International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Technical Efficiency of Yam Based Intercropping System among Farmers in Abia State, Nigeria (Using Trans - Log Frontier Production Function)

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ABSTRACT

This study was conducted to estimate technical efficiency of yam - based intercropping system among smallholder farmers in Obingwa Local Government Area of Abia State, Nigeria. Descriptive statistics such as percentage response and frequency distribution were used to determine the socio-economic characteristics of the farmer and the constraints to yam based enterprise. Trans –Log Frontier Production Function was adopted to estimate technical efficiency of the farmers. 120 farmers were randomly selected from ten villages in the study area. Primary and secondary data were collected and used for the study. The result showed that 78 percent of the respondents were males, while 22 percent were females. Age bracket of 41 and above constituted the majority (80 percent) of the yam intercropping farmers in the study area. 47.5 percent of the respondents had secondary education, while the least, 14.2 percent had tertiary education. The result also indicated that majority (54.2 percent) of the respondents cultivated 1-2 hectares of land. The determinant factors to technical efficiency in yam enterprise production were: education, farming experience and extension contact. The major constraints to yam intercropping in the study area were poor access to credit (76 percent), high cost of planting material (54 percent), and high cost of labour (73 percent). The study recommended that extension agents should be well motivated through training and provision of other incentives which will help to improve on their effectiveness. More so, there is need to ensure policy option on fertilizer subsidy in order to make the resources affordable to poor resource farmers at farm level. Furthermore, policy options aimed at enhancing farmers' access to credit, education and improved production inputs should be formulated.

Keywords: Technical, Efficiency, Yam, Intercropping, Farmers.

INTRODUCTION

Agriculture is the economic mainstay of the majority of household in Nigeria but with the advent of oil in the early 1970^{s}, the nation become highly dependent on oil revenue with the attendant deleterious consequences onoagricultural sector including low production and productivity. These have continued to characterize Nigeria agricultural sector which impede the sector in accomplishing its traditional roles in economic development (Tanko and Opara, 2005). Apparently, this state of affair has been a great challenge to government and households as food consumption accounts more than 50% of the total household spending in 2000 to 70 - 80% in 2005 (Central Bank of Nigeria (CBN), 2007).

Nevertheless, for farmers to enhance their status, expenditure and income, they cultivate large array of staple food among which yam has risen to the position of preeminence (Nweke *et al*, 2001).Yam is a starchy and staple food produced by annual and perennial vines grown in Africa, the America and the Caribbean. There are hundreds of wild and domesticated Dioscorea species, of which white yam (*D. rotundata*) is the most important species especially in the dominant yam producing zone of Nigeria (Nwosu and Okoli, 2010). Traditionally, yam can be cooked, fried or roasted for human consumption. Alternatively, it can be processed into pounded yam, yam flour, yam chips or porridge (FAO, 2008). Yam is an industrial source of dysgenic, the primary precursor of corticosteroid and anabolic drugs (Nweke, *et al* 2001). In addition, yam peel is of economic value as it can be recycled and used as feed stuffs for livestock. Also yam is used in marriage ceremonies, birth and death rites (NAQAS, 2002).

Yam production, just like any other arable crop is produced through intercropping with other arable crops by most traditional farmers in the tropics and sub tropics ((Nweke*et al*, 2001). However, the system of mixed cropping has evolved over generations, benefits such as efficiency use of environment resource (Light, water, nutrient) and Labour, higher yield monetary ventures and source of insurance against crop failure (IITA 2006). Though yam has different cropping enterprise, number and the type of crop grown are primarily determined as reported by Okigbo, (1999) and Nweke *et al.* (2001) by ecological consideration, available resources, tastes and preferences of consumers and farm family's own subsistence requirement. The cropping enterprise combinations commonly in South East Nigeria, include Yam/Vegetable/Maize/Cowpea, Yam/Maize/Egusi and Yam/Vegetable (Nweke*et al*, 2001).

