International Journal of Science and Healthcare Research
Vol.5; Issue: 3; July-Sept. 2020
Website: ijshr.com
Original Research Article *ISSN: 2455-7587*

Technical Inefficiency of Pro Vitamin A Cassava Varieties Farmers in South East, Nigeria (Using Normalized Trans-Log Production Frontier Function Model); Bridging Agriculture and Nutritional Divide in Rural Areas of Sub-Saharan Africa

S.I. Ume, Uloh, E V, Onyeke, A C, Nwose, D I

[1]Department of Agricultural Extension and Management. Federal College of Agriculture Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria.
[2]Department of Agric. Education, Federal College of Education, Eha Amufu
[3]Department of Agric. Education, Ebonyi State College of Education, Ikwo

Corresponding Author: S.I. Ume

ABSTRACT

Technical efficiency of pro vitamin A cassava varieties farmers in South East, Nigeria (Using normalized trans-log production frontier function model) was studied. A sample size of one hundred and twenty farmers was selected using purposive and multistage random sampling techniques. A structured questionnaire and oral interview were used to elicit data for the study. Mean and normalized translog stochastic frontier production function model were used to address the objectives of the study. The result shows that among the production factors considered only farm size, labour and planting material were positive and significant. More so, level of education, farm size and farming experience were the determinant factors to the technical inefficiency of the farmer. There is need to enhance farmers' access to education and extension services, and large farm size.

Keywords: Technical Efficiency, Pro Vitamin A, Cassava Varieties, Farmers, Normalized trans-log, production, frontier function, model

INTRODUCTION

Sub-clinical vitamin A deficiency (VAD) is prevailing public health challenge that is prevalent in many developing Countries, Nigerians inclusive to all ages with extremely low serum retinol levels found predominant among vulnerable people, including the poor, nursing mothers and children of less than 5 years. VAD is common in areas where cassava consumption is high and low financial powers to purchase fortification food (Etuk, and Umoh, 2014, Onunka, Ume, Ekwe and Silo, 2017). Studies (Food Agriculture Organization, (FAO), 2003; Harvest Plus., 2013, National Root Crop Research Institute, (NRCRI), 2015) revealed that VAD is capable of resulting to impaired vision, reduced immunity, increases risk of disease, reproductive disorders and retardation of growth and development and in extreme case death results. In 2011, Uchendu, (2013) reported that an estimated 157,000 of global child deaths were attributable to vitamin A deficiency and 964,000 Disability Adjusted Life Years (DALYs) in Nigeria by the year 2015(Egesi and Ilona, 2015).

However, addressing vitamin A deficiencies among such vulnerable where supplementation programs cannot reach or who cannot afford fortified products is through promotion of food-based agricultural interventions (bifortification)

(Egesi, Njoku, Olojede and Kulakow, 2015). Biofortification of crops has promise of sustainable impact on a large scale and cost effective when compared with other methods of food fortification (Effiong and Udo; 2015). Additionally, biofortification, especially when carried out on people's staple foods, has the likelihood of increasing adaptability of such crop (Uchendu, 2013). Literature show that one encouraging intervention is the introduction and promotion of new varieties of cassava that are rich in beta carotene (EFFIONG, Effiong and Udo, 2015, Egesi, Njoku, Olojede and Kulakow; (2015) It is imperative to state that most cassava varieties introduced to sub-Saharan Africa as asserted by Anyanwu, 2007 and NRCRI (2015) *i*s rich in starch but poor in protein and micronutrients (iron, zinc and Pro-vitamin A).

In Nigeria, Federal government in collaboration with International Institute for Tropical Agriculture (IITA) and National Root Crops Research Institute (NRCRI), Umudike developed improved cassava varieties that contain beta carotene (β-carotene) known as "Pro vitamin A cassava. These new improved varieties are NR07/0326, NR07/0506, NR07/0497, NR07/0499, NR07/0427 and NR07/0432 (Egesi, et al; 2015 and NRCRI, 2015). Others are TMS 01/1371, TMS 01/1412, TMS 01/1368, TMS 07/593, and TMS 07/539 (FAO, 2013)

The aforesaid varieties apart from their "Pro-vitamin A" content quality, they have intrinsic characteristics of having high dry matter content, high yielding, pests and disease tolerant, high leaf retention in dry season and high quality flour (Etuk, and Umoh, 2014, NRCRI, 2015 Egesi and Ilona, 2015). These improved varieties were disseminated to the farmers for cultivation with technical assistants through extension arm of NRCRI, Ministry of Agriculture in the Local Government Areas and Agricultural Development Programme (ADP) (An extension arm of the State Ministry of Agriculture (NRCRI, 2015).

