Direct Research Journal of Agriculture and Food Science
Vol. 9, Pp. 282-289, 2021
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS45968737
Article Number: DRJAFS45968737
Copyright © 2021
Author(s) retain the copyright of this article
https://directresearchpublisher.org/drjafs/

Full Length Research Paper

An analysis of the efficiency of cassava production in Imo State South-East, Nigeria (a stochastic frontier approach)

***Nwosu, F. O., and Gbolagun, A. O.**

Department of Agricultural Economics, Federal University of Technology, Owerri, Imo State, Nigeria.
*Corresponding author email: fidelis.nwosu@futo.edu.ng

Received 3 July 2021; Accepted 18 August 2021; Published 23 August 2021

ABSTRACT: The study analyzed the efficiency of cassava farmers in Imo State, Nigeria. It analyzed the profitability and allocative efficiencies of cassava farmers in Imo state. Sixty (60) cassava farmers were selected through multistage sampling technique and administered with validated questionnaire. Data obtained were analyzed using descriptive statistics such as mean, frequency distribution and percentages. Stochastic cost and production frontier were used to estimate allocative efficiency and its determinants. The Profitability index of 53.1% showed that the venture is profitable. The result of technical and cost efficiencies revealed that the farmers operate in stage three of the classical production function and thus increased use of land, labour, fertilizer and farm implement should be discouraged since the factors are either misallocated or over utilized leading to increased cost inefficiency. The estimate of the sources of allocative efficiency revealed that age, farm size, level of education, farming experience, extension contact, credit access, co-operative society membership, household size, gender are all important factors dictating the allocative efficiency. The study concludes that most farmland in the area are not fertile due to intensive cultivation over time hence other factors such as labour hired, fertilizer and farm implements are ineffective in increasing yield to justify their additional utilization. Unavailability of fertile land, inadequate supply of subsidized inputs, unavailable infrastructure facilities, insufficient finance, high cost of labour are major problems limiting efficient production of the crop. The study recommended that cassava farmers should be encouraged to join cooperative societies and pool their resources together for large scale farming in order to ensure allocatively efficient farming.

Keywords: Cassava, production frontier, multi-stage sampling, profitability, allocative efficiency

INTRODUCTION

Over the years, the difficulties faced by many developing countries in satisfying their populations' food requirements with domestic food production have increased (FAO, 2010). Even with sustained efforts, it has not always been possible to meet the growing food demand by raising the domestic production of staple food crops especially in developing countries. As a result, food insecurity has persisted in developing countries, particularly among the low-income groups. Roots and tubers belong to the class of food that basically provides energy in human diet in the form of carbohydrates. Roots and tubers refer to any growing plants that store edible materials in subterranean root, corm or tuber (Oke, 1990). Interestingly, cassava is a member of this important class of food. As a food crop, the place of cassava in the diet of the people in West Africa and in Nigeria in particular cannot be overemphasized. Babaleye (2003) observed that root and tuber crops contribute more than 200 dietary calories per capita daily for more than 150 million people in West Africa while serving as an important source of income to the people.

Cassava is a widely grown crop in most countries in the tropical regions of Africa, Latin America and Asia; and ranks as one of the main crops in the tropical countries

(Coelli, 1996). It is widely cultivated in Nigeria where it plays vital role in the food security of the rural economy because of its capacity to yield under marginal soil conditions and its tolerance of drought (FAO, 2010). The crop is a major source of calories for two out of every five Nigerians (IITA, 2009). In Nigeria, food production has continued to dwindle while food demand continues to increase exponentially due to high population growth, leading to high food import bills. The annual rate of population in Nigeria has been as high as 2.9% (Amaza and Maurice, 2005). The persistent gap between food production rate and food demand has continued to widen irrespective of the various programmes of various tiers of government to increase food production and at the same time reduce hunger and poverty.

