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Efficiency and Profitability of Small-Scale Cassava Production in Akure Area of Ondo State, Nigeria

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ABSTRACT

The study assessed the productivity of small-scale cassava farmers in Ondo State, Nigeria. One hundred respondents were selected using a multi-stage sampling technique. Data were collected from the respondents and analysed using a combination of descriptive statistics and Stochastic Frontier Production Function model (SFPF). Maximum Likelihood Estimates of the Stochastic Frontier Production Function results showed that farm size, quantity of labour, quantity of agrochemicals and quantity of cassava stem cuttings were the major determinants of output of cassava farmers in the study area. In addition, level of education, farming experience, household size and age of farmers were the major determinants of efficiency of cassava farmers in the study area. The level of education and age were observed to have led to increase in technical efficiency of the farmers. The presence of technical inefficiency effects on the farmers studied, accounted for most output variations in cassava production. The estimated mean technical efficiency was 0.69. The results of simulation on changes in labour cost revealed that increase in labour cost brings about decrease in Gross Margin while decrease in labour cost brings about increase in Gross Margin. The level of profitability of cassava production was found to be high with a mean Gross Margin per hectare of ₦160, 762.04. Arising from the findings of the study, some recommendations were made for increased productive efficiency and income of cassava farmers in the study area.

Keyword: Cassava, Farmers, Efficiency, Profitability, Income, Determinants

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most important food crops in Tropical Africa. This is because of its efficient production of food energy and suitability for present farming and food systems in Africa (Olakulehin and Ajijola, 2005). Cassava is a leading source of food and income in the humid forest areas of West and Central Africa (Food and Agriculture Organisation, 2004). Cassava plays vital role in the food security of the rural economy because of its capacity to yield under marginal soil conditions and its tolerance to drought (Nweke *et al*., 2002). It is considered as the most widely cultivated crop in Nigeria and it is predominantly grown by smallholder farmers and depends on seasonal rainfall. As a staple, cassava has certain inherent characteristics which make it attractive especially to smallholder farmers in the country. First, the crop is capable of thriving on soils where other crops, most especially grains, failed (Nweke *et al.,* 1994). Secondly, cassava is regarded as a famine reserve crop which requires relatively low amounts of inputs (Enete *et al.,* 2005). Thirdly, the crop can withstand stress such as drought as it can stay in the ground for several months (Nweke *et al*., 1994). Fourthly, cassava is available all year round, thus providing household food security (Taiwo, 2006). Lastly, although cassava is cheap to cultivate, it can generate good income for peasant farmers.

The performance of small holding farms in Nigeria is observed to be unsatisfactory. The agricultural sector of Nigeria has failed to keep pace with the demand of households and industries for farm produce as food or raw materials (Nwaiwu *et al*., 2010). Despite the involvement of many rural farmers in agricultural production, several odds however still work against their efforts to produce abundant food for the nation and live a better life. A larger proportion of people all over the World are still underfed and malnourished, because appropriate solutions have not been found to the problem of inadequate food supply (Lupien and Menza, 2004). However, the saddening story is that poor performance of the country's agricultural sector most especially the food sub-sector had made the country dependent on food importation as a means of solving the country's food problem. Nigeria's food production could not match the food demand rate and this had led to the problem of food deficit currently experienced in the country which has constituted a major drain on the nation's foreign reserves (CBN, 2005). This study therefore seeks to assess the profitability and technical efficiency of cassava farmers in Ondo State, Nigeria.

METHODOLOGY

The study was conducted in Akure Area of Ondo State. The state is located in the southwest zone of Nigeria and is made up of 18 Local Government Areas (LGAs). The State lies between latitudes $5^{o}45'$ and $7^{o}52'$N and longitudes $4^{o}20'$ and $6^{o}5'$E. Its land area is about 15,500 square kilometres. Presently the state has a total population of about 3.4 million inhabitants (National Population Commission, 2006). Agriculture is the dominant occupation of the people of Ondo State providing income and employment opportunities for over 70% of the population.

