Direct Research Journal of Agriculture and Food Science

Direct RESEARCH JOURNALS

Vol.6 (12), pp. 378-384, December 2018
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS.2018.1590
Article Number: DRJA937251590

http://directresearchpublisher.org/journal/drjafs
Research paper

Economic Efficiency of Male and Female Irish Potato Farmers in Plateau State, Nigeria: A Translog Profit Function Approach

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Received 3 November 2018; Accepted 7 December, 2018

This study compares relative economic efficiency between male and female Irish potato farmers in Plateau State. Multi-stage sampling technique was used in this study. A sample of 500 farmers was randomly selected using proportionality factor from the 27 villages selected from nine local government areas. Data were collected using structured questionnaire and analyzed using descriptive statistics, t-test and the translog profit function model. The results revealed that the mean age were 47 years and 42 years for male and female farmers, respectively, with average household size of 7 and 5 persons. The Cobb-Douglas profit function models, Zellner's method without restriction; restriction 1, 2 and 3 revealed that the coefficients of all the variables have expected signs except fertilizer. To increase the output/profit level of male farmers by N1.00/kg of potato yield, labour cost should be increased by N0.52, fertilizer cost by N0.72, seed cost by N0.46 and agro-chemical by N3.33. The major conclusion from the result of this study is that female farmers are as efficient as male farmers in potato production. There is no economic rationale for any bias against women. Both farmers should be encouraged to use organic fertilizer because of high cost of inorganic fertilizers in the study area.

Keywords: Economic efficiency, Profit function, Coefficient, Zellner Restriction, Share factor

INTRODUCTION

Irish potato was introduced into Nigeria as far back as the later part of the 19th Century and early 20th Century by Europeans, notably the tin miners (Okonkwo *et al.* 1995). Varieties introduced then and which deteriorated in quality were Hajiya, Ampijan Kamarun, Botos, Gwaiwan Kare, Kamerun, Dafom, Kankule and Mai Tumatur. However, with the establishment of Irish Potato Programme in Kuru by NRCRI in 1976 improved varieties were imported and bred. These were screened and those found adaptable to the temperate regions of the country were released to farmers. These are RC 767-2, RC 7716-4, Nicola, Desiree, Kondo, Cliamant, Bartita, Roslin Ruaka, Lady Christyl and Kennebec. Irish potato requires an optimum temperature of 15°C for tuber formation (Borah and Milthrope, 1962). Jos Plateau meets this condition in both rainy and dry seasons. In the dry season potato is planted in late October or early November to take advantage of the low December and January temperatures for tuberization. Time of planting potato in the rainy season depends on the onset of rains. Generally, it is planted between the last week of April and end of May each year. Off season productions occurs between August-November (Okonkwo *et al.,* 1995).

Variety of literature is available on the role of agriculture in economic development in Africa and on the critical role that rural women play within this sector. With the share of 42.7% of the total GDP in 2003, agriculture is the largest contributor to the Nigerian economy, by far surpassing wholesale and trade (17.3%) and the oil and gas sector (17.54%). It is also the single largest contributor to the welfare of the rural poor, sustaining about 86% of rural household in Nigeria. Further, there is a significant gender dimension to agriculture too, as about 80% of the rural female populations are engaged in

agricultural activities (Okoro and Ujah, 2010). According to NBS, (2008), the working population data indicates that growth rate of agricultural working population seems to be the driver of the growth rate in total working population compared to any other sector of the economy. The growth rate of agricultural working population dropped from 3.73% in 2003 to 1.94% in 2007, while that of the total working population dropped from 4.46% in 2003 to 3.22% in 2007. This suggests that agriculture holds the potentials for tackling unemployment in the country at least in the short run.