Nigeria is being enlisted as one of the most food insecure countries (Babaleye, 2003). It is believed that cassava demand outweighs the supply as evidenced by the high prices of the various cassava food products in the country. The low productivity of the crop is attributed to the fact that it is mainly cultivated by small scale, resource poor farmers who can hardly afford farm inputs. It is also suggested that the inefficiency of farmers in the use of various farm resources and farm inputs led to unprofitable production. This therefore made it necessary for empirical measures of efficiency to determine the profit that could be obtained by improving performance in cassava production with a given technology. Farming in general has to use available inputs as efficiently as possible to achieve optimum production. Food production, availability, and security can all be jeopardized and hampered by inefficient resource use and utilization (Udoh and Akintola, 2001; Udoh and Etim, 2010). The inefficiency problem is attributed to factors such as use of low input technologies, poor farm management skills, poor extension services, unavailability and high cost of inputs. Hence, this study was designed to examine the production efficiencies of cassava production given available resources in Imo state. This is aimed at recommending resource-use mix strategies to maximize productivity, profitability and efficiency of the farmers in the state.

METHODOLOGY

The study was conducted in Imo State, South-East Nigeria. The State lies between latitude 5^{o} 10’ and 6^{o} 35’ North of the equator and longitude 6^{o} 35’ and 7^{o} 31’ East of the Greenwish Meridian. It is in the tropical rainforest zone. Imo State is composed of twenty seven local government areas which are zoned into three agricultural zones of Owerri, Orlu and Okigwe. Two distinct seasons are clearly identified: the wet and the dry seasons. The temperature of the study area varies with season. The hottest period occurs between the months of February and May, with temperatures varying between 27ºC to 35ºC. Temperatures are generally below 20^{o}C between the months of December and January during the Harmattan period. The soil type of the area is sandy-loam which favours mostly the cultivation of root crops such as yam, cassava, cocoyam and cereals like guinea corn, millet, etc. This study employed multistage random sampling technique. In the first stage, two LGAs were purposively chosen from each of the zones based on the facts that these local government areas engaged more in cassava production. LGAs include Ohaji/Egbema and Ngor-Okpalla (Owerri Zone), Obowo and Isiala Mbano (Okigwe Zone); and Nwangele and Orsu (Orlu Zone). In the second stage, two communities were randomly selected from each LGA making a total of 12 communities. The lists of communities were collected from the office of the community Development Officer in each selected LGA. The last stage was a random selection of 5 cassava farmers each from the 12 communities, giving a sample size of 60 cassava farmers selected for the study. Data used for this study were obtained from the primary data. Primary data were collected through a structured questionnaire. Data were collected on the socioeconomic characteristics of the farmers and their production activities in terms of inputs, output and their prices. Also, secondary information were obtained from the textbooks, journals, internets, publications, past project works and materials that are relevant to the study. The data collected were analyzed using descriptive statistical tools such as means, frequencies, and percentages. Also, Profitability and Stochastic frontier models were also employed in the analysis of the collected data.

Model specification

Profitability analysis

$$GM=TR-TVC \quad (1)$$
$$NR=TR-TC \quad (2)$$

TR = Revenue accrued from the sales of their farm produce
TC = Total cost expended in the farming activities which could be expanded to be equal to Total variable Cost (TVC) and Total Fixed Cost (TFC)

$$TVC=\sum a_1+a_2+a_3+a_4+a_5+a_6 \quad (3)$$

Where a_1= cost of land preparation
a_2= cost of planting materials in naira
a_3 = cost of weeding in naira
a_4 = cost of fertilizer usage plus application in naira

a_5 = cost of harvesting
a_6 = cost of transporting farm produce to the markets
TFC is the cost of farm land purchased or hired and depreciation cost of farm tools such as cutlass, hoes, wheelbarrow e.t.c.

Stochastic Production and Cost Frontier Functions

Technical efficiency

This was measured using Stocahastic (Cobb Douglas) Production frontier function for cassava production. The functional form is implicitly specified as follows;

$$\text{Ln } Yi = bo + b_1LnX_1 + b_2LnX_2 + b_3LnX_3 + b_4LnX_4 + b_5LnX_5 + Vi - Ui \quad 4$$

where Yi is output in kg, X_1 is farm size in hectares, X_2 is quantity of seeds in kg, X_3 is labour input in man-day's, X_4 is fertilizer input in kg, X_5 is capital (depreciation on implements) in Naira, $b_1 - b_5$ are parameters to be estimated, bo is intercept, V_i is error term not under the control of farmers while U_i is error term under the control of farmers.

