P-ISSN: 2305-6622; E-ISSN: 2306-3599
International Journal of Agriculture and Biosciences
www.ijagbio.com; editor@ijagbio.com

Research Article

# Resource Use Efficiency of Plantain Farmers in Ise/Orun and Ekiti South West Local Government Areas of Ekiti State, Nigeria

Sow Toluwase

Ekiti State University, Ado – Ekiti, Nigeria
***Corresponding author:** sowtoluwase@yahoo.co.uk; sunday.toluwase@eksu.edu.ng

**Article History:** Received: February 22, 2016 Revised: June 15, 2016 Accepted: June 24, 2016

**ABSTRACT**

This study presents an empirical study of resource use efficiency of plantain farmers in Ise/Orun and Ekiti South-West Local Government Areas of Ekiti State, Nigeria. Data were collected from 120 plantain farmers that were randomly selected among the plantain farmers in villages and hamlets within the study area using well-structured questionnaires. Percentages and frequency counts were used to analyze the socio-economic characteristics of the farmers. Regression analysis was used to obtain the determinants of plantain output in the study area. The result revealed that farm size, labour, pesticides, herbicides, and fertilizer usage, all have positive significant relationship with the output. Farmers who utilizes their resources efficiently especially capital (pesticides, herbicides, and fertilizers), labour (either hired or family) are found to obtain higher yields than those who did not use the resources efficiently. Gross margin in percentage (%) was used to analyze the respective profit of the farmers. It was shown that the farmers make profit as 16.5% was calculated. From the regression result it was shown that the coefficient of the variable of farm size, use of tractor, amount of hired labour use, amount of family labour used, amount of herbicides used, amount of fertilizers used were significant at 1% and 5% levels. $R^2$ Value was 0.808. For the farmers in the study area to obtain higher profit in plantain enterprise, farmers should be encouraged to increase their farmland and use more appropriate modern technology and pesticides. If productivity must increase, small scale farmers must improve their use of modern inputs and practice better soil conservation techniques.

**Key words:** Resource use, Efficiency, Plantain, Farmers, Ekiti

## INTRODUCTION

A key feature of the Nigeria agricultural sector is the dominance of small scale farms, which constitute an important and invaluable component of the Nigerian economy. It is a known fact that over 10millions farmers, scattered in different ecological zones, engage in the production of a wide variety of arable crops and this is done under traditional subsistence or peasant agriculture.

Olayemi (2006) and Okuneye (2008) affirm that 90% of Nigeria total food production comes from small scale farms and that at least 60% of the country's population earn their living from these small farms. Therefore, effective economic development strategy will depend critically on promoting productivity and output growth in the agricultural sector, particularly among small scale producers since they make up the bulk of the nation's agriculture.

In Africa as a whole, the economies of the region are mostly dominated by agriculture (FAO, 2006). Also there is a general consensus about the way agriculture is evolving in response to demographic and economic trends. The increase in production of the developing countries can only be achieved through intensification of agriculture which intends to leads to increase in yield or productivity per unit area.

As urbanization reduces the workforce, agriculture will also need to adopt new forms of mechanization and shift to land use intensification with all its connotations. These scenarios point to an increase in efficiencies use of all natural resources, and the need for greater use of synthetic inputs such as fertilizer (Louisse, 2008).

Nevertheless, existing knowledge is poorly used and that is why development of more intensive agricultural production systems for sustainable development is effectively promoted only in rare instances throughout Africa. However, a special application systems analysis,

**Cite This Article as:** Sow Toluwase, 2016. Resource use efficiency of plantain farmers in Ise/Orun and Ekiti South West local government areas of Ekiti State, Nigeria. Inter J Agri Biosci, 5(4): 215-220. www.ijagbio.com 

combining agro-ecology and socio-economic approaches will allow a more rigorous analysis and will also provide a systematic approach to identify and classify obstacles to rural development, and to quantify the potential for sustainable and efficient use of resources.

Breman (2007) suggested that the only one useful method for countries whose economy is based on agriculture should focus on analyzing the patterns and efficiency of the resources used.

Agriculture is an overwhelmingly resources based vocation. The resources employed in farming or the factors of production can be classified as land, labour, capital and management and also water as the case may be. These resources can be categorized into four, even though the distinction between some of the categories is not clearly cut. Firstly, there are the natural resources such as land, water which are given by God, but which could be made more productive by man, secondly, we have labour which is the human resources or manual input, thirdly, there is capital, sometimes defined as produced means of production, because it is a man- made input and finally, there is management or entrepreneurship which is a qualitative kind of input.