Yam production in Nigeria has tripled over the past 45 years from 6.7 million tonnes to 39.3 million in 2006(FAO, 2007). The increase in output according to Nwosu and Okoli (2010) could be attributed to largely areas of land planted with yam and increase in productivity. Eze and Akpa (2010) asserted that low production and productivity of yam have continued to characterize Nigeria agricultural sector, thereby limiting the ability of the sector to perform its traditional roles in economic development. Farmer's productivity as reported by Onyenweaku, (2000) can be enhanced through technology adoption and efficiency of resources use.

Efficiency in resource used is a better option in developing countries as asserted by Tanko and Opara (2010) and Ume (2014) where resources are meager and opportunities for adopting better technologies have started dwindling. The inefficiency in resources use as reported by Ume, *et al.* (2010), could limit the level of returns of an enterprise and in effect creating gap between demand and supply. The inefficiency of resource use according to Nwosu and Okoli (2010) can manifest in inefficient production techniques in form of technical and allocative efficiencies, over reliance on households' resources, intensive labour, agricultural technology and rapid declining soil productivity.

Technical efficiency (TE) in production is defined as the ability of the farmer to produce the maximum output (frontier production) at given quantities of input and production technologies (Battec and Coli 1997).Technical efficiency can be measured using Cobb – Douglas and Translog Stochastic Production Frontier (Okoye and Onyenweaku 2007, Ume 2014). Several studies from both developing and developed countries have used the Cobb Douglas production functional form to analyze farm efficiency despite its well-known limitations (Battese, 1992, and

Coelli; 1994). Bravo Ureta and Puncharo, (1997) observed that Cobb Douglas production functional form has a discernible impact on estimated efficiency. Onyenweaku and Okoye (2007) clearly pointed out that in an efficiency study, for the cost function to be Cobb Douglas, the coefficients of the second order terms should be zero. The rejection of this hypothesis in the Trans log Function is a confirmation of the fact that the Trans log function is more suitable for the data and model specification than the Cobb Douglas function. The Trans log Production Function has the advantage of flexibility and allows analysis of interactions among variables. The use of the Trans log Functions in efficiency studies has been on the increase in recent times. Ume (2014) applied Trans log Stochastic Production Function to estimate the determinant factors to efficiency of small holder cocoyam farmers in South East Nigeria.

This study joins several empirical studies on Trans log stochastic production function with emphasis on estimation of the efficiency of yam based intercropping system among farmers in Obingwa Local Government Area with a view of assisting them in making rational decision and to ensure optimal productivity of input to maximize output.

The Specific Objectives are to: describe the socio-economic characteristics of the farmers, estimate the technical efficiency of the yam based intercrop farmers and identify the problems associated with yam based intercropping production in the study area.

Literature Review and Theoretical Framework of Stochastic Production Frontier

Kalirahan and Flinn (1983) applied a Trans log Stochastic Frontier Production Function in their analysis of data on 79 rice farmer in the Philippines. The maximum likelihood method was used in estimating the parameter of the model. Results of this analysis indicate that the individual technical efficiency was regressed on farm specific variables and farmer specific characteristics. This led to conclusion that the practice of transplanting rice seedlings, incidence of fertilization, and number of extension contacts and years of farming had significant influence on the variation of the estimated farm technical efficiencies.

Eze and Akpa (2010) found membership of cooperative, access to credit, farming experience and educational level to be positively related to technical efficiency of national FADAMA III facility in arable farmers in Imo state using a Trans log stochastic frontier production function. Okoye and Onyenweaku (2007) studied economics of cocoyam production in Anambara State using Trans log stochastic frontier cost function approach. The result from analyzed primary data derived from a sample of 120 cocoyam farmers indicated that labour, material inputs and wages were the determinant factors to the output of cocoyam. The distribution of economic efficiency that indicated that the current state of technology used by the sampled farmers was inferior, was large with the farm having 0.87 and worst farmers having 0.14 with the mean of 0.56 This wide variation could be improved through use of improved planting materials, use of fertilizers and herbicides in orderer to enhance farmers' output.