Economic efficiency

Economic efficiency was measured using stochastic (Cobb Douglas) cost frontier function specified explicit as;

$$\text{Ln } Ci = bo + b_1Lnq_1 + b_2Lnq_2 + b_3Lnq_3 + b_4Lnq_4 + b_5Lnq_5 + Vi - Ui \quad (5)$$

where C is total input costs of the ith farm, q_1 is land rent in naira per hectare, q_2 is price of seeds in naira per kg, q_3 is average wage rate in naira per man-day, q_4 is price of fertilizer in naira per kg, q_5 is depreciation on implements in naira, bo is intercept, $a_1 - a_6$ are parameters to be estimated, while V_i and U_i are as defined for equation (4). Estimation of Allocative Efficiency and its Determinants Following Ohajianya *et al.* (2010), Allocative Efficiency (AE) for each farmer was calculated as the ratio of estimated Economic Efficiency (EE) to estimated Technical Efficiency (TE) from equations 4 and 5,

$$EE=AE*TE \quad (6)$$

Therefore,

$$AE=EE/TE \quad (7)$$

The multiple regression analysis was used to isolates the determinants of the allocative efficiency. The allocative efficiency scores from equation (7) were regressed against the farm specific factors to obtain the determinants for allocative efficiency following Udoh and Etim (2010) and Ohajianya *et al.* (2010)

$$\text{Exp } (-Ui) = Ko + K_1 Z_1 + K_2 Z_2 + K_3 Z_3 + K_4 Z_4 + K_5 Z_5 + K_6 Z_6 + K_7 Z_7 + K_8 Z_8 + K_9 Z_9 + Ei \quad (8)$$

where, Exp ($-U_i$) is the allocative efficiency of the farmer, Z_1 is the age (years), Z_2 is farm size (hectares), Z_3 is level of education (No. of years spent in school), Z_4 is farming experience (years), Z_5 is extension contact (No. of visits), Z_6 is credit access (dummy, 1 if the farmer has access to credit, zero if otherwise), Z_7 is co-operative society membership (dummy, 1 if the farmer belongs to a co-operation society or farmers' association, zero if otherwise), Z_8 is household size (No. of persons), Z_9 is gender (dummy, 1 for male, zero for female), E_i is error term, Ko is intercept while Ko - K9 are regression parameters to be estimated. The a priori expectation is that K_2, K_3, K_4, K_5, K_6, K_7, K_9 be positive, while K_1, K_8 and K_0 are negative. The estimate was done using the method of maximum likelihood using the computer program, frontier 4.1 (Coelli, 1996).

RESULTS AND DISCUSSION

Socio – economic characteristics of cassava farmers

The Socio-economic characteristics are presented in (Table 1). From the table, 33.3% of cassava farmers are between the ages of 40 years and 49 years, 10% are in the age range of 70 years and 79 years. The mean ages in the study area are 49.3 years. This indicates that the study area is dominated by middle aged people who are energetic and innovative to carry out the enterprise profitably. It follows that apart from increase in labour supply, respondents within the productive age bracket are likely to adopt innovation more than the aged farmers (Okoye *et al.,* 2007). The socio-economic data in (Table 1) shows that the study area is dominated by female as 81.7%. This can be attributed to the belief in Ibo land of which the study area is one of the states that Cassava farming is a feminine occupation. 60% of the respondent had secondary education. This means that farmers in Crop productions are fairly educated in the area. The level of education attained by a farmer not only increases his farm productivity but also enhances his ability to understand, adopt and evaluate new production technologies. About 26.7% of them have between 4 - 6 persons in their household. The mean household size was 6 persons for cassava farmers. This implies that most of the households would save labour costs by

