Analysis of allocative efficiency of plantain Farmers in Southwest Nigeria

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Abstract: Plantain is an important starchy fruit crop grown in all humid tropical zones of Africa, Asia, Central and North America. The study determined the allocative efficiency of plantain growers in Southwest Nigeria. Also the factors influencing the allocative efficiency of the farmers were determined. Structured questionnaire was used to retrieve information from 120 plantain growers. Descriptive statistics and stochastic frontier cost function were used to analyse the data collected. The diagnostics statistics revealed that the variance parameters for the stochastic frontier cost function were significant statistically at 1 percent level of significance. The estimated value of variance ratio represented by gamma (γ) was 0.927. This indicates that about 93 percent variations in the cost of production among the plantain growers were due to cost inefficiencies while the value of sigma squared (σ^2) 6.761 indicates good fit and correctness of the distributional form assumed for the composite error term in the model. The exogenous variables included in the efficiency model were positively related to the cost of plantain production. The main determinants of allocative efficiency were age of the farmer, farming experience, access to credit, access to extension services and the educational level. The mean allocative efficiency of the plantain farmers was 0.72 while the maximum and minimum were 0.94 and 0.40 respectively. The farmers were fairly efficient in allocating the available factors of production. It is recommended that the governments and non-governmental organizations should improve upon the extension services available to the plantain growers.
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Introduction

It is widely held that inefficiency plagues the agricultural sector of less developed countries. Efficiency in agricultural production may be regarded as ability, of a farmer, to produce a given level of output at the lowest cost. Adebayo (2006) opined that efficiency analysis is associated with the possibility of firms/farms producing a given level of output from the available resources or certain level of output at least cost. Maximum efficiency is said to be attained when it becomes impossible to reshuffle resource combination without decreasing the total output. Over the years in agriculture, researchers have distinguished between types of efficiency. These are technical, allocative and economic efficiency. In order to promote commercialization in agriculture, there is need to encourage farmers to be allocatively and technically efficient. Allocative efficiency is a measure of how farm uses inputs optimally in the right combination to maximize profits (Latifat, Ogbaji and Ocholi, 2013).

According to Rahman, Mia and Bhuiyan, (2012), for the farm to realize allocative efficiency, answers must be provided to the following questions; what is the best combination of factors of production so that output is produced at minimal cost? How much profit could be increased by just reallocating resources? Therefore, the farm has to select a combination of factors of production to be used in right proportions and technically efficient at low prices so that output is produced at minimal costs. Lau and Yotopoulos (1989) believed that a farm is said to be allocatively efficient if is able to maximizes profit by equating marginal product of every variable input to its corresponding opportunity cost. Russell and Young (1983) considered allocative efficiency as a condition that exists when available inputs are allocated within the farm according to market prices.

The purpose of this study was to explore the allocative efficiency of the plantain growers. Plantain, generally known as cooking banana, is one of the important food crops that can be grown along the Coast of West and Central Africa stretching from Guinea to the Democratic Republic of Congo and Central Africa Republic. According to Swennen (1990), it provides more than 25 percent of the carbohydrate and 10 percent of the calorie for approximately 70 million people in sub-Sahara Africa. Musa paradisica is a perennial plant that can be as tall as 9 meters. Plantain is believed to originate in Southeast Asia, having been cultivated by farmers in south India by 500 BC. From this region it was distributed to Africa through Madagascar. Nigeria is regarded as one of the largest plantain producing

nations in the world but it produces more for local consumption than for export. Over the years the demand for this crop has increased and in order to increase its production there is need to look at the allocative efficiency of its growers. This study determined the allocative efficiency of the plantain growers in the study area. The factors influencing the farmers' allocative efficiency were also determined.

Method and materials

Study area

The research took place in Southwest Nigeria. Southwest Zone is made up of six States. They are, Ekiti, Lagos, Ondo, Ogun, Oyo and Osun States. The Zone falls on latitude 6^0 to the North and 4^0 to the South. It is marked by longitude 6^0 to the East and 4^0 to the West with a total population of 27,511,892 people. Southwest Zone covers about 114,271Km^2. The Zone is bounded in the East by Edo and Delta States, in the North by Kwara and Kogi States, in the West by Republic of Benin and in the South by the Gulf of Guinea. The climate of the study area is tropical in nature and is characterized by wet and dry seasons. The wet season last from April to October while the dry season last from November to March. Its temperature ranges between 33^0C and 38^0C while its annual rainfall is between 1500mm and 3000mm. The official language in the Zone is English while the native language is Yoruba. The majority of the people in this Zone are engaged in agricultural activities while some are civil servants, artisans and traders. Some of the crops grown in this area include, rice, maize, beans, cassava, cocoa, kolanut, banana, plantain, etc.