Efficiency analysis is an issue of interest among economists in recent times, given that the overall productivity of an economical system is directly related to the efficiency of production of the components within the system. As such agricultural productivity is said to be a measure of efficiency, Olayide and Heady (2008), said that maximum resource productivity will imply obtaining the maximum possible output from the minimum possible set of input. In this context, optimal productivity of resources involves an efficient utilization of resources in the production process. In the same vein, Kyi and Oppen (2006), defined agricultural productivity as a measure of efficiency with which an agricultural production system employs land, labour, capital and other resources.

Economists have defined different types of productive efficiency; Farrel (2007), widely accepted definition is the one commonly quoted in literature. He specified two types of efficiency: technical and allocative efficiency. Farrel (2007), defined technical efficiency as the ability to extract the maximum output from a given level of input, while allocative efficiency refers to the farmers ability to achieve the optimal mix i.e. having the right and efficient combination of inputs that gives optimal output.

Darst (2006) records that the level of technical efficiency of a particular firm is characterized by the relationship between the observed and some ideal or potential production. The measurement of firm specific technical efficiency is based upon deviations of observed output from the best production or efficient production frontier. If a firm's actual production point lies on the frontier, it is perfectly efficient; if it lies below the frontier, then it is technical inefficient with the ratio of the actual to potential production defining the level of technical efficiency of the individual firm. Technical efficiency is just one component of overall economic efficiency. However, in order to be economically efficient, a firm must be technically efficient (Akinyemi *et al*, 2006).

Akinyemi, Aiyelaagbe, and Akyeampong, (2006), went further to say "profit maximization requires a firm to produce the maximum output given the level of inputs employed (i.e., be technically efficient), use the right mix of inputs in light of the relative price of each input (i.e., the input allocative efficient) and produce the right mix of output given the set of prices (i.e. be output allocative efficient)'

Efficiency can be considered in terms of the optimal combination of inputs to achieve a given level of input (an input orientation) or the optimal output that could be produced in a given set of inputs (an output orientation).

**Problem statement**

It has been realized that domestic production of food has not been able to meet the domestic demand for food crops. The reason for this is that there are some problems at the micro level, one of which is the relationship between inputs used in production such as fertilizers, suckers, land, labour and capital. It has been established that appreciable yield increase could be obtain through the use of modern technologies in production of crops, hence, this has been chosen as a vital way to improve total farm output and to curb food shortages because of its great impact in production.

Louisse (2008), said organic agriculture which eliminates the use of synthetic inputs, does not appear to be a feasible alternative, this is because a large amount of land would have to be brought under rotation with legumes or under animal production to make up for the lack of mineral fertilizer, since synthetic inputs, such as fertilizer, affect the soil as it cause dangers in terms of nutrient depletion which needs thorough review with the recent population explosion and the on-going trend of continual increase in the population density, man may have no option than to make the best and most efficient use of the land available for farming as there may not be so much land as to allow for shifting cultivation. In this regard, there is need for intensification if production must increase. The problem is that most rural farmers are not exposed to these new technologies and do not have access to the basic resources. In cases where they have been exposed to it, financial constraints will not afford them the opportunity to use them effectively; therefore most farmers still depend on their old methods, manual labour etc. for farming. How then, do we increase production?. Imagine a rural farmer cultivating plantain plantation on about ½ acre (3 plots) or 0.2ha and getting less than 1700kg of harvest per hectare per year. His large family will still have to feed from this, which leaves him with very little to sell and have profit. As a result of the increased in demand for food by the growing population and insufficient production to meet the demand, there has been sharp and frequent rise in food prices. This situation has necessitated the diversion of scarce foreign exchange to the importation of basic staple foods.

As emphasized earlier, the majority of farmers in Ekiti State engage in subsistence or peasant farming for their livelihood. These farmers are faced with problems of low income due to low productivity from their farm, thus resulting in lack of finance for other investments to meet their domestic needs. In view of all these problems encountered by the rural farmers, this study aims at

looking at the resource use level and efficiency of farmers in the study area vis-à-vis the technology use by farmers and the effect of the variety of suckers used and chemical with respect to productivity of the plantain.

**Objective of the study**

The main objective is to determine the production efficiency of plantain farmers in the study area. The specific objectives are:-

i. To describe the socio-economic characteristics of the plantain farmers in the study area
ii. To estimate the determinants of plantain output in the study area
iii. To compute the efficiency of resource use of farmers in the study area
iv. To determine the profit level of the plantain production

To make appropriate policy recommendations based on the findings.