In Sub-Saharan Africa (SSA), agriculture accounts for approximately 21% of the continents GDP with as low as 8% in Congo and as high as 50% in Tanzania (FAO, 2008). Employment in agriculture ranges from as low as 40% in Morocco to as high as 85% in Burkina Faso. Women contribute 60-80% of the labour used to produce both for household consumption and for sale (FAO, 2008). A growing body of empirical evidence from both developing and developed countries now indicates that allocation decisions within households are commonly not consistent with the unitary household model (Quisumbing, 1996). Allocation decisions appear to reflect both different preferences among different household members by gender, age and differences in resource control including income, assets and education as well as factors external to the household such as laws, norms and economic institutions. Power relations within the household and the community also affect household and resource allocation choices. Studies that have measured productivity of men and women farmers without attempting to take into account women's lower access to resources have found women to be less productive than men. Quisumbing, (1996) documents the difficulty in comparing levels of productivity between men and women. The author attributes this to methodological and conceptual difficulties. This arises from defining appropriate measures of productivity in different farming systems. Omission of individual characteristics in attempts to measure productivity differences by sex, and the lack of clarity regarding the measurement of sex and gender differences. It is feasible to estimate technical efficiency differences between male and female farmers in farming systems where men and women manage different plots. It is however more difficult to isolate managerial efficiency differences in settings where plots are cultivated jointly by male and female members and hired labor (Quisumbing, 1996).

The focus on the gender relations within which resources are controlled and used is crucial both for understanding local resource management, practices and innovations, and for assessing policies to support or supplement them. Both conventional gender blind approaches and those, which isolate women's roles for analysis, tend to obscure these gender relations (Nwaru *et al.,* 2012). Time allocation studies have been used to describe gender and age based labor patterns (Njuki *et al.,* 2009). Labor patterns have been analyzed to support a wide range of findings including the determination of peak labor periods, income opportunities for female farmers, the contribution of children to farm production, crop labor investments, and seasonal fluctuations in agricultural and non-agricultural activities and inter household differences in the family cycle (Suleiman and Ibrahim, 2014).

Among the various functional forms, a flexible functional form for the profit function is preferred and translog, normalized quadratic and generalized Leontief are some of them. Restricted normalized translog profit function is utilized as it can depict input demand and output supply simultaneously. The translog profit function is a flexible functional form to estimate the input demand as it can eliminate problems related to the restrictiveness as required by Cobb-Douglas profit function (Carl and Hammonds, 2016). Therefore, many researchers chose to start from a profit function and derive input demand and supply response functions from the profit function based on Hoteling's Lemma (Carl and Hammonds, 2016). The study attempts to resolve the following research questions:

(a) What are the socio-economic characteristics of male and female Irish potato farmers?
(b) Is there any difference in profit between male and female Irish potato farmers in Plateau State?
(c) Is there gap needed to bridge the gap of output/ profit relationship?

The broad objective of the study is to compare relative economic efficiency between male and female Irish potato farmers in Plateau State of Nigeria. Specifically, the study intends to:

(a) Describe the socio-economic characteristics of male and female Irish potato farmers.
(b) Determine the factors that affect farm profit between male and female Irish potato farmers in the study area.
(c) Determine the output/profit relation for optimum profit maximization.

METHODOLOGY

Study area

Plateau state, North-central Nigeria, was created in 1976 out of the northern half of former Benue-Plateau state. It is located between latitude 08°24'N and longitude 08°32' and 10°38' east. It is bounded by the states of Kaduna and Bauchi on the north, Taraba on the east, and Nasarawa on the south and west. The Jos Plateau rises to about 5,250 feet (1,600 m) above sea level in the state's north-central part, and the Benue River valley stretches along the southwestern border. Although there

are wooded valleys in the southeast, the vegetation is mostly open grassland (formerly wooded but now with only occasional hedges of cacti and scattered trees), which is used for grazing and farming.