Sampling technique

A multi-stage sampling technique was adopted to select 120 respondents. At the first stage, four States where plantain is well cultivated were purposively selected. These are, Oyo, Osun Ondo and Ekiti State. Also three Local Government Area (LGAs) were purposively selected from each LGA while 10 plantain farmers from each LGA were selected using snowball method of sampling. A structured questionnaire was used to collect primary data from the selected plantain farmers.

Data analysis

Descriptive statistics such as frequency, percentage and mean were used in conjunction with stochastic frontier cost function to analyse the data collected from the respondents. Descriptive statistics were used to describe the respondents' allocative efficiency while the stochastic frontier cost function was used to determine the farmers' allocative efficiencies and the factors influencing the allocative efficiency.

Model specification

Over the years, quite a number of researches have determined stochastic frontiers and predicted farm/firm level efficiencies using these determined function, and then further regressed the predicted efficiencies upon some firm/farm specific characteristics such as the socio-economics characteristics in an attempt to know the reasons why there are differences in predicted efficiencies (Battese and Coelli, 1995). This two-stage estimation procedure has been found out not to provide estimates which are as efficient as those that could be obtained using a single-stage estimation procedure.

The stochastic frontier function was proposed independently by Meeusen and Van den Broeck (1977) and Aigner, Lovell and Schmidt (1977). It was originally specified as production function of the form:

$$Y_i = X_i\beta + (V_i - U_i), i = 1, \dots\dots, N \dots\dots\dots\dots\dots\dots (1)$$

This could be transformed to cost function by altering the error term specification from (V_i - U_i) to (V_i + U_i) to give:

$$Y_i = X_i\beta + (V_i + U_i), i = 1, \dots\dots, N \dots\dots\dots\dots\dots\dots (2)$$

Where:

Y_i is the logarithm of the cost of production of the ith firm/farm;

X_i is a K x 1 vector of transformation of the input prices and output of the ith firm/farm;

β is vector of unknown parameters;

V_i are random variables which are assumed to be. $N(\sigma_V^2)$;

U_i are non-negative random variables and they are assumed to account for the cost of inefficiency in production and also assumed to be $iid.|N(\sigma_U^2)|$

The two error terms are independent of one another in equations 1 and 2.

The empirical stochastic frontier cost function for plantain growers in the study area is expressed as:

$$lnCOP_i = \aleph_0 + \aleph_1 lnROL + \aleph_2 lnVOF + \aleph_3 lnVOA + \aleph_4 lnVOL + \aleph_5 lnIOL + \aleph_6 lnDOT + \aleph_7 lnVSP + \aleph_8 lnPOU + (V_i + U_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where:
COP is the cost of production (Naira);
ROL is the rent on land (Naira);
VOF is the value of fertilizer used (Naira);
VOA is the value of agrochemical used (Naira);
VOL is the value of labour used (Naira);
IOL is the interest on loan (Naira);
DOT is the depreciation of farm tools (Naira);
VSP is the value of suckers planted (Naira);
POU is the plantain output (Kg).
$\aleph_0 \ldots \aleph_8$ are the parameters to be estimated.

In equation 3, the U_i shows how farm operates above the cost frontier. If allocative efficiency is assumed, the non-negative random variable U_i is closely related to the cost of technical inefficiency.

The cost inefficiency model is shown as:

$$U_i = \Pi_0 + \Pi_1 \text{AGE} + \Pi_2 \text{FEX} + \Pi_3 \text{ACR} + \Pi_4 \text{AES} + \Pi_5 \text{HOS} + \Pi_6 \text{EDL} \ldots (4)$$

Where:
U_i is the cost inefficiency of the i^{th} farmer;
AGE is the age of the farmer (years);
FEX is the farming experience (years);
ACR is the access to credit (1 yes, 0 no);
AES is the access to extension services (1 yes, 0 no);
HOS is the household size (number);
EDL is the educational level (year);
$\Pi_0 \ldots\ldots \Pi_6$ are parameters to be estimated.

Allocative efficiency ranges between zero and one. It is an inverse function of cost efficiency. The maximum-likelihood estimates of $\aleph$ and Π coefficients were estimated simultaneously using the computer programme FRONTIER 4.1 developed by Coelli in 1996.