The term efficiency of a farm can be defined as its ability to produce the largest possible quantity output from a given set of intputs. The modern theory of efficiency dates back to the pioneering work of Farrel (1987) who proposed that the efficiency of a firm has two components namely: technical and allocative efficiency and the combination of these two components provide a measure of total economic efficiency (overall efficiency). Technical efficiency which is ability to produce a given level of output with a minimum quantity of input can be measured either by input-observation oriented technical efficiency or output-expanding oriented technical efficiency (Jondrow *et al*, 1982; Ali 1996).

Measurement of farm efficiency via frontier approach has been wildly utilized and studied. The term frontier involves the concept of maximality in which the function sets a limit to the range of possible observations (Forsund *et al,* 1980). The observation of points below the production frontier for firms producing below the minimum possible output can occur, but there cannot be any point above the production frontier given the available technology. Deviations from the frontier are attributed to inefficiency. Frontier studies are however classified according to the method of estimation. Kalaizandonakes *et al.* (1992) grouped these methods into two broad categories: parametric and non-parametric methods. The parametric method can be deterministic, programming and stochastic depending on the specification of the frontier model. Many researchers including Schmidt (1976) have argued that efficiency measures from deterministic models are affected by statistical noise. This however led to the alternative methodology involving the use of the stochastic production frontier models. The major feature of the stochastic production frontier is that the disturbance term is a composite error consisting of two components: one symmetric, the other one-side component.

The symmetric component, V_i, captures the random effects due to measurement error, statistical noise and other influences, and is assumed to be normally distributed. The one-sided component U_i, captures randomness under the control of the firm. It gives the deviation from the frontier attributed to inefficiency. It is assumed to be either half-normally distributed or exponentially distributed.

By definition, stochastic frontier production function is

Y_i=F (X_i; β) exp (V_i-U_i) I =1, 2. N (1)

Where Y_i is the output of the i^{th} firm; X_i is the corresponding (MX2) vector of inputs; β is a vector of unknown parameter to be estimated; F (.) denotes an appropriate form, V_i is the symmetric error component that accounts for random effects and exogenous shock; while U_i = 0 is a one - sided error component that measures technical inefficiency.

MATERIALS AND METHODS

This research project covered Obingwa Local Government Area of Abia State. Obingwa is located between latitude $5^0$41 and $6^0$50N of Equator and Longitude $5^0$25 and $7^0$30E of Greenwich Meridian. Its rainfall ranges from 1500mm-2500mm per annum, temperature of 28-48^0C, and relative humidity of 75%. Obingwa covers an area of 395km^2 and with population of 181,439 people (NPC, 2006).Obingwa Local Government Area comprises of several communities, with its administrative headquarters at Mgboko. The Local Government Area is bounded in the North by Isialangwa South Local Government Area of Abia State, in the East by Ikot-Ekpene Local Government Area of Akwa Ibom State and in the west by Aba North and South Local Government Areas of Abia State respectively.

Multi-staged random sampling technique was used to select clans, villages and respondents. Firstly, five (5) autonomous communitiesout of eight (8) were randomly selected from the Local Government Area. In the second stage, four (4) villages out of six (6) were selected from each of the clans. This brought to a total of twenty (20) villages. Thirdly, six (6) yam - based intercropping farmers were randomly selected from each village. This brought to a total of hundred and twenty (120) farmers for detailed study.

Structured questionnaire and oral interview were used to collect primary data. Secondary data will be obtained through text books journals, seminars, workshops and the internets. Descriptive statistics such as percentage and frequency distribution was used to address objectives 1 and 3, while. Objective ii was addressed using technical efficiency vis-à-vis Trans log Stochastic Frontier Production Function.