Table 1: Socio-economic characteristics of Cassava Farmers in Imo state

Socio – economic characteristics	Frequency	Percentage	Mean	St.dev
Age				
30 – 39	14	23.3	49.3ye	12.8years
40 – 49	20	33.3		
50 – 59	13	21.7		
60 – 69	6	10.0		
70 - 79	7	11.7		
Total	**60**	**100.0**		
Sex				
Male	11	18.3		
Female	49	81.7		
Total	**60**	**100.0**		
Marital Status				
Single	8	13.3		
Married	50	83.3		
Divorced	2	3.4		
Total	**60**	**100.0**		
Level of Education				
No formal education	9	15.0		
Primary education	10	10.0		
Secondary education	36	60.0		
Tertiary education	5	8.3		
Total	**60**	**100.0**		
Household size				
1 - 3	20	33.3	6persons	2persons
4 - 6	16	26.7		
7 - 9	15	25.0		
10 – 12	9	15.0		
Total	**60**	**100.0**		
Years of Experience				
3 - 12	11	18.3	23.28years	12.28years
13 - 22	23	38.3		
23 –32	15	25.0		
33 - 42	4	6.7		
43 – 52	7	11.7		
Total	**60**	**100.0**		
Membership of Cooperative Organization				
Yes	35	58.3		
No	25	41.7		
Total	**60**	**100.0**		
Asses to Credit				
No	40	66.7		
Yes	20	33.3		
Total	**60**	**100.0**		
Farm size				
0.1 – 0.5	11	18.3	2.48ha	0.84ha
0.6 – 1.0	23	38.3		
1.1 – 1.5	26	26.7		
1.6 – 2.0	10	16.7		
Total	**60**		**100.0**	

Source: field survey data, 2019

employing household labour. The mean years of experience were 23 years. This indicated that many people had been engaging in cassava farming. Experience in farming is a key factor affecting production. About 58.3% of them were members of cooperative organization; this is a measure of social capital which would encourage them to pool resources such as finance, labour and other essential facilities together for sharing among themselves. It would also improve their productivity and training essential to operate profitably in the venture. 33.3% have accessed credit in form of external finance and loan from friends, cooperative society and banks while 66.7% are unable to assess credit. The scale of production is largely influenced by the availability of finance to purchase essential inputs and improve the efficient use of land resources. 38.3% have between 0.6ha and 1.0ha of farm land, the mean farm size was 2.48ha. Low farm size is an indication that

Table 2: Profitability analysis of cassava production in Imo State

Variable Cost	₦/plot	% of TC
Cassava cuttings	3,060.81	4.94
Transportation	6,104.01	9.87
Agrochemical used	3,309.98	5.35
Cost of Labour hired	5,744.06	9.28
Land clearing/preparation	5,000.67	8.08
Total Variable Cost (TVC)	23,219.53	37.51
Fixed Cost		
Land Hired	34,699.37	56.06
Depreciation cost on fixed assets	3,980.30	6.43
Total Fixed Cost (TFC)	38,679.67	62.49
Total Cost (TC): TVC + TFC	61,899.20	100.00
Total Revenue (TR)		
Value of sell	131,986.50	
Gross Margin (GM): TR – TVC	108,767.00	
Net Margin (NM): TR – TC	70,087.31	
Profitability index: (NM/TR) ×100%	53.10	
Prod. Eff.: (NM/TC) ×100%	1.13	
Mean Farm size cultivated (plot)	2.48	

Source: field survey, data, 2019.

Table 3: Parameter estimates for Stochastic Production Function.

Parameters	Coefficient	Std. Error	t-ratio
Constant	1180.578	0.950	1243.303***
Farm size	3.404	0.779	4.370***
Labour	0.145	0.069	2.101**
Seed	9.203	0.864	10.652***
Fertilizer	-2.154	0.791	-2.723***
Depreciation cost	-0.846	0.424	-1.995**
(σ^2)	0.825	0.133	6.225***
γ	0.658	0.009	73.111***
LR Test	7.656		39.020

Source: Computed from frontier 4.1 MLE/Survey, data, 2019.

farmers in both enterprise operate in small scaled level, this could be because of the limited availability of farm land due to land fragmentation (Mbam and Edeh, 2011).

