Journal of Economics and Sustainable Development www.iiste.org
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.4, No.7, 2013

Effect of Farmer Education and Managerial Ability on Food Crop Production in Nigeria

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Abstract
The purpose of this study was to determine the effect of education and managerial ability on the technical efficiency of food crop production in Nigeria, using the stochastic frontier production analysis. The research which was conducted in Oyo state of Nigeria used primary data which were obtained from one hundred and fifty representative samples of food crop farmers through the use of well structured questionnaire. Results of the analysis showed that the technical efficiency level ranged between 84.4% and 99.4% with a mean of 94.3%. The study showed that there still existed some levels of inefficiency among the sampled food crop farmers. The contributing factors to efficiency were age and level of education of the farmers. The study observed that there was a scope for increase in farmers' efficiency by improving their level of education, and therefore suggested policy recommendations which could ensure food security thereby enhancing national development.
Keywords: Food Crop Production, Farmer Education, Managerial Ability, Nigeria

1.0 Introduction

In Nigeria, agriculture constitutes a very significant sector of the nation's economy. Amongst the contributions of the agricultural sector are the provision of food for the teeming population; contribution of over 30% of the total Gross Domestic Product (GDP) of the country (CBN, 1999); provision of employment opportunities for over 65.0% of economically active population of the country; provision of raw materials for agro-allied industries and the generation of foreign exchange earnings. Food crops account for the bulk of the crop sub-sector of the nation's agriculture and comprise broadly of cereals, pulses, roots and tubers, plantains, oil seeds and nuts, vegetables and fruits. Food was relatively adequate in Nigeria at independence because of high farming activities and productivity level within the food crop sub-sector and the situation remained the same during the first few years that followed. However, effects of the subsequent neglect of the agricultural sector started to take its toll on the nation's food supply in the early 1970s (Oni, 1998). The Federal Office of Statistics FOS (1986) claimed that between 1970 and 1985, there was an average decline of 1.3% per year in crop production while food crop production declined by 0.4 percent on the average. The factors which contributed to the decline in food crop production since the early 1970s included:
(i) low level of production technology; (ii) aftermath of Nigerian civil war;
(iii) upsurge in petroleum revenues; (iv) huge government expenditure in financing large construction projects in urban centres and, (vi) neglect of agriculture attendant upon the discovery and exploitation of crude petroleum in large quantities.

The downward trend in food crop output influenced the sub-sector's contribution to GDP as its contribution to the GDP shrank to about 21.0% by the early 1980s (FOS, 1986). As a result, Nigeria began to experience food supply deficits while food import bills began to rise astronomically. From a level of ₦88.3 million in 1971, representing 8.2 percent of total imports, food import bills rose to ₦1.8 billion in 1981, representing 14.4percent of total imports for that year; instability in food production was higher between 1986 and 1994 than between 1981 and 1985 (World Bank, 1996).
However, food importation constitutes a drain on the nation's foreign exchange reserves, hence; greater efforts should be geared-up to boost domestic food crop production.

According to Wikipedia, the free encyclopedia, education in the largest sense is any act or experience that has a formative effect on the mind, character, or physical body of an individual. In its technical sense, education is the process by which society deliberately transmits its accumulated knowledge, skills, and values from one generation to another. Cotlear (1990) describes three different types of education: formal, non-formal and informal. Non-formal education includes agricultural extension contacts and apprenticeships as well as adult literacy training. Informal education may refer to a wide range of experiences, including 'learning by doing' and migration or other activities which provide exposure to new ideas and facilitates learning. Formal education tends to promote formative of cognitive skills and abstract reasoning ability as well as changes in attitudes. Non-formal education most often serves to transmit specific information needed for a particular task or type of work. Informal education may serve mainly to shape attitudes, beliefs and habits (Cotlear, 1990).

Education may enhance farm productivity directly by improving the quality of labour, by increasing the ability to adjust to disequilibria through its effect upon the propensity to successfully adopt innovations. Education is thought to be most important to farm production in a rapidly changing technological or economic environment (Schultz, 1975). It has been argued that high rates of education are essential for countries to be able to achieve high levels of economic growth, and empirical studies on developing countries show that farmers with higher levels of education produce more crops because they are more likely to adopt innovative technologies than a farmer with little or no education (Weir, 1999; Khisa and Heieman, 2004; Asadulla and Rahman, 2005).This study however, focused on formal and non-formal education as well as other managerial factors.