Model Specification

The Trans log stochastic production functions as specified by Coelli, (1994), Okoye and Onyenweaku, (2008) are as follows:

$InQ=\beta_0+ \beta_1 Inx_i + \beta_2 Inx_2 +\beta_3 Inx_3 + \beta_4 Inx_4 +\beta_5 Inx_5 + 0.5\ \beta_6 Inx_1 + 0.5\ \beta_7 Inx_2^2 + 0.5\beta_8 x_3^3 \times 0.5\beta_9 Inx_4^2 + 0.5\beta_{10} Inx_5^2 + 0.5\beta_{11} Inx_1 Inx_2 + \beta_{12} Inx_1 Inx_3 +\beta_{13} Inx_1 Inx_4 +\beta_{14} Inx_1 Inx_5 + \beta_{15} Inx_2 Inx_3 +\beta_{16} Inx_2 Inx_4 +\beta_{17} Inx_2 Inx_5 +\beta_{18} Inx_3 Inx_4+\beta_{19} Inx_3 Inx_5+\beta_{20} Inx^4 Inx_5 +V_i - U_i$ (2)

Where In represent the natural logarithm, the subscript represents thei$_{th}$ sample farmer, Y_i = farm size (ha), X_2= labour used (man-day), X_3 = quantity of fertilizer used (kg), X_4 = quantity of planting material (yam sets) (kg), X_5 = depreciation in capital inputs (in naira), B_0 = intercepts, $B_1 - B_6$ = coefficient estimated, V_i= random error and U_i = technical efficiency. In addition, U is assumed in this study to follow a half - normal distribution as is done in most applied frontier production literatures.

Where: $U_i = б_0+ б_1 Z_1+ б_2 Z_2 + б_3 Z_4 +б_6 Z_6 + б_7 Z_7 + б_8 Z_8 + б_9 Z_9$ (3)

Where U_i =technical efficiency of the i^{th}farmer, Z_1 = age of the farmer (yrs), Z_2 = level of education (yrs), Z_3 = household size (No), Z_4= farming experience (yrs), Z_5 = farm size (ha), Z_6 = extension contact (No), Z_7 = credit access, Z_8 = membership of organization (No), Z_9 = marital status (dummy), $б_0$ = constant, $б_1 - б_7$ = coefficients to be estimated.

RESULTS AND DISCUSSION

From table 1 above, 78% of the respondents were males, while 26% were females. This implied that males are very much involved in yam production than females in the study area. Yam production in South East Nigeria is male stereotyped and highly labour and capital intensive, and can be best accomplished by male - folk (Ume *et al* 2014).

Table 1: Distribution of Respondents According to Socio economic Characteristics

Variable	Frequency	Percentage (%)
Gender		
Male	94	78
Female	26	22
Marital Status		
Single	12	10
Married	62	51.7
Divorcee	5	4.1
Divorced	10	8.3
Widower	11	9.2
Widow	20	16.7
Age of the Farmers		
20-30	8	6.7
31-40	16	13.33
41-50	25	20.83
51-60	25	20.83
61-70	25	20.83
70- above	21	17.5
Educational level		
No formal education	21	17.5
Primary education	25	20.8
Secondary education	57	47.5
Tertiary education	17	14.2
Farm size		
0.01-1.00	32	26.7
1.01-2.00	65	54.2
2.01-3.00	13	10.8
3.01-5.00	10	8.3
Credit		
Yes	58	48.3
No	62	51.7
Farm experience		
1-7 years	10	8.3
8- 14 years	27	22.5
15- 21 years	20	16.7
22- 28 years	28	23.3
29- 35 years	35	29.2
Contact with extension agent		
Yes	30	25
No	90	75
Labour		
Family	65	54.2
Hire	25	20.8
Communal labour	10	8.3
Family labour hire	20	16.7

Source: Field Survey, 2015

The result in table 2 indicated that 90% of the respondents were married, while only 10% were single. Married people are often associated with children who could be used in accomplishing certain agricultural activities in the farm, especially where they are of labour age. This assertion agrees with Iheke (2006).

In Table 3, most (80%) of the farmers interviewed were 41 years of age, indicating that old people who are often conservative to technology adoption and as well cannot with stand the rigors and strains involved in farming dominated the sampled farmers. This contradicts the findings of Ume *et al.* (2012), whose finding was dominated by young, energetic and enterprising individuals.