Primary data were used for this study. The data were collected from the respondents with the aid of a structured questionnaire. The questionnaire was used to obtain data on a number of variables which include the socio-economic characteristics of the cassava farmers and their production operations. Multi-stage sampling technique was used for selecting the respondents used in this study. In the first stage, two LGAs in Ondo State were purposively selected as a result of preponderance in cassava production. From the list obtained from Agricultural Development Project, in each of the LGAs, five communities were randomly selected. From each community, ten cassava farmers were randomly selected to make a sample size of one hundred respondents used for the study. Data collected were analysed with the use of descriptive statistics, budgeting analysis and econometric analysis involving the use of stochastic frontier production function. Descriptive statistics was used to present the socio-economic characteristics of the respondents. Budgeting analysis was used for the estimation of profitability of cassava production in the study area. The stochastic frontier production function model was used to estimate farmers' technical efficiency.

Budgeting Analysis

The Gross Margin (GM) of an enterprise is the difference between the Total Value of Production (Total Revenue) and the Total Variable Cost (TVC) of production that is (eqn. 1):

$$GM = TR - TVC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$= \sum_{i=1} P_i Q_i - \sum_{j=1} C_j X_j$$

Where: subscript i refers to the i-th respondents while j represents observation of the j-th variable costs and

TR = Total value of cassava output /ha

TVC = Total Variable Cost / ha

P_i = Unit price of cassava produce from the i-th enterprise in (₦)

Q_i = Quantity of cassava produce in tonnes/ ha

C_j = Unit price of inputs used (₦)

X_j = Quantity of Variable inputs used in number

If GM > 0, then the farm enterprise is profitable

If GM < 0, then the farm enterprise is not profitable

The Net Revenue (NR) represents the difference between total revenue and total cost. The Net Revenue is given by (eqn 2):

$$NR = TR - (TVC + TFC) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where:

TFC = Total Fixed Cost (cost of implement such as cutlasses, hoes and spraying pump).

TC = Total Cost of production

TVC = Total Variable Cost

The Stochastic Frontier Production Function

The stochastic frontier production function model was estimated using the Maximum Likelihood Estimation (MLE) method. The model is implicitly specified as (eqn. 3):

$$TE = \frac{\ln Y_i}{\ln Y^*} = \frac{f(X_i, \beta_i)\exp(V_i - U_i)}{f(X_i, \beta_i)\exp(V_i)} = \exp(-U_i) \quad \ldots\ldots (3)$$

Where: TE is the Technical Efficiency, Yi is the observed output and Yi* is the frontier output. V_i = random error assumed to be independent of Ui, identical and normally distributed with zero mean and unknown variance. U_i's are non-negative random variables called technical inefficiency effects of production which are assumed to be independent of V_i, β_i's are vectors of unknown parameters to be estimated; and X_i is the vector of input quantities for ith farming household. The TE ranges between 0 and 1 i.e. $0 \leq TE \leq 1$.

Model Specification for Technical Efficiency

The production function analysis for cassava farmers was assumed to be specified by the Cobb- Douglas functional form as stated below (eqn. 4).

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + (V_i - U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where: subscript i refers to the observation of the i-th farmer and

Y_i = total output of cassava

X_1 = cost of labour in naira

X_2 = farm size (ha)

X_3 = cost of agro-chemicals in naira

X_4 = cost of cassava cuttings in naira

β_i = the parameters to be estimated

1n = natural logarithm

Technical Inefficiency Model

The inefficiency model estimated the influence of some farmers' socio-economic variables on the technical efficiency of the farmers. The model is specified by (5):

$$U_i = \partial_0 + \partial_1 Z_1 + \partial_2 Z_2 + \partial_3 Z_3 + \partial_4 Z_4 + \partial_5 Z_5 \ldots\ldots\ldots (5)$$