The low cassava production and productivity have characterized cassava could be linked to poor efficiency in resource use, as result of poor management of resources which characterized the smallholder farming population of the most sub Saharan Africa countries, Nigeria inclusive.

The term efficiency as stipulated by Amaechina and Ebo, (2013) is the comparison between the real or observed values of input(s) and output(s) with the optimal values of input(s) and maximal output(s) used in a particular production process. Efficiency could be attained by minimizing the resources necessary for producing a given output, and exits in two forms; technical efficiency and allocative efficiency, as stated by Farrell, (1957).

The technical efficiency which forms the onus of this study could be measured through using parametric function, of which stochastic production frontier function is the most popular (Amaza and Olayemi, 2001; Addai and Victor, 2014).This Stochastic frontier has perculiar attributes of defining the limit to a range of potential observed production levels and as well classifies the extent to which the firm lies above or below the frontier. Second, it assumes that deviations of the observed output from the frontier could be correlated to partly due to random events (measurement errors and statistical noise) and firm specific inefficiency. Third, it creates allowance for stochastic errors due to statistical noise or measurement errors. Fourth, the stochastic frontier production function model has the advantage of allowing simultaneous estimation of individual technical efficiency of respondent farmers as well as determinants of technical Efficiency (Adzawla, Fusein and Donkoh, 2013; Abdulai, Nkegbe, and Donkoh, 2018).

Here, the most commonly used stochastic production frontier functional forms is the Cobb-Douglas, constant elasticity of substitution (Asefa, 2012) with translog production functions less popular in efficiency measurement (Ewuziem, Onyenaobi, Dionkwe, 2009). This is despite the pluses of the translog over Cobb Douglas, which included more inflexibility as it provides a local, second-order approximation to any function, but it is more difficult to estimate due to the larger number of parameters and attendant problems of multicollinearity among the regressors. Hence, with five inputs, the translog production function requires the estimation of twenty parameters, compared to only five for the Cobb-Douglas Onyenweaku, Igwe, and Mbanasor, 2005, Ewuziem, et al, 2009). Despite its well-known limitations, the transcendental logarithmic (translog) function has been widely used in farm efficiency analysis (Okoye and Onyenweaku, 2007)

However, the important of efficiency studies are well documented in both developing and developed world (Amaza and Olayemi, 2001; Okoye and Onyenweaku, 2007; Amaechina and Ebo; 2013; Addai and Victor, 2014). For this subject matter, efficiency study could aid in formulation of technical policies probable to improve producer efficiency and output, increase income through increased profit and reduction in poverty, provide guidelines to governments on how to improve farmers' productivity, source of research information for scholars for further studies in related subjects and as teaching aid to students.

However, several studies have been undertaken regarding measuring the efficiency of cassava production in Nigeria, but no known study to the best knowledge of the researcher have used the stochastic frontier approach using translog production function to measure technical inefficiency of pro vitamin A in the study area. Specifically, the objective of study is to determine the technical inefficiency of pro vitamin A cassava producer in South East, Nigeria using the stochastic frontier approach.

MATERIALS AND METHODS

Study Area

The South East Nigeria is studied and it lies between latitude $5^0$9' and $7^0$75'N of equator and longitude $6^0$85' and $8^0$46' East of Greenwich Meridian. It has a total land mass of 10,952.400ha, with population of 16,381.729 people (NPC, 2006). The zone is made up of five states viz: Abia, Anambra, Ebonyi, Enugu and Imo States. It is bounded in the North by Benue and Kogi States, in the West by Delta and Rivers States, in the South by Akwa Ibom State and in the East by Cross River State. South east has annual temperature of between 18^0C-34^0C and relative humidity of about 60-70%. The people in the area are agrarians and engage in non-agricultural activities, include petty trading, vulcanizing, driving, carpentry, mechanics and others.