Table 2: Maximum Likelihood Estimates of the Trans log Stochastic Technical Efficiency Production Function

Production factor	Parameter	Coefficient	Standard Error	t-value
Constant	Bo	2.022	0.619	3.265***
Farm size	β_1	0.524	0.242	2.165
Planting material	β_2	-013	0.096	1.372
Labour input	β_3	0.270	0.992	2.720**
Fertilizer used	β_4	-4.138	0.613	-6.753***
Depreciation	β_5	0.249	0.123	0.372
Farm size^2	β_6	0.377	0.307	1.220*
Planting material^2	β_7	-0.002	0.279	-0.006
Labour input^2	β_8	0.720	0.224	-7.767***
Fertilize^2	β_9	0.223	0.194	1.149*
Depreciation^2	β_{10}	-303	0-.387	-0.783
Farm size x labour used	β_{11}	0.16	0.225	0.0711
Farm size x Fertilizer used	β_{12}	6.578	0.056	0.368
Farm size x planting material	β_{13}	0.567	0.309	0.175
Farm size x depreciation	β_{14}	0.243	0.182	0.044
Labour x fertilizer	β_{15}	0.860	0.323	0.280
Labour x depreciation	β_{16}	2.088	1.032	2.774**
Fertilizer x depreciation	B_{17}	0.136	0.099	1.377*
Diagnostic statistic				
Log-likelihood function	(б^2)	288.001	0.3000	4.1606***
Total variance		1.2482	0.0021	416.1904***
Variance ratio		0.774		
Likelihood ratio test(LR)		.5021		

Source: Computed from frontier MLE/Field Survey, 2015

Note: ***, **, and * indicates statistically significant at 1.0, 5.0 and 10.0 percent respectively.

Table 3: Maximum Likelihood Estimation of the Trans log Stochastic Production Function

Production factor	Parameter	Coefficient	Standard Error	t-value
Constant	Bo	8.060	1.907	4.223***
Farm size	β_1	1.648	1.703	0.968
Planting material	β_2	0.704	0.227	3.101***
Labour input	β_3	4.238	1.323	3.203***
Fertilizer used	β_4	0.900	0.218	4.128***
Depreciation	β_5	-0.441	0.486	-0.908
Efficiency factor				
Constant	б$_0$	0.778	0.041	18.976***
Age	б$_1$	-0.0408	0.285	-1.720*
Level of school	б$_2$	0.912	0.261	3.494***
Household size	б$_3$	0.812	0.271	2.996**
Farming experience	б$_4$	0.866	0.220	3.936**
Farm size	б$_5$	0.039	0.012	3.25***
Extension visit	б$_6$	1.483	0.898	1651*
Credit access	б$_7$	0.508	0.041	3.603***
Membership of organization	б$_8$	0.51	0.662	0.773
Off farm income	б$_9$	2.774	0.842	3.295***
Diagnostic statistic				
Total variance	(б^2)	1.4428	0.3001	4.807***
Variance ratio		0.9841	0.0015	656.067***
Likelihood ratio test	475.77	325.1171		
Log-likelihood				

Source: Field Survey, 2015

Note: ***, **, and * indicates statistically significant at 1.0, 5.0 and 10.0 percent respectively.

Table 1 revealed that 92.5 percent of the respondents were educated, while 7.5 percent had no formal education. Education helps to enhance managerial skills, resource management, decision making and adaptability of an individual. (Ume *et al*, 2010). The Table revealed also that 91.7 percent of the total respondents had farm size less than 3ha, while the least above 5 hectare were cultivated by 8.3 percent of the respondents. This result conforms to the prior knowledge that farmers in most developing countries are largely small scale in their operation with their farms scattered everywhere. This farm hold could be of a great inhibition to farm modernization and mechanization to the detriment of the nation's food security (Iheke, 2006).

Also, 51.7% of the respondents had no access to credit, while 48.3% had access.