Although the state is best known for its mining activities or exploration, agriculture is the major occupation of the people. Acha (a grain known as “hungry rice”) and millet are the chief cash crops; yams, sorghum, corn (maize), potatoes, cowpeas, rice, fruits, and vegetables are the staple crops. Fulani herdsmen graze their cattle on the tsetse-free plateau and supply milk to the dairy at Vom. Among the major exports of the state are hides and skins. Though situated in the tropical zone, a higher altitude means that Plateau State has a near temperate climate with an average temperature of between 18 and 22 °C. Harmattan winds cause the coldest weather between December and February. The warmest temperatures usually occur in the dry season months of March and April. The mean annual rainfall varies from 131.75 cm (52 in) in the southern part to 146 cm (57 in) on the Plateau. The highest rainfall is recorded during the wet season months of July and August. The average lower temperatures Plateau State has led to a reduced incidence of some tropical diseases such as malaria. The Jos Plateau makes it the source of many rivers in northern Nigeria including the Kaduna, Gongola, Hadejia and Yobe rivers. It has an area of 30,913 square kilometer and a population of 3,582,720 people, NBS, (2017). The study area covered nine local government areas out of the 17 local government areas of Plateau State. The nine local government areas with a total land area of 9,217 square kilometers and an estimated population of 2,196,732 are noted for intensive Irish potato production in Plateau State. These are Jos North (492,300), Jos South (346,716), Jos East (110,602), Bassa (159,993), Riyom (151,557), Barkin Ladi (205,267), Bokkos (199,681), Mangu (314,931) and Pankshin (215,685). The total number of farmers engaged in different farm enterprises were estimated at 52,881 and 4,989 of this number were engaged in potato enterprise PADP, (2017).

Sampling procedure

The correct sample size is difficult to arrive at but depends upon the nature of the population. Titus *et al.* (2008) recommended at least 10% of the population to be used as sample size. The author added that researchers require statistical input and consideration in sample size determination and this appears to be a more acceptable rule in research. A sample size of 11% for this study is considered adequate. Multi stage sampling procedure was employed. First, Plateau State was purposively selected based on a priori knowledge that the State is a potato producing State and that both men and women were actively involved in Irish potato production.

Data analysis

Appropriate models were developed to analyze the specific objectives. The various models so specified were highlighted under separate headings in line with the objectives of the study.

Descriptive statistics

Descriptive statistics such as mean, percentages and t-test had been used by Ike, (2012); Simonyan *et al.* (2012); Adegbite *et al.* (2008) and Kudi *et al.* (2008) in their various studies. These models were also used in describing the socio- economic characteristics of male and female potato farmers in Plateau State.

Normalized profit function

Normalized profit function was used to analyze objective five of the study. The normalized profit function was used to determine the economic efficiency as adopted by Adesina and Djato, (1997) and Ajani, (2000). It was estimated as a function of variable inputs and the quantities of the fixed inputs of production under the assumption that they are the independent variables (Yotopoulous, 1986).

The cobb-Douglas normalized profit function with four variable input labour, seed, fertilizer and agrochemicals and one fixed input land is written as;

$$\ln \prod^{*} = \ln A + \alpha^{*} X_1 \ln P^{*} X_1 + \alpha^{*} X_2 \ln P^{*} X_2 + \alpha^{*} X_3 \ln P^{*} X_3 + \alpha^{*} X_4 \ln P^{*} X_4 + \beta^{*} X_5 \ln Y^{*} X_5 + \delta D_1 \quad \text{----------} (1)$$

Where

∏* = Normalized profit in Naira (revenue less variable cost)
A = the intercept.
$P^{*}X_1$ = Money wage in Mandays normalized by the price of potato.
$P^{*}X_2$ = Price of fertilizer in kilogram normalized by price of potato.
$P^{*}X_3$ =Money price of seed in kilogram normalized by the price of potato per hectare.
$P^{*}X_4$ = Money price of chemical in litre normalized by the price of potato in hectare.
$Y^{*}X_5$ = the net area sown to potato in hectare.