Sampling Procedures

Purposive and multistage random sampling and techniques were used to select states, Local Government Areas, communities and respondents. In stage one, four out of five states in South East Nigeria were purposively selected because of high intensity of pro vitamin A cassava cassava production. The selected states were Abia, Ebonyi, Anambra, and Enugu. In stage two, ten Local Government areas (LGA) were randomly selected from each of the States. This brought to a total of forty LGAs. Stage three involved the random selection of three communities from each of the LGAs. This brought to a total of one hundred and twenty communities. Fourth, from each of the communities, a pro vitamin A cassava farmer was selected from each community from the list of the cassava farmers provided by the local leaders and extension agents in the areas and these brought to a total of one hundred and twenty farmers for detailed study.

Method of Data Collection

Structured questionnaire and oral interview were used to capture primary data on farmers' socio-economic characteristics (such as age, gender, marital status, farming experience, level of schooling, household size, farm size and membership of organization). Secondary data were obtained from published and unpublished survey articles, journals, textbooks, internet, proceedings and other periodicals.

Method of Data Analysis

Percentage responses and normalized translog stochastic frontier production function model.

The Theoretical Model

Analytical Framework

Stochastic Frontier Production Model

Farrell (1957) the study on the stochastic frontier model divided efficiency into technical and allocative efficiency (or price efficiency) with technical efficiency implying production with minimal wastes. Also, technical efficiency as asserted by Amaechina and Ebo, (2013) is the ability to produce a given level of output at lowest quantity of inputs under a given technology. Allocative efficiency according to Alemu, Bamlaku, Nuppenau and Boland (2008) is ability for an individual to select best input levels for given factor prices. A stochastic frontier production function comprises two error term; one error component symbolizes the effect of statistical noise (e.g. weather, topography, distribution of supplies, measurement error), while other error component captures systematic influences that are unexplained by the production function and are attributed to the effect of technical inefficiency (Bravo-Ureta, T. and Pinheiro,1997).

Efficiency can be estimated by use of non-parametric programming approach, the parametric programming approach, deterministic statistical approach and the stochastic frontier production function approach (Battese, and Coelli, 1976, Abedullah and Khalid, 2007). Amongst the estimators the stochastic frontier production function and non-parametric programming, known as data envelopment analysis (DEA), are widely used. The inherent stochasticity ie takes into account measurement errors and other noise in the data could be one of the reasons for the popular choice of stochastic frontier approach by scientist especially in agriculture among developing countries (Coelli, *et al.*1998). The SFA approach inquires that a functional firm be specified for the frontier production function while DEA approach uses linear programming to construct a piece-wise frontier that envelops the observations of all firms. An advantage of the DEA method is that multiple inputs and output can be considered simultaneously, and inputs and outputs can be quantified using different units of measurement (Alemu, et al; 2007).

The SFA, which is also referred to as the econometric frontier approach, specifies the relationship between output and input levels and decomposes the error term into two components: (a) a random error, and (b) an inefficiency component. The random error which is assumed to follow a symmetric distribution is the traditional normal error term with zero mean and a constant variance while the inefficiency term is assumed to follow an asymmetric distribution and may be expressed as a half-normal, truncated normal, exponential or two parameter gamma distribution. The maximum likelihood estimates of the parameters in the Cobb-Douglas and translog stochastic frontier production function models given the specification for the technical inefficiency effects in the equations on the model specification was obtained using Frontier 4.1 a computer software frontier version 4.1 package (Coelli, 1994). The unknown parameters of the stochastic frontier and the inefficiency effects are estimated simultaneously.

The empirical studies in the use of stochastic frontier of technical inefficiency both domestically and abroad are abound. For instance, Onu, Amaza and Okunmadewa (2000) used stochastic frontier production function to study efficiency among cotton producers in Nigeria using a sample size of 250 cotton respondents. The results revealed that labour and material inputs were the major determinant to the output of the cotton produce by the respondents. The model for the inefficiency effects in the frontier production function includes status of the farmer, years of farming experience, number of years of schooling (education), access to extension services and credit facility, they added.