## MATERIALS AND METHODS

**The study area:** The study was carried out in Ise/Orun and Ekiti South West Local Government areas of Ekiti State, Nigeria, which are predominantly plantain producing communities in Ekiti State. The state is an agrarian societies and one of the six (6) states constituting the south western region of Nigeria.

Ise/Orun and Ekiti South-West Local Government are two of the Local Government areas out of the 16 Local Governments areas that makes up of Ekiti State. The rain spread almost evenly throughout the wet season (April – October), while the dry season is between November and March. Agriculture provides employment for almost 70% of the population. The soils are fertile, deep and well-aerated loamy soils. The characteristics of the soil type and its large spread led to the springing up of many hamlets and farmstead in these two Local Government areas chosen for the study. Major crops grown are plantain, banana, yam, maize, cassava, cocoyam, and rice.

**Sampling procedure:** Purposive sampling procedure was employed in order to get a respondents sample. Farmers are selected purposively from the villages within the sampling frame.

In each of the Local Government areas, three villages were selected and in each of the village, twenty plantain farmers was purposively selected and interviewed. A total of one hundred and twenty respondents were used for the study.

Villages within the sampling frame include;

1. In Ise/Orun Local Government
i. Obada farm settlement
ii. Aba Kojola farm settlement
iii. Aba oko Oyo farm settlement
2. In Ekiti South-West Local Government
i. Aba Efon farm settlement
ii. Ilupeju farm settlement
iii. Igunrin farm settlement

**Method of data collection:** The data used for this study were obtained from both the primary and secondary sources. The primary data were collected through a pre-tested and structured questionnaire schedule, which was administered, on various groups of the respondents. The secondary data were obtained from the journals and textbooks. Resources tested for include land, labour, capital (pesticides, herbicides, and fertilizers) and other factors that contribute to the output obtained.

**Method of data analysis:** A number of statistical tools were employed in this study to address the stated objectives. The tools include descriptive statistics, regression (OLS) model, and gross margin.

Descriptive statistics - This was used to analyze the socio-economic characteristics of the plantain farmers specifically; percentage and frequency counts was used in the analysis of the socio-economic characteristics.

Regression analysis (OLS) – The ordinary least square regression contains a dependent variable (regressant) and two or more independent variables (regressors).

Regression analysis (OLS) was used to obtain the determinants or factor affecting the farmers' output.

**Model specification**

The implicitly function is given as

$Y= f (X_1……..X_n +e_i)$

Y=Dependent variable (Output in Naira)

$X_1$ ……...Xn= Explanatory variables

ei = Error term

Linear function $Y = b_o+b_1X_1+b_2X_2….+b_{11}X_{11}+ e_i$

$b_o$ = intercept coefficient

$b_1, b_2, b_3…. b_{11}$ = slope coefficient

$X_1$ = Farm size (ha)

$X_2$ = Use of tractor

$X_3$= Number of days for which tractor is used every season

$X_4$= Amount of hired labour used on the farm (man/days)

$X_5$ = Amount of family labour used on the farm (man/day)

$X_6$ = Quantity of pesticides used on the farm (LT)

$X_7$ = Quantity of herbicides used on the farm (LT)

$X_8$= Quantity of fertilizers used on the farm (KG)

$X_9$= Number of years of formal education

$X_{10}$=Number of years of farming experience

$X_{11}$= Gender of the farmer

Apriori expectation is expected that farm size will have a positive relation with the output i.e., as farm size increases, output should also increase. Also, availability of farm labour for farm operation should increase the output, as this will ensure timeliness of operations. The same explanation goes for hired labour. Unavailability of labour could cause delay of operations and affect output.

Pesticides and herbicides kills pests and weeds in the plantain farm respectively, giving the crops enough breathing space, these variables will have positive relations with output. The same explanation goes for fertilizer.

The farmers' socio-economic characteristics are expected to contribute to farmers' resources use efficiency. As farmers' advance in age, they tend to wear in energy and their ability to cope with stress reduces.

An experienced farmer should have knowledge that would help him to take measures to counteract bad (safety nets) and exploit the favourable ones. An educated farmer

is expected to accept more readily technological change and has a higher technical efficiency.