Profitability analysis of cassava production

The profitability analysis of cassava production in the study area is presented in (Table 2). The table revealed that acquisition cost (of cassava stems) was 4.95% of the total cost, 9.28% of the total cost was incurred as cost of hired labour. 6.43% of the total costs were gulped as the depreciation value of fixed assets such as cutlass, hoes, watering cans, wheel barrow e.t.c. The cost of land hired accounted for 56.06% of total cost of both enterprises respectively. The total cost was ₦61, 899.20 out of which total variable cost accounted for 37.51%. The gross margins of the ventures were ₦108, 767.00 and a net margin was ₦70, 087.31. The Profitability index of 54.7% showed that cassava production is a very profitable, and production efficiency of 1.13 showed that for every ₦1 expended as cost in the each business, cassava farming would return 13k as profit.

Estimation of production function in cassava production

Table 3 revealed that the coefficient of total variance (σ^2) is 0.825; the variance ratio (σ^2), which is the ratio of the variance of farm specific technical efficiency to the total variance. Total variance estimates goodness of fit and the correctness of the specified distributional assumption of the composite error term; the estimate of the variance parameter (σ^2) was significantly different from zero indicating a good fit and the correctness of the distributional assumption specified. The variance ratio (γ) in yam and cassava farms which were significantly different from zero showed that the farm specific variability contributed about 65.8% variation in yield among the cassava farmers, which implies that about 65.8% cassava farmers respectively were the differences between the observed and maximum production frontier outputs and were due to differences in farmer's levels of technical inefficiency and not related to random variability. These technical inefficiencies are factors are under the control of the farmers and the influence of which can be reduced to enhance technical efficiency of

Table 4: Estimation of Cost function of cassava farmers in Imo state;

Parameters	Coefficient	Std. Error	t-ratio
Constant	-1.303	0.233	-5.589***
Farm size	-0.696	0.157	-4.433***
Labour	-0.090	0.048	1.868*
Seed	1.253	0.199	6.313***
Fertilizer	-0.254	0.089	-2.854***
Dep Cost	0.102	0.047	2.165**
(σ^2)	0.800	0.410	3.200***
γ	0.514	0.120	4.283***
LR Test =	-9.281		98.866

Source: Computed from frontier 4.1 MLE/Survey, data, 2017.

cassava producers. The stochastic production estimates revealed the signs of the coefficients of farm size (4.370), labour (2.101) and seed (10.652) were positive while fertilizer (-2.723) and depreciation on farm implements (-1.995) were negative and all are significant at 5%. This implies that a unit increase in farm size, labour and quantity of seed would increase the cassava output by 4.4%, 2.1% and 10.7% respectively while a unit increase in fertilizer and depreciation on farm implements would reduce the cassava technical efficiency by 2.7% and 2.0% respectively. But a unit increase in fertilizer and depreciation on farm implements would reduce the cassava farms' technical efficiency by 2.7% and 2.0% respectively.

Estimation of cost functions in cassava production

The result of the analysis is presented in (Table 4). The maximum likelihood estimates of the cost frontier for cassava productions in Imo State shows that their variance ratio (γ) is 0.514 respectively and total variances (σ^2) is 0.800 respectively and all statistically significant at 1% level (Table 4). Total variance estimates goodness of fit and the correctness of the specified distributional assumption of the composite error term. The cost variance error of 51.4% of disturbance in the systems is due to cost inefficiencies in respective farmers, since total cost (the dependent variable) is in natural logarithm and has been normalized, the first order coefficients are interpretable as cost elasticities evaluated at the sample median. For cassava cost efficiency estimates; only seed price (1.253) and cost of farm implements (0.102) are positive while labour (-0.090), land rent (-0.696) and fertilizer (-0.254) have negative signs; It means an increase in seed and farm implement by 1% would increase cost efficiency by 1.253% and 0.102% respectively while such 1% increase in land, labour and fertilizer would increase cost inefficiency by 0.090%, 0.696% and 0.254% respectively. This is in consonance with Udoh and Akinola (2001) and Ohajianya *et al.* (2010) that farmland is over utilized due to land fragmentation problems that are predominant in the study area.