According to Kalaitzandonakes and Dunn (1995), a farmer managerial ability is influenced by level of education, experience, age, number of contact with extension agents as well as personal ability and traits.

Technical efficiency is defined as the ability to produce maximum output from a given set of inputs, given the available technology (Yao and Liu, 1998).

1.1 Statement of the Problem

In order to prevent the depletion of the nation's foreign exchange earnings (through huge food import bills) and achieve a satisfactory level of self- sufficiency in domestic food production, concerted efforts should be made to improve individual factor productivity. The low level of productivity in food crop production is a reflection of the low levels of productivity and efficiency in the sub-sector. Therefore, one approach at solving this problem is to investigate the effect of farmer education and managerial ability on the technical efficiency in food crop production. Towards this end, there was a need to conduct empirical study on the measurement of factor efficiencies in the production of food crop in the country with a view to making appropriate policy (-ies) for improvements.

Thus, this study was planned to examine the effect of farmer education and the managerial ability on the technical efficiency of food crop production in Oyo State of Nigeria. The study attempted to provide answers to the following policy questions: What is the current level of efficiency in food crop production in Oyo State of Nigeria? Is the level of education among the factors influencing this level of efficiency among the farmers? The result of the study would be useful to policy makers in their bid to boost the output of the food grain crop in the country.

1.2 Objectives of the Study

The overall objective of the study was to determine the effect of farmer education and managerial ability on the technical efficiency of food crop production in Oyo State of Nigeria. Specifically, the study identified and discussed the socio-economic characteristics of the farmers; estimated the technical efficiency of food crop farmers; as well as determined if the level of education is among the factors which influenced technical efficiency of the representative sampled farmers.

1.3 Analytical Framework

Empirical estimation of efficiency is normally done with the methodology of stochastic frontier production function. The stochastic frontier production model has the advantage of allowing simultaneous estimation of individual technical efficiency of the respondent farmers as well as determinants of technical efficiency (Battese and Coelli, 1995).

The stochastic frontier production function independently proposed by Aigner *et al* (1977) and Meeusen and Van Den Broeck (1977) assumes that maximum output may not be obtained from a given input or a set of inputs because of the inefficiency effects. It can be written as:

$$Y_i = f(X_{ai}; \beta) + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

Y_i = the quantity of agricultural output,

X_{ai} = a vector of input quantities and,

β = a vector of parameters

ε_i is an error term defined as:

$$\varepsilon_i = V_i - U_i \qquad i = 1, 2, \ldots n \text{ farms} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

V_i is a symmetric component that accounts for pure random factors on production, which are outside the farmers' control such as weather, disease, topography, distribution of supplies, combined effects of unobserved inputs on production etc. and U_i is a one-sided component, which captures the effects of inefficiency and hence measures the shortfall in output Y_i from its maximum value given by the stochastic frontier $f(Xa;\beta)+V_i$. The model is expressed as:

$$Y_i = \exp\,(X_i\beta + V_i - U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

1.4 Technical Efficiency

The technical efficiency of production of the i[th] farmer in the appropriate data set, given the levels of his inputs, is defined by:

$$TE_i = \frac{\exp(X_i\beta + V_i - U_i)}{\exp(X_i\beta + V_i)} = \exp(-U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

From equations (1) and (2) above, the two components V_i and U_i are assumed to be independent of each other, where V_i is the two-sided, normally distributed random error ($V_i \sim N(0, \sigma_v^2)$, and U_i is the one-sided efficiency component with a half normal distribution ($U_i \sim / N(0, \sigma_u^2)$. Y_i and X_i are as defined earlier. Theβ's are unknown parameters to be estimated together with the variance parameters.

The variances of the parameters, V_i and U_i, are σ_v^2 and σ_u^2 respectively and the overall model variance given as σ^2 are related thus:

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

The measures of total variation of output from the frontier, which can be attributed to technical efficiency, are lambda (λ) and gamma (γ) (Battese and Corra, 1977) while the variability measures derived by Jondrow, *et al* (1982) are presented by equations (6) and (7):

$$\lambda = \frac{\sigma_u}{\sigma_v} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

and,

$$\gamma = \frac{\sigma_u^2}{\sigma^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

On the assumption that V_i and U_i are independent and normally distributed, the parameters β, σ^2, σ_u^2, σ_v^2, λ and γ were estimated by method of Maximum Likelihood Estimates (MLE), using the computer program FRONTIER Version 4.1 (Coelli, 1996). This computer program also computed estimates of technical efficiency.