Where:
U_i = Technical inefficiency effects
Z_1= Years of formal education
Z_2 = Farming experience in years
Z_3 = Age of the farmers (years)
Z_4 = Household size (number)
∂i = Unknown scalar parameters to be estimated

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

The results of the summary of socio-economic characteristics showed that the average age of heads of households in the study area was 43 years. About 43% of the respondents were in the middle age group of 40-49 years, while the young farmers who were not more than 30 years accounted for 11.0% of the sample. This age group of most respondents was appropriate in providing the requisite strength required in farm operations. The ratio of male and female farmers involved in cassava farming is almost equal. Most of the farmers (71.0%) were married. The large proportion of married respondents may be as a result of the fact that early marriage is a common practice in the study area.

Table 1 shows that about 21.0% had secondary school education; about 31.0% had no formal education while 42.0% and 6.0% had primary education and tertiary education respectively. A huge proportion (69.0%) of the respondents had one form of western education or the other. This high level of literacy no doubt could affect the level of technology adoption and skill acquisition among the farmers since, education enhances technology adoption and the ability of farmers to plan and take risk. Farmers with higher levels of western education are likely to be more efficient in the use of inputs than their counterparts with little or no education. The average household size of the farmers in the area was 6 persons /household. Forty-one percent (41.0%) of farm households had 6-10 members, 50.0% had 1-5 members while only 9.0% had over ten household members. Thus, majority of the sampled farmers had large number of family members in the study area.

Table1: Distribution of Respondents according to Socio-economic Characteristics

Variables	Frequency	Percentage
Age		
<30	11	11.0
30-39	15	15.0
40-49	43	43.0
50-59	22	22.0
60-69	7	7.0
≥70	2	2.0
Total	100	100.0
Sex		
Male	52	52.0
Female	48	48.0
Total	100	100.0
Marital Status		
Single	8	8.0
Married	71	71.0
Widowed	15	15.0
Divorced	6	6.0
Total	100	100.0
Educational Status		
No Formal Education	31	31.0
Primary Education	42	42.0
Secondary Education	21	21.0
Tertiary Education	6	6.0
Total	100	100.0
Household Size		
1-5 members	50	50.0
6-10 members	41	41.0
Above 10 members	9	9.0
Total	**100**	**100.0**

Source: Field Survey, 2012

Distribution of Respondents by Yield

Distribution of respondents by yield as shown in Table 2 showed that few (13.0%) of the respondents had a yield of less than 5 tonnes/ha; 35.0% had between 6 to 10 tonnes/ha; while 52.0% had between 11 to 15 tonnes/ha. The results signified that majority (52.0%) of respondents had between 11 to 15 tonnes/ha in the study area. An estimated average yield of 12.09 tonnes/ha was obtained by cassava farmers in the study area. This is in conformity with the national average of 12 to 15 tonnes/ha.

Table 2: Distribution of Respondents by Yield

Farmers (tonnes/ha)	Frequency	Percentage
≤5	13	13.0
6-10	35	35.0
11-15	52	52.0
Total	100	100.0

Source: Field Survey, 2012. Average Farm Yield**:** 12.09 tonnes/ha

Profitability

Table 3 presents the Gross Margin (GM) result of cassava production in the study area. The Total revenue per hectare obtained was ₦213, 238.09. The Total Variable Cost per hectare incurred by the cassava producers in the study area was ₦52, 476.05 while the GM per hectare was ₦ 160,762.04. This finding indicated that cassava production is profitable in the study area. Also the Net Revenue (NR) per hectare obtained was ₦ 144,534.67 (Table 3).

Table 3: Net-Revenue for Cassava Production.