Okoye and Onyenweaku (2007) studies economics of cocoyam production in Anambra State using Translog stochastic frontier cost function approach. They analysed primary data derived from a sample of 120 cocoyam farmers. The result of the analysis showcased that labour, material inputs and wage were the determinant factors to the output of cocoyam. The distribution of economic efficiency indicated that the current state of technology used by the sampled farmers was large with the best farm having 0.87 and the worst farm having 0.14 with the mean of 0.56. This wide variation could be improved through use of improved planting materials, use of fertilizer and herbicides in other to enhance farmers' output. As well, Ume, Ezeano, Eluwa, and Ebe (2016) analysed of technical inefficiency in rice production among Farmers in Ezza South LGA of Ebonyi State of Nigeria (Application of Stochastic Frontier Production) They applied translog stochastic frontier production in analyzing 120 rice farmers. The maximum likelihood method was employed to estimate the parameters of the model. The result indicated that educational level, farming experience, farm size; extension services and membership of cooperative organization were significant to the variation of the estimated farm level technical in efficiencies.

Ume and Nwaobiala (2012) applied stochastic production frontier model in estimating a production frontier for the upland rice farmers across gender in Anambra agricultural zone of Anambra State. Data from 120 sample farmers were used in the empirical analysis, 60 males and 60 females. The result showed that only level of education and access to credit were found to be positive and significant at 1% between the two farmers groups. The mean economic efficiencies for the male and female farmers were 0.65 and 0.61 respectively, indicating wide range of opportunities for improvement of upland rice farmers which could be through the use of improved production inputs.

Model Specification

The stochastic production frontier function was specified as:

$$Y = f(X_i, \beta)\exp(e_i) \quad \text{.................} (1)$$

Y =Cassava output in ith farm (measured in Kg).

X_i =Vector of inputs used by the ith farmer.

β= vector of unknown parameters

$e_i = V_i - U_i$ = (Composite error term).

Where,

V_i= Random variable assumed to be independently distributed N(0,1) and independent of

U_i = Random variable that accounts for technical inefficiency and assumed to be independently distributed as truncation of the normal distribution with mean μ and variance.

$$\mu = AK \quad \text{..................................} (2)$$

Where,

A = I × e Vector of farm/farmers characteristics that may cause inefficiency.

K = e × I Vector of unknown parameter to be estimated.

The farm level stochastic production frontier functions that signify the maximum possible output can then be denoted as:

$$Y^* = f(X_i, \beta)\exp(V_i) \quad \text{..................} (3)$$

Where,

Y^* = The frontier output

Rewrite equation (1) using equation (3) gives:

$$Y = Y^* \exp(U) \quad \text{.....................} (4)$$

Therefore, the technical efficiency of an individual farmer can be given as:

$$TE = \frac{f(X_i,\beta)\exp(V_i - U_i)}{f(X_i,\beta)\exp(V_i)} \text{Therefore}, TE = \frac{Y}{Y^*} \quad \text{.......} (5)$$

It implies that the difference between observed output (Y) and frontier output

(Y*) is embedded in U when U = 0, then I production is in the frontier (i.e., Y = Y*) and the farmer is said to be technically efficient. However, if U >0, the farmer is inefficient since production will lie below the frontier ( ).

The variance parameters are expressed as:

$$\sigma_u^2 + \sigma_v^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6)}$$

$$C = \frac{\sigma_u^2}{\sigma_v^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

Where,

C ranged from 0 - 1. When C = 1, it implies that all deviations are due to technical inefficiency ( ). The following studies (Okoye and Onyenweaku; 2007, Ewuziem, et al; 2009)) adopted translog production function fitted to the stochastic frontier function and estimated.

Explicitly, the production function was stated as translog stochastic frontier was used to estimate technical efficiency as specified by Coelli, (1995); Okoye and Onyenweaku, (2008), as follows:

$\ln Q = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + 0.5\beta_6 \ln x_1 + 0.5\beta_7 \ln x_2^2 + 0.5\beta_8 x_3^3 \times 0.5\beta_9 \ln x_4^2 + 0.5\beta_{10} \ln x_5^2 + 0.5\beta_{11} \ln x_1 \ln x_2 + \beta_{12} \ln x_1 \ln x_3 + \beta_{13} \ln x_1 \ln x_4 + \beta_{14} \ln x_1 \ln x_5 + \beta_{15} \ln x_2 \ln x_3 + \beta_{16} \ln x_2 \ln x_4 + \beta_{17} \ln x_2 \ln x_5 + \beta_{18} \ln x_3 \ln x_4 + \beta_{19} \ln x_3 \ln x_5 + \beta_{20} \ln x_4 \ln x_5 + V_i - U_i$ ....(8)