Results and discussion

Table 1 shows the estimates of the parameters of stochastic frontier cost function for plantain growers in the study area. All the included exogenous variables in the model were positively related to the cost of plantain production. This implies that an increase in the use of any of the variable leads to a rise in the cost of production and vice versa. The rent on land was statistically significant at 10 percent level of significance and the more the rent paid on farm land the more the cost of production. Also value of fertilizer used was significant at 5 percent level of significant while value of agrochemical used was not significant at any level of significance considered in the study. This might be due to the fact that most of these chemicals are very expensive and most of the time farmers hardly use them in the course of production.

Table 1: Maximum Likelihood Estimates of parameters of Cobb Douglas Stochastic Frontier Cost function for plantain growers.

Variables	**Parameters**	**Coefficient**	**t-ratio**
constant	$\aleph_0$	0.478	2.643***
Rent on land (ROL)	$\aleph_1$	0.290	1.935*
Value of fertilizer used (VOF)	$\aleph_2$	0.497	2.580**
Value of agrochemical used (VOA)	$\aleph_3$	0.609	1.420
Value of labour used (VOL)	$\aleph_4$	0.727	8.731***
Interest on loan (IOL)	$\aleph_5$	0.780	0.367
Depreciation of farm tools (DOT)	$\aleph_6$	0.339	3.621***
Value of suckers planted (VSP)	$\aleph_7$	0.975	4.037***
Plantain output (POU)	$\aleph_8$	0.102	1.234
Inefficiency model			
constant	Π_0	0.543	1.321
Age of the farmer (AGE)	Π_1	0.407	1.826*
Farming experience (FEX)	Π_2	-0.501	2.432**
Access to credit (ACR)	Π_3	-0.981	9.176***
Access to extension services (AES)	Π_4	-0.461	2.070**
Household size (HOS)	Π_5	0.534	0.610
Educational level (EDL)	Π_6	-0.823	5.901***
Variance parameters			
Sigma squared	σ^2	6.761	4.619***
Gamma	γ	0.927	9.871***
Log likelihood function	LLF	91.23	

*,** and*** significant at 10 percent, 5 percent and 1 percent respectively.

In addition, the value of labour used was highly significant at 1 percent level of significance. This implies that in most of the traditional farming system the importance of labour cannot be over emphasized. Interest on loan used in production was not significant. This might be so because most of the farmer do not use loan for plantain production. Both depreciation of farm tools and value of suckers planted were statistically significant at 1percent level of significance while plantain output was not significant at the levels of significance considered.

Table 1 also shows the result of the estimates of parameters of inefficiency allocative model. It reveals that the coefficient of age was positive and statistically significant at 10 percent level of significance. This implies that as the age increases, the level of allocative inefficiency increases and hence the level of cost efficiency of a farmer in production decreases. The result corroborates the findings of Tijjani and Bakari (2014) that as age increases, allocative efficiency decreases. This indicates that the youths are more efficient in allocation of resources.

Also according to Table 1, farming experience had negative sign and significant at 5 percent level of significance. This implies that as the number of years spent in farming increases, allocative inefficiency of a farmer decreases and vice versa. This indicates that experienced farmers are more efficient in resources allocation. The result is in line with those of Bakari (2010) and Rahman et al., (2012) that experienced farmers tend to be more efficient in resource allocation.

Access to credit also had a negative sign and highly significant at 1 percent level of significance. It shows that access to loan promotes resource allocation efficiency. This implies that farmers that have access to loan are more efficient in allocation of factors of production. It has been argued that availability of credit from any source can enhance the allocative efficiency level of farmers.

Also access to extension services variable had negative sign and significant at 5 percent level of significance. This indicates that those farmers that have access to services of the extension agents are more efficient in the allocation of farm inputs to produce a given level of output. Household size was positively signed but not significant. It implies that increase in household size leads to increase in allocative inefficiency and hence reducing cost efficiency. This result is in agreement with the findings of Latifat, et al., (2013) that increase in household size decreases the allocative efficiency of palm oil processors in Benue State. Educational level of the household head was negatively signed and significant at 1 percent. This implies that education promotes allocative efficiency because it boosts farmer's managerial ability.

The diagnostics statistics in Table 1 shows that the variance parameters for the stochastic frontier cost function were significant statistically at 1 percent level of significance. The estimated value of variance ratio represented by gamma (γ) was 0.927. This implies that about 93 percent variations in the cost of production among the plantain farmers is due to cost inefficiencies while the value of sigma squared (σ^2) 6.761 indicates good fit and correctness of the distributional form assumed for the composite error term in the model.