Factor share functions

The factor share equation was used to analyze objective five. The factor share represents the ratio of expenditure on each input used to profit. Thus, the expenditure on the variable inputs is given by;

$$PjXj \ldots (2)$$

Where

P_j= Prices of inputs used.
X_j = Quantity of inputs used per hectares

The factor share function which is the ratio of inputs to profit is given by:

$$\alpha^{**}L = \frac{P^{*}_{L} X_L}{\Pi^{*}} \quad \text{----------(3)}$$

$$\alpha^{**}F = \frac{P^{*}_{F} X_F}{\Pi^{*}} \quad \text{----------(4)}$$

$$\alpha^{**}S = \frac{P^{*}_{S} X_S}{\Pi^{*}} \quad \text{----------(5)}$$

$$\alpha^{**}H = \frac{P^{*}_{H} X_H}{\Pi^{*}} \quad \text{----------(6)}$$

Where

X_L = the total labour use in days.
X_s = quantity of seed use in kilograms
X_F = quantity of fertilizer used in kilograms.
X_H = quantity of chemical used in liter.
α^{**}_L = factor share for labour.
α^{**}_F = factor share for fertilizer per hectare.
α^{**}_s = factor share for seed used per hectare.
α^{**}_H = factor share for chemical per hectare.
P^{*}_F = Unit price of fertilizer per 50Kg bag.
X^{*}_F = Fertilizer used per hectare (Kg).
P^{*}_S = money price of seed in kilogram.
P^{*}_H = Unit price of chemical in litre per hectare.
Π^{*} = normalized profit.

RESULTS AND DISCUSSION

Socio-economic parameters considered here were age, years in farming experience, years in potato farming, household size, household members engaged in potato farms, education, farm land acquisition and labour. Socio-economic status is a composite measure of an individual economic and sociological standing. In this study influence of individual socio-economic characteristics of male and female potato farmers and their impact on farm efficiency were described. The results of the analysis were presented in (Table 1) which covered the study objective of determining the socio-economic characteristics of farmers in the study area. Table 1, showed the average ages for men and women potato farmers are 46 and 42 years respectively. Age is a very important parameter used in measuring the productivity and efficiency of farmers. It is assumed that young and active farmers will be more productive than older farmers. This therefore showed that majority of the two groups were within their economically productive age (15-64 years) as defined by FAO, (2008) though there was a significant difference between men and female farmers. The finding further affirms the claim of Adegbite *et al.* (2008), who stated that, the farmers' average of 47 years and 48 years were still within a productive and active working age range.

The average years of experience of male and female are 18 and 12 years respectively. The result of significant difference showed a positive and significant difference between male and female at 1% level of probability, indicating that male was more experienced than their female counterparts and were expected to have higher efficiency. Farmers in the study area have experience in potato farming with a mean of 13 and 9 for male and female respectively. There was a significant difference between the male and female potato farmers. This finding implied that male farmers were more experienced in potato farming as such could manage risk better than the female farmers. The longer experience in potato production by male farmers also implied better production efficiency. Nwaru, (2003) reported that farmers count more on their experience than educational attainment to increase their productivity. the mean household size were 7 and 5 persons for male and female farmers respectively. There is a positive and significant difference at 1% level of probability between male and female potato farmers' household size, indicating male had more number of family members than the female farmers. Effiong, (2005), Okonkwo *et al.,* (2008) and Idiong, (2009) reported that a relatively large household size enhances the availability of family labour though large household size may not guarantee increased efficiency since family labour which comprises mostly children of school age were always in school. The implication of the result is that family size is an important source of family labour and a reduction in the cost of hired labour. The mean households' size that was engaged in the cultivation of potato farms for both male and female farmers were 4 and 2 respectively. There was a significant difference between male and female potato farmers at 1% level of probability, indicating male had engaged their family more to supplement their inability to hire labour to complete all farm operations.