Variables (Item)	Mean (₦)
(TVC/ha)	52,476.05
(TFC/ha)	16,227.38
(TC/ha)	68,703.43
(TR/ha)	213,238.09
(GM/ha)	160,762.04
(NR/ha)	144,534.67

Source: Field Survey, 2012

Simulation of Changes in Labour Cost on Costs and Returns Structure

A simulation of 5% and 10% increases and decreases in labour cost was done. When the labour cost was increased by 5% and 10%, the total cost increased from 14,427.72 to 14,969.15 and from 14,427.72 to 15,510.58 respectively. When the labour cost was decreased by the same percentage 5% and 10%, the total cost decreased from 14,427.72 to 13,886.29 and from 14,427.72 to 13,344.87 respectively. When labour cost was increased by 5% to 10%, the Gross Margin reduces from 33,218.60 to 32,677.18 and when labour cost was reduced by 5% to 10%, the Gross Margin increases from 34,301.46 to 34,842.89. This showed that an increase in labour cost brings about a decrease in Gross Margin while a decrease in labour cost brings about an increase in Gross Margin.

Table 4: Simulation of Effects of Changes in Labour Cost on Costs and Returns Structure

Variables	+5%	+10%	-5%	-10%
Total Cost	14,969.15	15,510.58	13,886.29	13,344.87
Total Revenue	47,019	49,258	42,541	40,302
Gross Margin	33,218.60	32,677.18	34,301.46	34,842.89
Net Revenue	32,049.85	33,747.42	28,654.71	26,957.13
TR/naira invested	3.14	3.18	3.06	3.02
GM/naira invested	2.22	2.11	2.47	2.61
NR/naira invested	2.14	2.18	2.06	2.02

Source: Field Survey, 2012

Efficiency Analysis

Stochastic Frontier Estimates of Production Function Parameters

The maximum likelihood estimate of the stochastic frontier production function for cassava farmers in the study area is presented in Table 5. The variables such as farm size, quantity of agrochemicals, cost of labour and quantity of cassava cuttings were the significant (at least 5% level) determinants of output of the farmers. From the table, there was a positive relationship between the level of output of cassava and the cost of labour, quantity of agro-chemicals, quantity of cassava cuttings and farm size. These results agree with apriori expectation as the level of production depends largely on the quantities of these inputs used on the farm. However, this can only be up to a level that is considered optimal after which farmers will be operating at sub optimal level. By implication, output increased with an increase in their values.

Table 5: Maximum Likelihood Estimates of the Stochastic Frontier Production Function

Variables	Parameters	Coefficients	Std. Error
Constant	β_o	0.3732	0.0001
Farm Size	β_1	0.2830***	0.0005
Cost of Labour	β_2	0.0145***	0.0011
Quantity of Agrochemicals	β_3	0.0022***	0.0001
Quantity of Cassava Cuttings	β_4	0.0073**	0.0006

Source: Field Survey, 2012; ******* Significant at 1% level of significance; ** Significant at 5% level of significance
$\sigma^2 = 0.33$*. $\gamma = 0.57$. Log- likelihood function = - 27.69

Technical inefficiency Determinants

The estimated coefficients in the inefficiency model are presented in Table 6. It should be noted that the analysis of the inefficiency model shows that the signs and significance of the estimated coefficients in the inefficiency model have important policy implications on the technical efficiency of the farmers. A negative sign implies that the variable has the effect of increasing inefficiency. The results of the inefficiency model showed that all the included variables except household size and farming experience had the expected sign that corresponds to literature review. The coefficients of household size and farming experience were estimated to be positive, which suggested these variables enhanced technical inefficiency of the farmers. The results of the inefficient estimated function revealed that coefficients of age were negative, which implied that older farmers tend to be less technically inefficient in cassava production and corroborates the findings of Kareem *et al*; (2008).