The high interest rate, lack of collaterals, short - term repayment of loans, ignorance and bank location in urban area could be invoked to explain for the poor access to credit by most farmers interviewed (Ume and Nwaobiala, 2012; Ume and Uloh, 2011).Most (52.4%) of the respondents had years of farming experience above 21 years. This signified that sampled yam farmers in the study area are well abreast with yam farming. Onyenweaku, (2000) reported that aftermath of wealthy years of experience in farming enhances the farmers' capacity of maximizing their farm output and profit at minimal cost through efficient use of resources.

Only 25 percent of the farmers interviewed had contacts with extension agent, while 75 percent had no contact. This implies poor extension outreach and could be related to negligence of the extension activities by the change agent This situation is detrimental to agricultural development as farmers' access to improved technologies and technical assistance offered by extension services are limited (Ume *et al.* 2012).

Majority (54.2%) of the respondents used family labour in their farms, followed by hired labour (20.8%) while the least (8.3%) were engahed in communal labour. The high proportion of family labour used by the farmers could be linked to high cost of hired labour which is occasioned by ferminalization of agriculture and the migration labour force youth to urban area in pursuit of white collar jobs. This finding occurred with (Iheke, 2010.).

The estimated square of the total variance was significantly different from zero at 1.0% alpha level as indicated in Table 2. This gives credence to the goodness of fit of the model and the correctness of assumption of the composite error term. The variance ratio parameter (λ) was estimated at 1.4428 and statistically significant at 1% probability level. This indicated 98.4 % of the total variations in yam intercrop output while the remaining 1.6% was due to technical inefficiency. This signified that the variation in actual output from maximum output between farms mainly arose from differences in farmer practices rather than random variability.

The coefficient of planting material, fertilizer and labour inputs had the desired positive signs and statistically significant except the coefficient of farm size. The coefficient of planting material (0.704) was positive and statistically significant at 1.0% probabiltly level. This is in conformity to a prior expectation that the more the planting material used, the more the quantity of output accruing to the yam enterprise farmers.

Labour inputs coefficient was positively signed and was statistically significant at 1.0%. The implication is that one percent (1%) increase in labour input, would result in the in yam 4.234 yam intercrop to increase by 4.238 percent. The estimated coefficient (0.900) of fertilizer was positive and statistically significant at 1.0% alpha level. This implied that one percent increase in fertilizer use would lead to 0.900 percent increase in yam inter-crop farmers' output.

The estimated determinants of technical efficiency in yam intercropping system are also presented in Table 2. The result shows that the age of the farmer had a negative sign and significant at 10% alpha level. This implies that age of the farmer reduces technical efficiency or increase, technical inefficiency. The finding is attributed to the fact that older yam farmers in the study area are relatively more reluctant to take up better technologies, instead they prefer to hold to the traditional farming methods thus become more technically inefficient compared to their younger counterparts. This reluctance to embrace innovative farming methods is also responsible for the constant returns to scale realized earlier. This finding is in consonance with Usman *et al.* (2010) who opined that age variable picks up the effects of physical strength as well as farming experience of the farmer. Onu *et al.* (2000) found positive relationship between age and technical efficiency, which could be linked to the notion that older household farmers are more experienced in managing farm work than younger farmers. The inconsistency may be due to differences in socio-economic characteristics of the sampled farmers. However, it is important to emphasize that being older may not always mean being more experienced.

Educationally, level of household coefficient was also positively related and associated with technical efficiency and significant at 1% alpha level. Infact, education is usually considered as a clue of higher possibilities of literate household in having better managerial skills access and understanding of information operation. Thus, household head with more years of schooling are more technically efficient (Ume, 2014; Getahum, 2014). Several researchers (Onyenweaku, 2000, Onyenwaku *et al* 2010, Ume *et al.* 2010, Eze and Akpa 2010, Ume, 2014), made similar finding, .