**Gross margin**: Gross Margin was used to analyze the respective profit of the farmers. Gross margin is the difference between the sales and the production costs or as the ratio of gross profit to sales revenue, usually in the form of percentage

$$\text{Gross margin (\%)} = \frac{\text{Revenue- cost of production}}{\text{Revenue}} \times 100$$

Profit is obtained by subtracting costs from revenue.

## RESULTS AND DISCUSSION

### Socio – Economic characteristics of the respondents

The study of the socio-economic characteristics of plantain farmers in the area are presented in table 1. The results revealed that majority of the farmers in the area are quite mature. It is observed that about 53.3% of the respondents is below 50 years of age. The mean age of respondents is 51.45 years. The implication of this is that most of the farmers are adult with much energy and as such can be so efficient in their farming activities with ability to cope with stress of farming.

Table 1 also shows that majority of the farmers are men, as 88.3% of the plantain farmers were men while only 11.7% are women. The marital status of the respondents revealed that 98.3% are married while 1.7% are single. The table also revealed that the majority of the respondents (52.6%) had between 4-6 family members and 34.2% had household size of between 7-9 members with only 1.7% having household size above 12.

Fifty five percent of the respondents had tertiary education while those with primary and secondary education were 21.7% and 22.5% respectively. Only 0.8% of them had no formal education. This larger percentage of plantain farmers interviewed attained tertiary educational level and hence, utilizes modern inputs which brought about high yields on their farms. Using of modern inputs such as herbicides, pesticides, fertilizers etc. as at when due helped the plantain farmers to boost the productivity of the crop. The more educated a farmer is, the more exposed he is and the more the chance that he will readily accept and adopt new innovations than the uneducated ones, who claim the soils are fertile and do not need fertilizers.

The table also shows that 79.1% of the respondents had less or equal to 10 years of plantain farming experiences. The little experience the farmer had, when getting into plantain production and ability to make used of the new innovation and the inputs efficiently helped the young farmers to produce more than farmers with long years of farming. Years of experiences in conjunction with the level of education has a lot to do with plantain production if the farmers actually need maximum profit/output. The Nigeria farming situation could be understood, according to Abdullahi (2008), 'general lack of scientific and technological capacity will severely limits actual production inspite of great inherent potential'.

**Table 1:** Socio – Economic characteristics of respondents

| Variable | Frequency | Percentage |
|---|---|---|
| Age | | |
| ≤ 40-50 | 12 | 10.0 |
| 51-60 | 52 | 43.3 |
| 61-70 | 40 | 33.4 |
| Above 70 | 13 | 10.8 |
| Total | 3 | 2.5 |
| Gender | 120 | 100.0 |
| Male | 106 | 88.3 |
| Female | 14 | 11.7 |
| Total | 120 | 100.0 |
| Marital status | | |
| Single | 2 | 1.7 |
| Married | 118 | 98.3 |
| Total | 120 | 100.0 |
| Household size | | |
| ≤ 3 | 4 | 3.4 |
| 4-6 | 63 | 52.6 |
| 7-9 | 41 | 34.2 |
| 10-12 | 10 | 8.3 |
| Above 12 | 2 | 1.7 |
| Total | 120 | 100.0 |
| Educational levels | | |
| No formal education | 1 | 0.8 |
| Primary education | 26 | 21.7 |
| Secondary education | 27 | 22.5 |
| Tertiary education | 66 | 55.0 |
| Total | 120 | 100.0 |
| Farming experience (yrs) | | |
| ≤ 10 | 95 | 79.2 |
| 11-20 | 15 | 12.5 |
| 21-30 | 5 | 4.2 |
| 31-40 | 2 | 1.7 |
| Above 40 | 3 | 2.5 |
| Total | 120 | 100.0 |

Source: Field survey, 2012.

### Determinats of Plantain output in Ise/Orun and Ekiti South-West LGAs.

**Regression equation**

$Y = bo + b_1X_1+b_2X_2\ldots+b_{11}X_{11}+e_i$

$Y=1.627+2.723X_1-1.879X_2- .561X_3+13.541X_4+7.448X_5+ 0.875X_6+4.282X_7+5.280X_8+1.560X_9 1.222X_{10}+0.185X_{11}+ 0.107$

### Regression analysis

This involves the use of ordinary least square (OLS) model to determine the factors that affect plantain output in the study area such as farm size, use of tractor, number of days for which tractor is used in every season, amount of hired labour used on the farm, amount of family labour used on the farm, quantity of pesticides used on the farm, quantity of herbicides used on the farm, number of years of formal education, number of years of farming experience, and gender of the farmer.