Estimated result of normalized profit function approach

The normalized profit function was used to determine the economic efficiency. It was estimated as a function of variable inputs and the quantities of the fixed inputs of production under the assumption that they are the independent variables. Results of the economic efficiency between male and female potato farmers using translog

Table 1. Socio economic characteristics of male and female potato farmers in Plateau State.

	MEAN (ha)		
Variables	**Male**	**Female**	**t-value**
Age	47	42	4.088***
Farming exp	18	12	7.808***
Exp in pot farm	13	8	1.164*
House hold size	7	5	3.482***
Household in pot farm	4	2	6.555****

Field survey 2017.

Table 2. Means and standard deviation of variables used in the analysis.

Variables	**Male**		**Female**		**t-value**
	Mean	**SD**	**Mean**	**SD**	
Normalized Wage rate (P^*_L)	0.0043	0.061	0.062	0.078	-3.001***
Normalized Price of fertilizer (P^*_F)	0.042	0.039	0.036	0.041	1.395^{NS}
Normalized Price of Seeds(P^*_S)	0.107	0.120	0.094	0.113	1.250^{NS}
Normalized Price of chemical (P^*_C)	0.021	0.052	0.014	0.035	1.795*
Farm size	0.772	0.470	0.693	0.345	2.147**

Source: Field Survey, 2017
*** Statistical significance at 1%
** Statistical significance at 5%
* Statistical significance at 10%
SD = Standard Deviation
SED = Standard Error Mean.

Table 3. Estimation of Cobb-Douglas profit functions for male and female potato farmers in Plateau State.

	Zellner's Method with Restriction			
Parameters	**Unrestricted**	**1. Restriction** $\alpha^{**m} = \alpha^{**f}$	**2. Restriction** $\alpha^{**m} = \alpha_i^*$ $\alpha^{**m} = \alpha_i^*$	**3. Restriction** $\alpha^{**m} = \alpha_i^*$ $\alpha^{**f} = \alpha_i^*$ $\beta^{**}_K = 1$
Constant	5.772*(6.372)	6.142*(6.782)	5.522*(6.115)	6.263* (34.821)
Labour α^*_L	-0.531***(-10.194)	-0.531*(-10.194)	- 0.56***(-12.551)	-0.529***(-10.181)
Fertilizer α^*_F	-0.318 (0.338)	-0.318 (-0.338)	-0.167* (-29.390)	-0.319 (-0.340)
Seed α^*_S	0.457** (2.929)	0.457* (2.929)	-0.442* (-20.890)	0.462* (2.968)
Chemical α^*_C	-0.558**(-0.342)	-0.563*(-3.210)	-0.563*(-4.210)	-0.563*(-3.710)
Farm size β^*_K	1.004*** (45.056)	1.004*** (45.056)	1.006*** (5.321)	1.002***(45.519)

Source: Field Survey, 2017
Values in parentheses are the respective t-value of the associated parameters
*** Statistical significance at 1%
**Statistical significance at 5%
*Statistical significance at 10%

profit function analysis were presented in (Tables 2 to 4). The Zellner's seemingly unrelated regression estimate (SURE) was used to estimate the system of equations. A quantitative assessment of the comparison of relative economic efficiency between male and female potato farmers included in the study was carried out using profit function analysis. Four variables inputs-labour, seed, fertilizer and chemical and fixed input land were considered to be important in estimating the Cobb-Douglas profit function model. The means and standard deviation were presented in (Table 2). These included the normalized wage rate, normalized price of seed, normalized price of fertilizer, normalized price of agro chemical, as well as area cultivated by male and female potato farmers. The extents to which all the variables affected differences in profit maximization of both male and female potato farmers were computed. Agro-chemical and farm size were the only variables with positive and statistical differences indicating differences between male and female farmers. Table 3 presented the joint estimation of Cobb-Douglas profit function and share factor equations. As predicted by Economic theory, the profit function was decreasing or convex in wage rate, fertilizer, seed and agro-chemical and increasing or concave in land. The estimated coefficients of all the variables had their expected signs except fertilizer.