The farm specific technical efficiency (TE) of the i[th] farmer was estimated using the expectation of U_i conditional on the random variable (ε_i) as shown by Battese and Coelli (1988). The TE of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology, that is:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{\exp(X_i\beta + V_i - U_i)}{\exp(X_i\beta + V_i)} = \exp(-U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

(Tadesse and Krishnamoorthy, 1997); so that $O \le TE \le 1$

2.0 Research Methodology

2.1 Study Area

The study was conducted in Oyo State of Nigeria. The State is one of the six States constituting the South-Western Zone of Nigeria. The other four States are Ekiti, Lagos, Ogun, Ondo and Osun States. Oyo State covers an area of 28,454 square kilometers (2,845,400 Ha) (FOS, 1997). According to the National Population

Commission (2006), Oyo State has a population of 5,580,894 people with females being 2,778,462 people and males being 2,802,432 people. The State has two distinct ecological zones: The moist forest to the south and the intermediate savannah to the north. Oyo State shares borders with Peoples' Republic of Benin in the West, Kwara State in the North, Osun State in the East and Ogun State in the South. Oyo State is currently made up of thirty –three Local Government Areas.

The climate in the State is of tropical type with two distinct rainfall patterns. The rainy season, which marks the agricultural production season is normally between the months of April and October. The heaviest rainfall is recorded between the months of June and August while driest months are November to March. The average total annual rainfall ranges between 1000mm and 1500mm with high daily temperature ranging between 28^0C and 30^0C (FAOSTAT, 2004). Agriculture is the main occupation of the people and small-scale traditional farming system predominates in the area. The major food crops grown in the State include maize, rice, yam, cassava and cocoyam while the major cash crops grown are: cocoa, kola nut and oil palm.

2.2 Sources of Data

This study used primary data which were supplemented with secondary information. The primary data were obtained through sample survey using structured questionnaire, administered by trained enumerators under the supervision of the researcher. The secondary information were obtained from publications of Central Bank of Nigeria (CBN), the Federal Office of Statistics (FOS), Food and Agricultural Organization (FAO), State Agricultural Development Programmes (ADPs), journals and other relevant publications.

2.3 Sampling Techniques

The study used multi-stage random sampling technique. Firstly, Ogo-Oluwa and Surulere Local Government Areas were purposely selected for the study from Ogbomoso agricultural zone in Oyo State. The second stage involved simple random selection of six towns/villages from the list of food crop growing towns/villages obtained from the Information Unit of each LGA-making a total of twelve villages.

The last stage involved a simple random sampling of thirteen food crop farmers from each of the 12 villages in the State. Thus, a total of 156 farmers out of all the population of food crop farmers were interviewed, using a structured questionnaire with interview schedule. However, 150 well-completed copies of the questionnaire were used for analysis. Data were obtained on the socio-economic characteristics of farmers, inputs, prices of inputs and physical output of the food crop.

2.4 Methods of Data Analysis

The analytical techniques used in this study are a combination of: descriptive statistics and stochastic frontier production function. For the purpose of this study, the stochastic frontier production functions where the functional form of the production frontier is Cobb-Douglas proposed by Battese and Coelli (1995) and used by Yao and Liu (1998) was applied in the analysis of data to capture the efficiency of food crop farmers. The Cobb-Douglas functional form is easily adaptable for most agricultural productions. It has been widely used in many empirical studies in agriculture especially in developing countries (Xu and Jeffrey, 1998). According to Heady and Dillon (1966), Cobb-Douglas functional form possesses some unique characteristics which make it easy to work with. These characteristics include: (i) when the input and output quantities are transformed to their logarithms, the resultant function is linear in the log, hence it is easy to fit data with the Cobb-Douglas form; (ii) the estimated co-efficients are the direct elasticities of production and, (iii) the sum of estimated coefficients are used to deduce returns to scale (RTS) directly, and hence productivity