In carrying out the above objective, functional production functions were fitted to the data. The lead equation was selected based on magnitude of coefficients of OLS determination ($R^2$), the significance of the T-value and the appropriateness of the signs of the regression analysis, the linear functional form was used for the equation.

The results in Table 2 above shows that six out of eleven coefficients of the explanatory variables are significant which means that any change in those factors

results in change of returns from the farms. Positive effect is established for the farm size, amount of hired labour, amount of family labour, amount of pesticides used, amount of herbicides used, years of formal education, and gender of the farmers while negative effect is observed for the use of tractor, number of days/season for which tractor is used, and years of farming experience. The positive effect shows that increase in these inputs will increase the output or decrease in these inputs will decrease the output (i.e., it has direct proportionality) while the negative effect implies that increase in the inputs decrease the output and vice versa (i.e., it has inverse relationship).

A unit increase in the farmers' age reduces the output and this was supported by the assertion that the old are weaker which makes it impossible for them to produce as expected compared to the young farmers. The coefficients of the farm size, amount of hired labour, amount of family labour, amount of herbicides, amount of fertilizer and use of tractor are significant at 1% and 5% level respectively while other factors are not significant at any level.

**Table 2:** Results of regression Analysis (OLS)

| Model | B (Coefficient) | Standard Error |
|---|---|---|
| Constant | 1.627 | 0.107 |
| Farm size | 2.723$^{xxx}$ | 0.008 |
| Use of tractor | -1.879$^{xx}$ | 0.063 |
| If yes, how many days/season used | -0.561 | 0.576 |
| Amount of hired labour used | 13.541$^{xxx}$ | 0.000 |
| Amount of family labour used | 7.448$^{xxx}$ | 0.000 |
| Amount of pesticide used | 0.875 | 0.384 |
| Amount of herbicide used | 4.282$^{xxx}$ | 0.000 |
| Amount of fertilizer used | 5.280$^{xxx}$ | 0.000 |
| Number of years of formal education | 1.560 | 0.122 |
| Number of years of farming experience | -1.222 | 0.224 |
| Gender of the farmer | 0.185 | 0.853 |

Source: Field survey, 2012; $R^2$ =0.808; $^{xxx}$t- value significant at 1%; $^{xx}$t – value significant at 5%.

**The efficiency of resource use of plantain farmers**

The result of descriptive analysis of the efficiency of resource use of plantain farmers are presented in table 3. Table 3 shows that 31.7% of respondents utilize hired labour compared to 12.5% which uses family labour while the remaining 55.8% utilizes both hired and family labour on their farms. It is observed that most of the farmers use hired and family labour for their production to maximize output or profit. This is feasible considering the moderate size of household that are not always available all the time for the farming work.

The table also revealed that 74.2% of the plantain farmers utilizes between 3-5 liters of pesticides while only 0.8% utilizes above 11 liters. In the same vein, 88.3% of the respondents utilize 3-8 liters of herbicides, 0.8% uses 18-20 liters while 16% uses more than 20 liters. The table also shows that 30.0% of plantain farmers uses between 26-65kg of fertilizer, 39.2% uses between 66-105kg and 1.3% uses between 106-145 of fertilizers during the production period. The farmers stand to benefit more with the increase in farm size and appropriate efficient use of the resources such as land, labour, capital (pesticides, herbicides and fertilizers) and management and other factors that contribute to the output obtained.

**Table 3:** The efficiency of resource use of Plantain farmers in the study area

| Variable | Frequency | Percentage |
|---|---|---|
| Labour | | |
| Hired | 38 | 31.7 |
| Family | 15 | 12.5 |
| Hired + Family | 67 | 55.8 |
| Total | 120 | 100.0 |
| Pesticides usage | | |
| ≤ 2 | 16 | 13.3 |
| 3-5 | 89 | 74.2 |
| 6-8 | 13 | 10.8 |
| Above 9 | 2 | 1.7 |
| Total | 120 | 100.0 |
| Herbicides usage | | |
| ≤ 2 | 11 | 9.2 |
| 3-8 | 106 | 88.3 |
| 9-14 | 0 | 0.0 |
| 15-20 | 1 | 0.8 |
| Above 20 | 2 | 1.7 |
| Total | 120 | 100.0 |
| Fertilizers usage | | |
| ≤ 25 | 34 | 28.3 |
| 26-65 | 36 | 30.0 |
| 66-105 | 47 | 39.2 |
| 106-145 | 1 | 0.8 |
| Above 145 | 2 | 1.7 |
| Total | 120 | 100.0 |

Source:- Field survey, 2012.

