed inputs as at when due there by leading to inefficiency in input utilization and allocation.

It was also found that, while only 29% of the respondents make use of improved hybrid cassava cutting, majority (70%) use local cuttings. This again will lead to poor productivity and, the cost of both variable and fixed resources expended in production will not be fully recovered hence, the resources will not be optimally utilized leading to inefficiency. The result also indicated that only 28% of the respondent farmers have had contact with extension agents while majority 72% have not had any contact with the extension agents hence are not opportune to learn modern innovations that could impact positively on their use of resource input. This could explain the low level of improved hybrid usage by the respondents.

Table 1: Socio-economic Characteristics of Respondents

Variable	Frequency	Percentages
Age in Years		
Less than 30	25	16.67
31 – 40	45	30.00
41 – 50	53	35.33
Above 50	27	18.00
Total	150	100.00
Sex		
Male	92	61.33
Female	58	38.67
Total	150	100
Educational status		
No formal	38	25.33
Primary education	67	44.67
Secondary education	30	20.00
Tertiary education	15	10.00
Total	150	100.00
Farming Experience (Years)		
1 – 5	14	9.33
6 – 10	20	13.33
11 – 15	54	36.00
16 – 20	43	28.67
Above 20	19	12.67
Total	150	100.00
Household Size (no of persons)		
1 – 5	48	32.00
6 – 10	76	50.67
Above 10	26	17.33
Total	150	100.00
Access to credit		
Access	32	21.33
No access	118	78.67
Total	150	100.00
Hybrid Variety use		
Hybrid culting	44	29.33
Local cuttings	100	70.67
Total	150	100.00
Extension Contact		
Contact	42	28.00
No contact	108	72.00
Total	150	100.00

Source: Field survey, 2016

The maximum-likelihood estimates for the parameters of the Cobb-Douglas stochastic frontier model for the cassava farmers are given in Table 2. The estimated coefficients of farm size and hired labour are positive and significant at 1% level. The implication is that these variables exert positive influence on the farmers output. The result also shows that the coefficient of family labour, fertilizer and herbicides had negative sign. The result showed that the average technical efficiency of the farmers is 0.73. This implies that these farmers could increase their efficiency by 27% through improved resource use.

Table 2: Maximum Likelihood Estimates Result of the Inefficiency Parameters of Cobb-Douglas Frontier Production Function.

Variables	Parameter	Coefficient	Standard Errors	T values
Stochastic Frontier				
Constant term	β_0	2.2062	0.7664	2.1356
Farm Size	β_1	0.5810	0.0876	6.0230**
Cassava cuttings	β_2	0.7336	0.0657	4.4215
Family labour	β_3	-0.8034	0.3122	-3.0342
Fertilizer	β_4	-0.3461	0.8793	-6.5741
Hired Labour	β_5	0.6652	0.4410	3.6857**
Capital Use	β_6	1.2034	0.9882	0.0784
Herbicides	β_7	-0.1042	0.0346	-3630
Inefficiency Factors				
Age	Z_1	-0.0473	0.0962	-2685
Sex	Z_2	0.3281	0.3643	0.1638
Education	Z_3	1.0425	0.6876	1.9382*
Experience	Z_4	-2.3464	0.0234	-3.8471
Household size	Z_5	-0.3145	0.6875	-4.0365
Credit Access	Z_6	0.0760	0.1038	7.0427**
Hybrid	Z_7	0.0865	0.0456	4.1384**
Extension	Z_8	0.0103	0.7158	0.0103
Mean TE	0.7315			

Note: Significant at 1% = **, Significant at 5% *

Again in Table 2, the estimated coefficient of the inefficiency variables indicated that education, credit access and hybrid cuttings were significant for the farmers. The coefficient of credit was positive and significant at 1% level. This implies that the farmer's access to credit will enhance their production through provision of the needed input as at when needed. It will also lead to increased productivity, increased scale and increased efficiency. The coefficient of education is positive and signification at 10% level indicating that education positively influenced the farmers' efficiency in resource utilization. This is in line with a-priori expectation that, literacy level of the farmer will positively influence his articulation and degree of adoption of modern production techniques.

The result of the technical efficiency analysis of the farmers as shown Table 3 indicated that about 3% has efficiency level of less than 0.50, about 13% had between 0.50-0.69, 32% has between 0.70-0.89 efficiency levels. However, the result further shows that many (52%) attained efficiency of between 0.90% to 1.00. The mean technical efficiency of 0.73 implies that the farmers are producing at about 73 percent of the potential frontier production levels with respect to their present resource base, method of production and the technology in use.

Table 3: Distribution of Resource use Efficiency of the Cassava Farmers

Efficiency level	Frequency	Percentages
0.01 – 0.39	2	1.33
0.40 – 0.49	3	2.00
0.50 – 0.59	7	4.67
0.60 – 0.69	12	8.00
0.70 – 0.79	21	14.00
0.80 – 0.89	27	18.00
0.90 – 1.00	78	52.00

Mean = 0.7315

Conclusion

This study analysed the efficiency of input utilization by cassava farmers in Anambra State. The results show that the farmers are operating below the Frontier. The farmers stand to expand their scope of production and improve productivity thereby reducing subsistence if resources are utilized efficiently.The study, based on the findings, recommend that Cassava farmers should be availed of production credit to help them expand their scope of operation, hence enjoy the benefit of economies of scale. The ministries of agriculture should provide the practitioners, through the various agricultural agencies, projects and programmes, hybrid planting materials as at when needed. The Agricultural Development Programme (ADPs) of the states should post extension agents to the hinter land to sensitize these farmers on modern production techniques. This will help to enhance their resource use efficiency that will culminate in increased productivity per farmer, reduced subsistency and poverty hence, improved living standard for the rural household.

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