Table 4. Estimation of Share Factor Equations for Male and Female Potato Farmers in Plateau State.

Zellner's Method with Restriction				
Parameters	**Unrestricted**	**1. Restriction** $\alpha^{**m} = \alpha^{**f}$	**2. Restriction** $\alpha^{**m} = \alpha_i^*$ $\alpha^{**f} = \alpha_i^*$	**3. Restriction** $\alpha^{**m} = \alpha_i^*$ $\alpha^{**f} = \alpha_i^*$ $\beta^{**}_K = 1$
Labour (α_L^{**M})	-0.516** (-8.53)	-0.559** (-23.972)	-0.522* (-12.550)	-0.875* (-8.521)
Labour (α^{**F}_L)	-4.531* (-20.194)	-2.531*(30.194)	-3.567* (-29.551)	-4.529*(-30.181)
Fertilizer α^{**M}_F	-0.718 (0.338)	-0.617 (-0.338)	-0.767* (-29.390)	-0.719 (-0.340)
Fertilizer α^{**F}_F	-0.318 (-34.338)	-0.328 (-42.358)	-0.219 (-31.346)	-0.118 (-34.128)
Seed α^{**M}_S	-0.457** (-12.929)	-0.457*** (-32.929)	-0.442*** (-20.890)	-0.462*** (-32.96)
Seed α^{**F}_S	-0.558** (-33.668)	-0.557** (-32.167)	-0.558** (-34.278)	-0.467** (-33.468)
Chemical α^{**M}_C	-3.334* (-45.056)	-3.454*(-45.056)	-1.786*(-5.321)	-3.892*(-45.519)
Chemical α^{**F}_C	-4.326*** (-43.156)	-4.434***(-43.156)	-4.535*** (-44.056)	-4.414***(-45.058

Source: Field Survey, 2017
Values in parentheses are the respective t-value of the associated parameters.
***Statistical significance at 1%
**Statistical significance at 5%
*Statistical significance at 10%

The wrong sign of the coefficient of fertilizer was attributed to the fact that fertilizer input was scarce, and farmers could barely buy because of the high cost. Land and labour inputs were highly significant at 1% (P >0.01), while seed and agro-chemical were significant at 5% (P >0.05) in the profit function. The coefficients were estimated using Zellner's seemingly unrelated regression estimates (SURE) with one, two and three restrictions respectively. When one restriction (restriction of equal factor shares of male and female potato farmers) was imposed, all the coefficients of input variables except fertilizer had the expected signs. However, when the restriction of profit maximization (2 restriction) were imposed, that is, equating value of each factor' s marginal product to their respective factor prices, all the variables had the expected theoretical signs. Similarly, all the variables were statistically significant. With three restrictions, that is maintaining the profit maximization restriction with constant return to scale, all the variables except fertilizer had their signs. Rajapaksha and Karunagoda, (2009) concluded that the fertilizer demand is highly responsive to the paddy rice output and profit. According to their estimation fertilizer demand is elastic with respect to its own price as it affects output and farmers profit. However, normalized translog profit function estimated by them used interaction between output price, profit and inputs prices in their model. Based on simple Cobb-Douglas approach using individual farm level data, Weligamage *et al*. (2009) also found that the coefficient of fertilizer is not significant and that the elasticity of paddy yield with respect to fertilizer application is inefficient. Wijetunga, (2016) in his study of rice production structures in Sri Lanka: the normalized translog profit function approach concluded that paddy output with respect to fertilizer price is also inefficient, and output significantly affect profit, as such fertilizer demand is inelastic, therefore, fertilizer subsidy is one of the main factor to increase fertilizer demand as well as paddy output/profit in the country. The variable inputs demand coefficients in potato production for the male and female farmers were presented in (Table 4). For the male farmers, the labour demand coefficients for unrestricted was -0.52. It was -0.72 for fertilizer, -0.46 for seed and -3.33 for chemical. The implication of the values of these coefficients was that, to increase the profit/output level of male potato farmers by one naira/kg potato yield, labour cost would have to increase by 52 kobo, while fertilizer cost would increase by 72 kobo, seed cost would increase by 46 kobo and agro-chemical would increase by ₦3.33. For female farmers, the labour demand coefficient was -4.53, it was -0.32 for fertilizer, -0.56 for seed and -4.33 for chemical. By implication, to increase the profit/output level of female potato farmers by one naira/kg of potato yield, labour cost would have to increase by ₦4.33, while fertilizer cost would increase by 32 kobo, seed would increase by 56 kobo and agro-chemical cost would increase by ₦4.33. This finding agreed with those of Hess and Surry, (2011) and Rajapaksha and Karunagoda, (2006). The null hypothesis which stated that the relative price or allocative efficiency of men and women farmers was not equal is hereby rejected. That is because male and female farmers equated the value of marginal product of labour to wage rate, the value of marginal product of seed to seed price, the value of marginal product of fertilizer to fertilizer price, to the same degree in the factor share equations. Hence, the implication is that men and female farmers do not have different price efficiency parameters, that is, they both succeed to the same in maximizing profits.