**Conclusion**

From the study carried out from the study areas, the following conclusion can be drawn. It is clear that plantain farmers in Ise/Orun and Ekiti South-West Local Government Areas operates on small scale, their farms are too small to permit economic efficiency. A lot of plantain farms cultivated are less than or equal to two hectares. 88.3% of the respondents has less than 1 ha farm, 10.8% of the respondents has less than 2 ha farm and 0.8% of the respondents has 2 ha farm, it shows that farmers in the study area usually plant plantain on just 0.2 – 2 ha which resultant to the yield of production.

Also, the use of both hired and family labour by the respondents accounts for the increased in production because, few farmer use family labour. The fact that the bulk of plantain farmers also revealed that 98.3% of the plantain farmers used moderns' technology such as tractor, herbicides, pesticides, and fertilizers which increases the output of plantain production.

It is envisaged that, the level of production efficiency is strongly affected by the management ability of the individual farmer and also by the use of chemical input. Social factor such as the size of farm holding, labour, level of education etc have a direct and indirect effect on agricultural production. Economic and technological factor, which are very dynamic, emerge in the form of mechanization to a large extent, have both direct and indirect effect on the production.

Application of science and technology for development remains the major tools which man has to employ to deal with dynamic challenges for his survival, the most critical thing is that of food to sustain life.

**Recommendations**

Within the context of this finding, the following recommendations are made:-

- Investing in agriculture to raise agricultural productivity, especially among small scale farmers should therefore be given the highest priority to achieve food security in the country.
- The illiterate farmers should be assisted with informal adult education so as to be better managers of their individual farms.
- Governments should provide subsidy to farmers as most of them cannot afford technological innovations due to lack of credit facilities.
- Of what use to a peasant farmer is credit scheme that requires collateral he does not even have? It is advised that policy and opportunities that meets the need of the ideal situation of the farmers be established and not those that favour large scale farmers only.
- Given the low level of cash income at the farmer's disposal, promoting micro finance institutions accessible to small farmers could pay an immense role in the use of modern inputs and technological transfer.
- Government should assist the farmers in the provision of inputs like fertilizers, pesticides, herbicides, and tractor hiring services at affordable rates.
- Extension agents should be provided and sent to this area to assist the farmers in bridging information gap between the research stations and the farmers as regard new findings and education of the farmers.
- Considering the high price of fertilizer, more research work should be concentrated on the best alternative method of soil consideration that can easily be developed locally so that yield dwindling would not be permanent.
- In addition, developing input markets, especially for pesticides, herbicides and fertilizers is crucial. Government should allow and encourage full participation by private traders so as to improve the supply and distribution of inputs.

Finally, if productivity must increase, small scale farmers must improve their use of modern inputs and practice better soil conservation techniques.

**Acknowledgement**

The contribution of FAGBEMI Abiodun Isaac is hereby acknowledged for collecting data utilized for this study.

## REFERENCES

Abdullahi A, 2008. Technology transfer: A paper presented at the World Agricultural Forum, 2008 World Congress.

Akinyemi SOS, IOO Aiyelaagbe and E Akyeampong, 2006. Plantain cultivation in Nigeria: A review of its production, marketing and research in the last two decades. Paper presented at the MUSACO Conference, Cameroon, 18-20 Sept, 2006.

Breman H, 2007. Opportunities and Constrain for Sustainable Development in Semi-arid Africa. UN/INTECH Working Paper No 18, March, 2007.

Darst BC, 2006. Sustainable Agriculture a Modern Perspective. Better crops, 84: 2006.

FAO, 2006. Food Security at National Level. FAO policy 2006 publication.

Farrel MJ, 2007. The Measurement of Production Efficiency. J Royal Statis Soc, series A, 120: 252-281.

Kyi T and M Oppen, 2006. An economic analysis of technical efficiency of rice farmer at Delta Region in Myanman.

Louise Fresco, 2008. Fertilizer and the future. FAO, Ag 21 magazine, 2008.

Okuneye PO, 2008. Under-employment and increased labour productivity. A linear programming analysis of family and commodity farms in Nigeria. NAAE Conference Proceeding, January 2008.

Olayemi JK, 2006. Food production by small farmers in Nigeria, problems and prospects in IRD, 18-32.

Olayide SO and EO Heady, 2008. Introduction to Agricultural Production Economics. Ibadan University press, 130 -136.