The model of the stochastic frontier production for the estimation of the TE as used by Battese and Coelli (1995) is specified and defined below:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + V_i - U_i \quad \text{..........} \quad (9)$$

Where subscript i refers to the observation of the i^{th} farmer, and

Y = output of food crop (kg);
X_1 = farm size (ha);
X_2 = family labour used (man-days);
X_3 = hired labour used (man-days);
X_4 = quantity of fertilizer used (kg);
X_5 = quantity of physical input(seed) (kg);
X_6 = amount spent on agrochemicals (₦);
X_7 = amount spent on implements (₦);
β_i's = the parameters to be estimated.
ln's = natural logarithms.

V_i = the two-sided, normally distributed random error.

U_i = the one-sided inefficiency component with a half-normal distribution.

The technical inefficiency effects U_i is defined by:

$$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} \quad \text{..} \quad (10)$$

Where:

U_i = technical inefficiency of the i^{th} farmer;

Z_1 = age of farmer (years);

Z_2 = level of education which incorporated both formal and non-formal education;

Z_3 = number of contacts with extension agent;

Z_4 = years of farming experience;

Z_5 = amount of credit available;

$\delta_i^{'}s$ = the parameters to be estimated.

In the presentation of estimates for the parameters of the above frontier production, two basic models were considered. Model 1 is the traditional response function in which the inefficiency effects (U_i) are not present. It is a special case of the stochastic frontier production function model in which the parameter $\gamma = 0$. Model 2 is the general frontier model where there is no restriction in which γ, $\sigma^2 s$ are present. T-ratio test was used to test for the significance of socioeconomic variables.

3.0 Results and Discussion

3.1 Socio-Economic Characteristics of Food Crop Farmers

The summary statistics of socio-economic characteristics of the farmers is presented in table 1 to give a broad view of selected socio-economic variables. The minimum and maximum ages of farmers were 20 and 62 years respectively with the mean age of about 38 years. The respondents had an average of about 4 years of formal education. The average household size per farming family was 7 persons. The mean output of food crop produced was about 2200kg from an average of 1.9ha of farmland. The average age obtained for the farmers suggested that in addition to being energetic, food crop farmers would be receptive to innovations which could boost rice production, all other factors remaining equal. The level of education attained by a farmer is known to influence the adoption of innovation, better farming decisions making including efficient use of inputs (Schultz, 1975). The finding implied that literate farmers would be more innovative than the non-literate farmers there by boosting rice production all other factors remaining unchanged. It is expected that the farmers should have experience in farming. The more the number of years a farm operator is engaged in farming, the more his experience will be. The farming experience distribution in the study area suggested that farmers were well experienced enough in food crop cultivation to boost its production, all other factors remaining equal.

3.2 Estimates of Stochastic Frontier Production Functions Parameters

The ordinary least squares estimates (OLS) (Model 1) and the maximum likelihood parameter estimates (MLE) (Model 2) of the stochastic frontier production model are presented in table 2.The variables with positive coefficients implied that any increase in such a variable would lead to an increase in food crop output, while an increase in the value of the variable with a negative coefficient would lead to a decrease in output of food crop. Negative coefficient on a variable might indicate an excessive utilization of such a variable. Thus, from table 2, all the variables carried positive signs while the coefficients of the farm size and hired labour were significant at 5.0% level of significance.

3.3 Relationship between Farmer education, Managerial ability and Technical efficiency

The estimated parameters of the inefficiency model in the stochastic frontier models of the food crop farms in Oyo State are presented in table 2. The analysis of the inefficiency model shows that the signs and significance of the estimated coefficients in the inefficiency model had important policy implications on the technical efficiency (TE) of the farmers. The coefficients of age and years of education were positive against *a priori* expectation (Coelli and Battese, 1996) while the coefficients of contact with extension agent, years of experience, and amount of credit available to farmers were negative, *a priori.* The positive sign on age variable indicated that increasing age would lead to increase in technical inefficiency, based on the fact that ageing farmers would be less energetic to work on the farm, hence, they were supposed to have low TE. The positive sign on years of education indicated that more educated farmers in Oyo State were probably involved in other enterprises and occupations and had less time for efficient supervision of their farms. The coefficients of contact with extension agents, years of experience and amount of credit available were negative and conformed with *a priori* expectation. The negative coefficients on the amount of credit available conformed to the findings of Onu *et al* (2000), and the result implied that availability of more credit enhances TE of farmers in food crop production because availability of credit will facilitate easy procurement of fertilizers, agrochemicals and other yield-improving inputs on timely basis.