Table 2: Distribution of respondents by allocative efficiency

Efficiency level	**Frequency**	**Percentage**
≤0. 40	2	1.7
0.41-0.50	3	2.5
0.51-0.60	35	29.2
0.61-0.70	17	14.1
0.71-0.80	51	42.5
0.81-0.90	4	3.3
>0.90	8	6.7
Total	**120**	**100**
Minimum	0.40	
Maximum	0.94	
Mean	0.72	

Allocative efficiency indices which measure how an enterprise uses production inputs optimally in the right combination to maximize profits are presented in Table 2. The mean allocative efficiency of the plantain farmers was 0.72 while the minimum and maximum were 0.40 and 0.94 respectively. This indicates that the most allocatively efficient farmer was 94 percent efficient while the least allocatively efficient farmer was 40 percent efficient. Also, since the maximum allocative efficiency was below 1, it shows that all the respondents were producing below the maximum cost efficiency frontier. On the average, the plantain farmers in the study area were 72 percent allocatively efficient. Table 2 shows that the majority (66.6%) had allocative efficiency between 0.61 and 0.94. It implies that the farmers are fairly efficient in allocating the limited factors of production available.

Conclusion and recommendations

Plantain is an important perennial herbaceous crop, supplying up to 25 percent carbohydrates for approximately 70 million people in humid zone of Africa. The research was carried out to determine the plantain farmers' allocative efficiencies and the factors influencing the allocative efficiency were also examined. The results showed that all the included

exogenous variables in the model are positively related to the cost of plantain production. Also, variables, rent on land, value of fertilizer used, value of labour used, depreciation of farm tools and value of suckers planted are significant. Also the main determinants of allocative efficiency are age of the farmer, farming experience, access to credit, access to extension services and the educational level. In the study area farmers are fairly efficient in allocating productive resources. In order to improve the farmers' allocative efficiency, it is recommended that the governments should make available to the farmers credit facilities and also, agrochemicals at affordable prices, should be distributed to those farmers that are in need of them. In addition, the governments and non-governmental organizations should improve upon the extension services available to the plantain farmers.

References

1. Adebayo, E.F. (2006). Resource-Use Efficiency and multiple Production Objectives of Dairy Pastoralists in Adamawa State, Nigeria. Unpublished Ph.D Thesis, University of Ibadan, Nigeria.
2. Afolabi, J.A. (2010). Fadama Farming as an Environment Friendly and Viable Enterprise in Undo State, Nigeria. *Journal of Human Ecology 30(2): 93-97*
3. Aigner, D.J; Lovell, C.A.K. and Schmidt, P. (1977). "Formulation and Estimation of Stochastic Frontier Production Function". *Journal of Econometrics, 6: 21-37.*
4. Bakari, U.M. (2010). Economics of Rice Production under Public Sector Irrigation Scheme: A Case Study of Gerio Irrigation Project, Yola. Unpublished doctoral thesis, Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, Bauchi State.
5. Coelli T.J. (1996). A guide to Frontier Version 4.1c: A computer Program for Stochastic Frontier Production and Cost function Estimation. Working Paper, Department of Econometrics, University of New England, Armidele, Australia.
6. Inoni, O.E. (2007). Allocative Efficiency in Pond Fish Production in Delta State, Nigeria: A Production Function Approach. Agricultural Tropical Subtropical.40 (4).
7. Latifat, L.W., Ogbaji, I.E. and Ocholi, A. (2013). Technical and allocative efficiency of palm oil processing in Benue State. *Journal of Sustainable Development in Africa*.15(6)
8. Lau, L. and Yotopoulos, P. (1989). The Meta-production Function Approach to Technological Change in World Agriculture. *Journal of Development Economics* 31, 241-269.
9. Meeusen, W. and Van Den Broeck, J. (1977). Efficiency Estimation from Cobb- Douglas Production Function with Composed Error, *International Economics Review, 18 (2): 435-444*
10. Rahman, K. M. M., Mia, M. I. A. and Bhuiyan, M. K. J. (2012). A Stochastic Frontier Approach to Model Technical Efficiency of Rice Farmers in Bangladesh: An Empirical Analysis. *The Agriculturists* 10(2),9-19.
11. Russell, N.P. and Young, T. (1983). Frontier Production Function and the Measurement of Technical Efficiency. *Journal of Agricultural Economics*, 34: 139-150. .
12. Swennen, R., (1990). Plantain cultivation under West Africa conditions: A Reference Manual. Institute for Tropical Agriculture, Ibadan, Nigeria. .
13. Tijjani, A. and Bakari, U. M. (2014). Determinants of allocative efficiency of rain-fed rice production in Taraba State, Nigeria. European Scientific Journal. 10 (33), 220-229.

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