In line with apriori expectation the coefficient of extension services was positive and significant at 10% alpha level. This suggests that access to extension services enabled yam producers to obtain information on crop diseases or pests and their control methods, as well as insights on innovative farming techniques that guarantee higher productivity. Similar findings were reported by Asiabaka (2002) among rural households in Nigeria. Asiabaka argued that farmers who received extension services were more knowledgeable on new and improved farming practices hence they showed higher technical efficiency levels. In addition, Unammah (2003) observed that farmers who get adequate extension contacts are able to access modern agricultural technology for input mobilization, input use and disease control, which enable them to reduce technical inefficiency. Nevertheless, Geta *et al.* (2013) found negative relationship between extension services and technical efficiency. They stated that the major problem in sub-Sahara Africa is that year after year, extension workers who are hardly afforded in-service training and are rarely linked to research; continue to disseminate the same messages repeatedly to the same audience. This situation has consequently arisen where the extension audiences have become technically redundant and obsolete.

Off - farm income coefficient had direct relationship with household technical efficiency and significant at 1% alpha level. Off farm income aids in alleviating financial restrain in terms of timely purchases of inputs. However, on the other hand, farmers with off –farm income have less time to monitor and ensure an efficient utilization of the purchased inputs they deployed in agricultural production (Singh *et al.* 2009, Geta *et al.* 2013).

The estimated coefficient of the years of farming experience was positive, conforming to a priori expectation, and it is significant at 5% alpha level. The implication is that farmers with many years of experience in yam enterprise production are more efficient in resource use and capable of setting realistic goals than the in experienced ones (Tanko and Opara, 2005) The Statistical test of the coefficient of household size was positive and statistically significant at 5% level of probability. Ume *et al.* (2010) reported that large household size means labour is proxy, thereby leading to increase in efficiency. Nevertheless, Nwaru (2004) was of the opinion that larger household size may not mean ease of labour availability to be engaged in farming. This is especially where most of the household members are schooling or not of labour age. In line with a priori expectation, the coefficient of credit was positive and statistically significant at 10% alpha level. This finding agrees with that of Ume,(2014) and disagrees with Onyenweaku *et al.* (2005) and Iheke (2010), who reported that most farmers divert this resource to non-farm uses. Credit facilities adoption of innovation in farming, encourage capital formation and marketing efficiency (Rogers, 2003).

Table 4: Frequency Distribution of Technical Efficiency Index

Technical Efficiency Index	Frequency	Percentage
0.00 - 0.20	*15*	12.5
0.21 - 0.40	*11*	9.17
0.41 – 0.60	*30*	25.00
0.61 – 0.80	*35*	45.83
0.81 – 1.00	*9*	7.5
Maximum Technical Efficiency	*0.95*	
Minimum technical efficiency	*0.23*	
Mean technical efficiency	*0.56*	
Mean of the beat 10	*43.4*	
Mean of the worst 10	*75.8*	

Source: Computed From Field survey; 2015

The wide technical efficiency indices differentials observed among yam farmers as show in Table 4 is an indication of need for efficiency improvement. To become most efficient farmer, an average yam intercropping farmer, requires, 43.4 (1-0.56/0.95)^{100} cost saving to attain the status of the most efficient yam intercropping farmers among the sampled best 10 category, while the least performing farmer would need 75.8 (1-0.23/0.95)^{100} to become the most efficient yam intercropping farmer among the worst sampled farmers.

The regression coefficients in the Cobb Douglas stochastic production Frontier function were the production elasticities and their sum indicate the returns to scale (Hazarika and Subramanian 1999). The sum of production elasticities (Return to Scale) was 7.049 as revealed in Table 5, implying that the farmers are in stage 1 of production phase. This is necessitated by high and negative coefficient of labour. It therefore means that yam enterprise farmers in the study were either misallocating or over-utilizing their labour and other factor inputs, hence, have not attained optimum allocative efficiency.