Conclusion

The quantitative assessment of the comparison of relative economic efficiency between male and female potato farmers was carried out using profit function analysis. Four variable inputs; labour, fertilizer, seed and chemical; and one fixed input area cultivated were fitted into the Cobb-Douglas profit function models. Zellner's method without restriction, restrictions 1, 2 and 3 showed that the coefficients of all the variables had expected signs except fertilizer.

Recommendations

(i) To increase the output/profit level of male farmers by ₦1.00/kg of potato yield, labour cost should be increased by ₦0.52, fertilizer cost by ₦0.72, seed cost by ₦0.46 and agro-chemical by ₦3.33. For female farmers, labour cost would have to increase by ₦4.33, fertilizer cost would increase by 32 kobo, seed would increase by 56 kobo and agro-chemical cost would increase by ₦4.33.
(ii) The need to completely liberalize the procurement and distribution of fertilizer is necessary to increase efficiency of both male and female farmers.
(iii) Providing labour saving technology to ease farm operations is also recommended for increase efficiency.

REFERENCES

Adegbite DA, Oloruntoba AO, Adubi KO, Oyekunle O, Sobanke SB (2008). Impact of National Fadama Development Project 11 on Small Scale Farmers' Income in Ogun State: Implications for Agricultural financing in Nigeria. *Journal of Sustainable Development in Africa*10 (3): 103-126.

Adesina AA, Djato KK (1997). "Relative Efficiency of Women as Farm Managers: Profit Function Analysis in Cote d'Ivoire." *Agricultural Economics*16: 47-53.

Ajani OIY (2000)."Resource Productivity in Food Crop Farming in the Northern Area of Oyo State, Nigeria." Unpublished Ph.D. Thesis, University of Ibadan, Nigeria.

Borah MN, Milthrorpe FL (1962). Growth of Potato as Influenced by Temperature. *Indian Journal of Plant Physiology* Vol.5:53-72.

Carl OW, Hammonds TM (2016). Use of Profit Function Models to Measure Efficiency. *Journal of Food Distribution Research*.7(3):54-60.

Effiong EO (2005). Efficiency of Production in Selected Livestock Enterprises in Akwa-Ibom State, Nigeria. Unpublished Ph.D. Dissertation, Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, Nigeria.

Food and Agricultural Organisation, FAO, (2008). International year of potato: The Potato Cultivation. Retrieved June 12th 2016 from www.potato2008.org@FAO,2008.

Hess S, Surry YR (2011). The CDET Profit Function: A Parsimonious Agricultural Sector Model. *European Journal of Agricultural Economics.* 13(4):88-101.