Estimates of allocative efficiencies in cassava production

The result of the frequency distribution of allocative efficiency estimates is presented in (Table 5). It shows that the allocative efficiency estimates for cassava farmers ranges from 0.16 to 0.78 and this shows that the. Cassava farmers had a minimum allocative efficiency of 0.16, indicating high levels of inefficiency in resource allocation, while the maximum allocative efficiency score was 0.78, indicating that the most efficient farmer operated almost on the frontier. The mean efficiency score for cassava farmers is 0.51; 51.0% of cassava farmers are frontier farmers because their efficiency scores are higher than the mean; the average cassava farmer requires a cost savings of 34.62 % (1 – 0.51/0.78)*100 to achieve the status of the most allocatively efficient farmer.

Farmer's age showed a positive relationship with allocative efficiency. This result disagrees with that of Ajibefun (2003) which implied that increasing age would lead to increase in allocative efficiency since aged farmers have enough farm experience and could efficiently allocate their resources in the farm. Gender is positive and significant to the allocative efficiency; this implies that male farmers have higher allocative efficiency than their female counterparts. Education shows a positive but significant relationship with allocative efficiency. This result agrees with Amaza and Olayemi (2000) whose results showed education and allocative efficiency to be positively related. Farming experience had a positive coefficient, implying that farmers that had acquired more experience in farming would increases in their allocative efficiency level. This is in line with those of Ohajianya *et al.* (2010). Co-operative membership had a positive coefficient, implying that farmers that belong to co-operative societies/farmers association have higher levels of allocative efficiency. Farm size had a positive coefficient which implies that smaller farm sizes lead to decrease in level of allocative efficiency. Credit access had a positive coefficient, suggesting that farmers that had poor access to credit have lower levels of allocative efficiency.

Table 5: Distribution of allocative efficiency of cassava farmers.

Allocative Efficiency Range	Frequency	Percentage
0.10 - 0.20	1	1.7
0.21 - 0.30	9	15.0
0.31 - 0.40	8	13.3
0.41 - 0.50	11	18.3
0.51 - 0.60	9	15.0
0.61 - 0.70	11	18.3
0.71 - 0.80	11	18.3
Total	60	100.0
Maximum Allocative Efficiency		0.78
Minimum Allocative Efficiency		0.16
Mean Allocative Efficiency		0.51

Source: field survey data, 2019.

Table 6: Parameter Estimates for Allocative Efficient Function of the Cassava Farmers.

Parameters	Coefficient	Std. Error	t-ratio
Constant	-0.007	0.689	-0.009
Age	0.104	0.018	5.778***
Gender	0.407	0.188	2.165**
Education	0.335	0.090	3.722***
Farm Exp	0.102	0.017	6.000***
Coop Memb.	0.951	0.344	2.765***
Farm size	0.116	0.068	1.705*
Household size	0.115	0.057	2.018**
Credit Assess	0.348	0.058	6.000***
Ext. contact	0.176	0.021	8.381***

Source: Computed from frontier 4.1 MLE/Survey, data, 2019.

Extension contact has a positive coefficient and statistically significant at 5% risk level. This result is in consonance with Amaza and Olayemi (2000). Household size is found to be positive and significant. This suggests that larger households may utilize family labour which helps in reducing labour cost and creates formidable basis for improved allocative efficiency. However, this result disagrees with the findings of Ohajianya et al. (2006) which showed household size and allocative efficiency to be negative and significantly related.