3.4 Efficiency Analysis

Table 3 shows the predicted technical efficiency estimates in Oyo State. The predicted farm specific TE indices ranged from a minimum of 84.4% to a maximum of 99.4% for the farms in the sample, with a mean of about 94.0% and a standard deviation of 4.3%. Thus, in the short run, there is a scope for increasing food crop production of an average food crop farmer by about 6.0% by adopting the technology and technique used by the best-practiced (most efficient) farmer. Many of the farmers were having efficiency greater than 90%.

4. Conclusion

From the findings, the following conclusions could be made concerning food crop production in Oyo State of Nigeria: food crop farmers were not fully technically efficient in the use of production resources available to them hence; there is an opportunity for farmers to increase their level of efficiency in food crop production. The finding that farmers' level of education had positive impact on their technical efficiency suggested that education has an important role to play in increasing technical efficiency of food crop production in Oyo State because the farmers were capable of adoption of innovation which could boost food crop production. It is therefore suggested that these educated farmers need to devote more time to the efficient supervision of their farms. More of the adopted innovations should be passed across to them (especially in the areas of training by the States' Agricultural Extension Services). In this connection, it is recommended that the existing Agricultural Extension Services be strengthened through the provision of funds, improved logistics and more manpower for them to be able to able to pass across these yields boosting innovations thereby ensuring food security.

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Table 1: Summary Statistics of Socio-Economic Variables of Food Crop Farmers in the Study Area

	Oyo State				
Variable	**N**	**Min**	**Max**	**Mean**	**SD**
Age (Years)	150	20	62	37.5	6.7
Education (Years)	150	1	17	4.2	3.9
Experience (Years)	150	1	34	10.5	7.0
Household Size (No)	150	1	20	6.7	3.2
Farm Size (Ha)	150	0.1	13.0	1.9	1.7
Output (kg)	150	150	10000	2200.4	1516.7

N = sample size; Min = minimum values; Max = maximum values; SD = standard deviation.
Source: Computed from data obtained from the Field Survey.

Table 2: Maximum Likelihood Estimates for the Parameters of the Stochastic Frontier Production Function for Food Crop Farmers in Oyo State

Variable	Model 1	Model 2
General Model (Production Function)		
Constant	2.093 (9.676)	2.376 (9.603)
Farm Size	0.306* (3.692)	0.314* (3.933)
Family Labour	0.162* (2.943)	0.142* (2.563)
Hired Labour	0.308* (3.783)	0.284* (3.588)
Quantity of Fertilizer	0.010 (0.556)	0.001 (0.044)
Quantity of Physical input	0.065 (0.846)	0.026 (0.346)
Amount spent on Agrochemicals	0.007 (0.323)	0.010 (0.437)
Expenditure on Implements	0.079 (1.239)	0.051 (0.794)
Inefficiency Model		
Constant	0	0.061 (0.609)
Age of Farmer	0	0.001 (0.573)
Years of Education	0	0.008 (1.526)
Contact with Extension Agents	0	-0.067 (-1.195)
Years of Farming Experience	0	-0.002 (-0.491)
Amount of Credit Available to Farmers	0	-0.00001 (-1.471)
Variance Parameters		
Sigma Squared	0.019	0.018* (8.047)
Gamma	0	0.159 (1.613)
Log Likelihood Function	90.16	93.65

Notes: * indicates estimated coefficients which were significant at 5.0% level.
Figures in parentheses are t-ratio values.
Source: Computed from data obtained from the Field Survey.

Table 3: Decile Range of Frequency Distribution of Technical Efficiency of Food Crop Farmers in Oyo State

Decile Range (%)	Technical Efficiency	
	No	**%**
> 90	124	82.67
81 – 90	25	16.67
71 – 80	1	0.66
Total No of Farms	150	100.0
Mean %	94.3	
Minimum %	84.4	
Maximum %	99.4	
Standard Deviation	4.3	

Source: Computed from data obtained from the Field Survey.