From Table 6, the coefficient of years of education was negative, indicating that this variable led to an increase in technical efficiency of the farmers. Years of education will facilitate the adoption of innovation and technologies. It is expected that technical efficiency should increase as years of schooling of the farmers' increase (Ojo *et al*; 2009). Education which represents human capital of farmers is generally postulated to have a positive impact on efficiency of farmers (Moloi, 2008). This is because it provides consciousness and awareness which enables decision makers to understand the various decisions to be made on their farms (Okunlola, 2010). On the other hand, the coefficients of farming experience and household size are positive meaning that these factors decrease the efficiency of the cassava farmers in the study area. For the farming experience, it may be due to the fact that farmers tend to be more conservative as they age and had a negative or reserved attitude towards the adoption of innovations and technologies that may improve their productivity. This might also be as a result of the farmers being used to their old methods of farming and they may no longer be interested in adopting innovations that would better their farming system which would invariably lead to increased output. On the other hand, household size decreased the efficiency of the cassava farmers which could mean that the family members were not available on farm. This may be due to increased schooling of children.

Table 6: Technical Inefficiency Determinants

Variables	Parameters	Coefficients	Std. Error
Constant	∂_0	-1.9990	2.05420
Education	∂_1	-0.7058***	0.23059
Farming Experience	∂_2	0.1566***	0.03085
Household Size	∂_3	0.6948***	0.14825
Age	∂_4	-0.2744***	0.02590

Source: Field Survey, 2012; ***Significant at 1% level of significance

Technical Efficiency Distribution

Table 7 revealed that the average technical efficiency of 69.0% was recorded in the study area. This suggests that an average of about 69% of potential maximum output is gained due to production efficiency while the short fall (discrepancy between observed output and the frontier output) can be attributed to inefficiencies. About 5.0% of the cassava farmers had technical efficiency range of between 0.50 and 0.55; about 5.0% had technical efficiency range of between 0.56 and 0.60 and 20.0% had between 0.61 and 0.65. The table further shows that about 33.0% of the farmers had technical efficiency of more than 0.66. The mean efficiency was 0.69, indicating that cassava farmers were fairly efficient. Hence, in the nearest future, there is possibility of increasing cassava productivity by about 31.0% by adopting new technologies and improved management practices practised by the best farmers in the area. From this estimation, maximum technical efficiency is not yet achieved suggesting a need for more effort at improving efficiency of cassava farmers.

Table 7: Distribution of Technical Efficiency Estimates

Efficiency Level	Frequency	Percentage
0.50-0.55	5	5.0
0.56-0.60	5	5.0
0.61-0.65	20	20.0
0.65-0.70	33	33.0
>0.70	37	37.0
Total	100	100.0

Max = 0.79, Min = 0.50, Std Dev. = 0.0256

Analysis of Elasticity of Production and Returns to Scale

The input elasticities are presented in Table 8. The estimated elasticities of the explanatory variables of the stochastic model indicated that all the variables exhibited decreasing returns to scale. The RTS was 0.307, which showed that most of the farmers were in the stage II of the production process. In order to increase efficiency in this stage, the use of the inputs could be continued until the productivity of such input would reach its optimal level.

Table 8: Elasticity of Production (EP) and Returns to Scale (RTS)

Variables	Elasticities of Production
Farm Size	0.2830
Quantity of Labour	0.0145
Quantity of Agrochemicals	0.0022
Quantity of Cassava Cuttings	0.0073
Returns to Scale	**0.307**

Source: Field Survey, 2012

Problems of Cassava Farming in the Study Area

Table 9 showed that 41% reported rodent infestation as major problem in the production of cassava, 10% complained of transportation problem, which was as a result of bad road network, 15% indicated lack of adequate financial support from government to the farmers. Also, 21% were facing high cost of labour for cassava production. About 6% and 7% of the respondents reported termite infestation and poor accessibility to agrochemicals to be the limiting factors in the production area.