Conclusion

The results of the study revealed that increas in farm size, labour and quantity of seed would increase technical efficiency but increase in fertilizer and depreciation on farm implements would reduce the cassava technical efficiency, cost efficiency estimates indicated that seed price and cost of farm implements are positive while labour, land rent and fertilizer have negative signs; It means increase in seed and farm implement, increases cost efficiency such increase in land, labour and fertilizer would increase cost inefficiency. It showed that cassava farmers operate in stage three of the classical production function and thus increased procurement of land, labour demand and fertilizer and farm implement should be discouraged since the factors are either misallocated or over utilized leading to increased cost inefficiency. This indicated that most farmland in the area are infertile due to extensive cultivation of a particular piece of land over time hence other factors such as labour hired, fertilizer and farm implements are ineffective to produce increase yield to justify their additional utilization on already infertile, unproductive and over cultivated farmland.

Recommendation

The study recommended that farmers should be encouraged to join cooperative society and pool their farmland together for large scale farming in order to ensure allocative efficient farming. Improved soil management techniques such as crop rotation, shifting cultivation and good cultural practices should be adopted and intensified rather than excessive fertilizer application which could lead to soil toxicity and poor crop yield, young, educated male individuals should be encouraged to participate in both enterprises to stem the rate of emigration from the villages as it is found that they are more efficient in farming activities, extension agents should intensify their visits to the farmers in the area to improve their farming techniques and innovative systems.

REFERENCES

Ajibefun IA (2003). Determinants of technical efficiency in traditional agricultural production application of stochastic frontier modelling to food crop farmers in South-Western Nigeria. *African Journal of Economic Policy*; 10 (2): 1 - 9.

Amaza, PS, Maurice DC (2005). "Identification of factors that influence technical efficiency in rice based production systems in Nigeria". Paper presented at workshop on policies and strategies for promoting rice production and food security in Sub-Saharan Africa in Cotonou, Benin.

Amaza PS, Olayemi JK (2000). An investigation of production efficiency in food crop enterprises in Gombe State, Nigeria. *Journal of Rural Economics and Development* 13 (2):, 111-121.

Babaleye T (2003). West Africa: Improving yam production Technology", ANB- BIA supplement Issue/ Edition Nr. 463.

Coelli, TJ (1996). A guide to FRONTIER version 4.1: "A computer programme from stochastic frontier production function estimation" CEPA Working paper (1996) 96/07, Department of Econometrics, University of New England Armidale, Australia.

FAO (2010). (Food and Agriculture Organization) 2007. F.A. FAO STAT. Statistics Division of Food and Agriculture Organization www. Faostat.org.

IITA (International Institute for Tropical Agriculture) (2009) http.//www.iita.org.

Mbam BN, Edeh HO (2011). "Determinants Of Farm Productivity Among Smallholder Rice Farmers In Anambra State, Nigeria." *Journal of Animal and Plant Sciences* 9(3): 1187–1191.

Ohajianya DO, Echetama JA, Offodile PO, Osuagwu CO, Henri-ukoha A, Okereke –Ejiogu N, Anyaoha NO (2010). Allocative Efficiency Among Maize Farmers In Imo State, Nigeria http://www.sciencepub.net/report; 2(12).

Oke OL (1990). Roots, Tubers, Plantains and Bananas in human nutrition, FAO food and nutrition series No. 24.

Okoye, B. C., C. E. Onyenweaku CE, O. O. Ukoha OO, G. N. Asumugha GN, and O. C. Aniedu OC. (2008). "Determinants of Labour Productivity on Small-Holder Cocoyam Farms in Anambra State, Nigeria." *Scientific Research and Essay* 3(11): 559–561.

Udoh EJ, Akintola JO (2001). Measurement of the Technical Efficiency of Crop Farms in the South Eastern region of Nigeria. *Niger. J. Econ. Soc. Stud* 43(1): 93 – 104.

Udoh EJ, Etim, NA (2010). Measuring Farm Level Efficiency of Peri-Urban Poultry egg Producers in Akwa Ibom State, Nigeria in Proceedings of 35th Annual Conference of Nigerian Society for Animal Production held in University of Ibadan 14 – 17 March, 2010.