Idiong IC (2009). Evaluation of Technical, Allocation and Economic Efficiency in Rice Production Systems in Cross River State, Nigeria. Unpublished Ph.D. Thesis, University of Ibadan, Nigeria Pp.52-53.

Ike PC (2012). An Analysis of the Impact of Fadama 111 project on poverty Alleviation in Delta State, Nigeria. *Asian Journal of Agricultural Science* 4(2):158-164.

Kudi TM, Usman L, Akpoko JG, Banta AL (2008). Analysis of the Impact of National Fadama Development Project 11(NFDP 11) In Alleviating Poverty Among Farmers in Giwa Local Government area of Kaduna State, Nigeria. *Ozean Journal of Applied Science* 1(1): 10-15.

NBS (2008). The Nigerian Statistical Fact Sheet in Economic and Social Development National Bureau of Statistics, Abuja, Nigeria.

NBS (2017). National Bureau of Statistics Annual Bulletin for the Year 2017, Abuja, Nigeria.

Njuki JM, Kihiyo VBM, Oktingati A, Place F (2009). Productivity Differences Between Male and Female Managed Farms in the Eastern and Central High Lands of Kenya. Contributed Paper for Presentation at the International Association of Agricultural Economists' Conference, Gold Coast, Australia, August 12-18, 2009.

Nwaru JC, Ndukwu PC, Tadele F, Abu G (2012). Estimation of Farm Level Technical Efficiency and its Determinants Among Male and Female Sweet Potato Farmers in Imo State, Nigeria. *Ethiopian Journal of Economics.*20:99-112.

Okonkwo JC, Ene LSO, Okoli OO (1995). *Potato Production in Jos Plateau* National Root Crops Research institute, Umudike, Nigeria.Pp.1-33.

Okonkwo JC, Amadi CO, Nwosu KI (2008). Potato production, storage, processing and utilization in Nigeria. National Root Crops Research Institute, Umudike, Nigeria.

Okoro D, Ujah O (2010). Investment Analysis of the Agricultural Sector in Nigeria 2000-2008 Volume 11. State Level Investment Analysis; Voices for Food Security.Pp. 4-32.

PADP (2017). Plateau Agricultural Development Programmes. Annual Report for the Year 2017. Plateau State, Nigeria.

Quisumbing A (1996) Male-female differences in agricultural productivity. Methodological issues and empirical evidence. World Development 24:1579-1595.

Rajapaksha RDDP, Karunagoda KS (2006). Fertilizer demand for paddy cultivation in Sri Lanka with special reference to fertilizer subsidy program. Sri Lanka Journal of Agrarian Studies, 13(2):25-38.

Simonyan JB, Olukosi JO, Omolehin RA, Atala TKA (2012). Productivity and Technical Efficiency among Beneficiary Farmers of Second National Fadama Project in Kaduna State, Nigeria: *American Journal of Experimental Agriculture.* 2(1): 102-110.

Suleiman HR, Ibrahim H (2014). Relative Economic Efficiency of Mechanized and non-Mechanized Rice Farmers in Nasarawa State, Nigeria. *Journal of Economics and Finance 5*(2):1-8.

Titus OG, Olise MC Eze GA (2008). Research Methods in Business Management Sciences, Iyke Ventures Production, Enugu, Nigeria. p.258.

Weligamage PCR, Shumway KA, Blatner WR, Butcher GM (2009). Production Function for Rice in Kiridi Oya Major Irrigation System in Sri Lauka. Presentation of the Third Annual Research Forum of Sri Lanka Agricultural Economics Association, October 21, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo.

Wijetunga CS (2016). Rice Production Structures in Sri Lanka: The Normalized Translog Profit Function Approach. *Asian Journal of Agriculture and Rural Development.* 6(2):21-35.

Yotopoulous PA (1986). Allocative efficiency in Economic Development. A Cross-sectional analysis of Epirus Farming. Research Monograph Series,18:68-72.