Table 5: Elasticity of Production and Return to Scale

Input	Elasticity
Farm size	*1.648*
Planting material	*0.704*
Labour	*4.238*
Fertilizer	*0.900*
Depreciation	*-0.441*
Sum of elasticities (return to scale)	*7.049*

Source: Computed from Table 11, 2015

Table 5 showed that 54% of the respondents encountered the problem of high cost of planting materials. The high cost of planting materials (yam tubers) could be attested to the fact that the same planting material are used for human consumption. Nevertheless, unless yam is propagated through vegetative means or seed, the problem of high cost of planting will persist (Ume *et al.* 2014). The problem of pest and disease infestation was complained by 65% of the respondents. Pest and disease attack is disincentive to yam producers as most farmers are either ignorant or cannot purchase the much needed pesticides for effective control, thus low yield results (Ezedenma, 2003). More so, 67% of the respondents encountered problems of low soil fertility. This is as a result of erosion and other poor farming soil management practice of which if not checked appropriately, farmers' efforts could be rewarded with misery (Okoronkwo 2008). Poor access to credit (76%) was reported by the respondents as shown in table 6. The poor access of farmers to credit is a negative sign to agricultural development, since credit is a vital catalyst in the procurement of production inputs and in payment of hired labour. In fact the need to increase farmers' access to credit is very mandatory in order to ensure agricultural development (Iheke, 2006).

Table 6: Distribution of Respondents According to Constraints to Yam Intercrop Enterprise Production

Factors	Frequency	Percentage (%)
Poor access to credit	87	76
High cost of planting materials	65	54
High cost of labour	87	73
Pest and disease infestation	78	65
Scarcity of farm land	83	69
Low soil fertility	80	67
Poor storage facilities	84	70
Climate	37	31
Lack of information and communication	91	78
Theft	18	15
Poor extension contact	81	68
High cost of fertilizer	93	78

Source: Field Survey; 2015
*Multiple Responses

In addition, land scarcity was reported by 69% of the respondents. The scarcity of farm land in the study area could be related to urbanization and land tenure system of land holding. In land tenure system, smallness and scatteredness of cultivated lands are common features in small holder agriculture. These scenarios impair significantly mechanization and commercialization of agriculture which are the heart- beat of agricultural development (Onyenweaku *et al.* 2010). This lends credence to the finding of Kruseman*et al.* (1995). Furthermore, 78% of the respondents encountered the problem of poor extension contact. The high extension agent-farmer's ratio and poor motivation of the change agents could be account for poor extension outreach in the study area (Royers, 2003), Nwosu and Okoli (2010) work is synonymous with this finding. High cost of fertilizer (78%) was recorded by the respondents as reported. Fertilizer is mostly essential in boosting farmers' production but the diversion of the resource as well as black market of the resource, made it to be scarce at farm level (Onyenweaku *et al*, 2010)

CONCLUSION AND RECOMMENDATIONS

In line with the findings of the study, the following conclusions were advanced:

Most farmers studied were aged, experienced in farming, majority of the farmers had formal education and small scale in operation.

The major determinant factors of technical efficiency in yam intercrop were: education, farming experience and extension contact. The major constraints to enterprise production were: high cost of labour, high cost of planting materials, land scarcity and problem of diseases and pests.

Apparently, based on the results obtained from the study, the following policy considerations and recommendations are made to enhance the efficiency of smallholder yam intercropping farmers:

(i) There is need to revisit the land use act of 1999 on land ownership. Adequate portions of land for Agricultural purposes should be mapped out and made available to farmers at affordable rates and conditions such that the farmer can embark on technologies to enhance output even on the long run.

(ii) Policies that would aim at improving the rural infrastructure to discourage rural -urbab migration of energetic youths that would serve as sources of labour should be implemented.

(iii) Labour saving device such as hand driving plough should be developed and disseminated to farmers to reduce high labour cost.

(iv) The study recommends motivation and training for extension agents, and deliberate policy on fertilizer should be put in place.

(v) Increased subsidy policy should be imposed on fertilizer in order to not only make the input available but as well affordable by poor resource farmers.

(vi) Credits should be made available to farmers through micro-finance banks, agricultural credit scheme and any other relevant government agencies at reduced interest rate and affordable collateral

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How to cite this article: Ume SI, Ebe FE, Ochiaka CD et al. Technical efficiency of yam based intercropping system among farmers in Abia state, Nigeria (Using Trans -log frontier production function). International Journal of Research and Review. 2017; 4(1):114-125.

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