Table 9: Distribution of Respondents by Problems Experienced

Problems	Frequency	Percentage	Rank
Rodents Infestation	41	41.0	1st
Labour Shortage	21	21.0	2nd
Inadequate Funds	15	15.0	3rd
Transportation Problem	10	10.0	4th
Poor Accessibility to Agrochemical	7	7.0	5th
Termite Infestation	6	6.0	6th
Total	100	100.0	

Source: Field Survey, 2012; * Mulple responses exist

Conclusion and Recommendations

Cassava farmers in the study area have not attained their best in terms of production. This has been confirmed by the presence of technical inefficiency effects in their operations. The mean of technical efficiency was 69%, suggesting that opportunities still exist for increasing productivity and income of cassava farmers in the state by increasing the efficiency with which resources are used at the farm level. From this estimation, maximum technical efficiency is not yet achieved suggesting a need for more effort at improving efficiency of cassava farmers. Moreover, the net revenue recorded from the analysis revealed that the returns to cassava cultivation could still be considered to be high considering the vast investment of the cassava farmers. In summary cassava production was found to be profitable in the study area considering the fact that the farmers were able to cover their operating expenses and fixed cost respectively as shown by the magnitude of the Gross-Margin and Net-Revenue obtained. More emphasis should therefore be placed on the resource utilization to be able to sustain the producers of the crop.

Based on the findings of this study, the following recommendations are made. Local government councils should provide and improve the existing rural access roads to farms to ease evacuation of farm produce to the markets. Efforts should be made by the State Government as well as donor agencies or institutions to make cassava farming less labour intensive through introduction of cassava farm mechanization scheme. Farmers should be given access to Labour Saving Devices (LSD) to enable them increase their farm size. Farmers should be encouraged to go for adult education since the level of education increases their technical efficiencies.

REFERENCES

Bureau of African Affairs, (2010): Background Note: Nigeria. Retrieved from: http://www.state.gov/r/pa/ei/bgn/2836.htm, (Accessed on: 01 November, 2010).

Central Bank of Nigeria (2006): Statistical Bullion 2(4), 138.

Enete, A .A., F. I. Nweke and E. Tollens (2005): 'Hired Labour Use Decisions in Cassava Producing Households of Sub-Saharan Africa'. Agricultural Economics 33: 269-275.

FAO (2004): Online Statistical Database. Rome, Italy: Food and Agriculture Organization of the United Nations, Web Site www.fao.org.

FMARD (2006): 'National Programme for Food Security (NPFS) Expansion Phase Project 2006-2010 (Main Report). Nigeria'.

Kareem, R.O., Dipeolu, A.O., Aromolaran, A.B. & Akegbejo, S. (2008): Analysis of Technical, Allocative and Economic Efficiency of Different Pond Systems in Ogun state, Nigeria. African Journal of Agricultural Research, Vol.3 (4), pp.246-254

Moloi, M. (2008): A Comparison of Socioeconomic Characteristics that Determine the Farm Income of

Emerging Livestock and Horticultural Farmers in South Africa, MSc Thesis, University of Limpopo.

National Population Census (2006): National Population Commission, Akure, Ondo State, Nigeria.

Nweke F. I, D. S. Spencer and J. K. Lynam. (2002): 'Cassava transformation'. International Institute of Tropical Agriculture, P. 273

Nweke, F.I., A.G.O., R. Asiedu and S.A. Folayan (1994): 'Cassava varietal needs of farmers and potentials for production growth in sub-Saharan Africa COSCA, Working paper No.10.COSCA, IITA, Ibadan, Nigeria'.

Ojo, M. A., Mohammed, U.S., Ojo, A.O. and Olaleye, R.S. (2009), "Return to Scale and Determinants of Farm International, 22: 29-42.

Level Technical inefficiency among Small Scale Yam Based Farmers in Niger State, Nigeria: Implication for Food Security", *International Journal of Agricultural Economics andRural Development*, Vol. 2 No.1, pp. 43 –51.

Okunlola, J.O. (2010). Factors Influencing Adoption of Rubber Based Technologies Among Small Holder Farmers in Delta State. Nigeria.Journal: Food, Agricultureand Environment 8: 391-394.

Olakulehin J.O, F.S. Ajijola (2005): Cassava production: Nigerians best kept secret Lagos farmers 1, 1-4.

Taiwo, K.A. (2006): 'Utilization potentials of cassava in Nigeria: the Domestic and Industrial Products'. Food Review