Where ln = represent the natural logarithm, the subscript represents the i-th sample farmers, Y_i = Cassava output in kg of the i-th farmer, X_1 = Farm size (ha), X_2 = labour used (man day), X_3 = quantity of fertilizer used (kg), X_4 = quantity of planting material (Cutting) (kg), X_5 = depreciation in capital inputs (in naira), β_0 = intercepts, $\beta_1 - \beta_6$ = coefficient estimated, Vi = random error and Ui = technical inefficiency. In addition, U is assumed in this study to follow a half normal distribution as is done in most applied frontier production literatures.

Technical Inefficiency

Technical inefficiency effect is the result of behavioral factors which could be controlled by efficient management. Some farmers as well as farm specific characteristics were included in the frontier function. The assumption is that they have direct influence on efficiency. The efficiency model is therefore implicitly specified as

$$\mu_i = \delta_0 + \sum_{i=1}^{8} \delta_i G_i + \omega_i \quad \ldots\ldots\ldots\ldots \text{(9)}$$

Where,

u_i = is a p´1 vector of variables hypothesized as having influence on technical efficiency of the farmers. They include:

Gi = technical inefficiency of the i[th] famer, G_1 = age of the farmer (yrs), G_2 = level of education (yrs), G_3 = household size (No), G_4 = farming experience (yrs), G_5 = farm size (ha), G_6 = extension contact (No), G_7 = credit access, G_8 = membership of organization (No), G_9 = marital status (dummy), б0 = constant,

Table 1; Description of variables in the stochastic frontier translog production model

Variable	Description	Measurement	Exp.sign
Y	Quantity of output	Kg	
C C	Quantity of Cuttings	Bundle(50 sticks)	+
Fert	Quantity of Fertilizer	50kg	+
Lab	Quantity of Labour	Manday	+
Age	Age of Farmer	No of years of household	-
EduYrs	Educational Level	No of years of schooling	+
Hhs	Household Size	Number of persons living with household head	+
Ep	Farming Experience	No of years in farming	+
FP	Farm Size	No of hectares farmed by the farmer	+
Ext	Extension Service	No of access to extension services by the farmer	+
Cdit	Credit	Access to credit; 1; otherwise, 0	-
Orga.	Organization	Membership of Organization; 1; otherwise, 0	-

RESULTS AND DISCUSSION

Average Statistics of Pro vitamin A Cassava Farmers

The average statistics of the sampled pro vitamin A cassava farmers are presented in Table 2.

TABLE 2: Average statistics of Pro Vitamin A farmers in South East, Nigeria

Variable	Mean Value	Maximum Value	MinimumValue
Farm Size Ha)	0.59	2.48	0.07
Labour (Manday)	44.82	136.92	8.62
Fertilizer input (Kg)	24.16	87.56	16.42
Cassava Cutting (Bundle)	32	68	43
Capital input (N)	4,776	26,890	11,356
Age (Yrs)	48	72	38
Education(Yrs)	4.2	15	0.00
Farming Experience (Years)	9.5	42	7.2
Household Size(No)	6.0	14	4
Outputs(Kg)	3400	12000	6,000
Female farmers (%)	78		

Source; Field Survey, 2019

On the average, a typical pro vitamin A cassava farmer in the agricultural zone was 48 years old, with 4.2 years of education, .9.5 years of farming experience and an average household size of 6.0 persons. The average pro vitamin A cassava farmer cultivated 0.59 ha, used about 24.16 kg of fertilizer and 32 bundles of cassava stem cuttings of 50 sticks per bundle and spent about N4, 766 on capital inputs. The table further reveals that the average farmer also engaged 44.82 mandays of labour to produce 3,400 kg of pro vitamin A cassava per annum.

Table 3 of the translog stochastic frontier production results indicated that, only two of the production factors of the first order coefficient were significant, while 5 were significant in the second order coefficient.

Table 3: Maximum Likelihood Estimates of the Trans-log Stochastic Technical Inefficiency

Production Factor	Parameter	Coefficients	Standard Errors	t-values
Constant	β_0	2.331	0.700	3.003**
Farm size	β_1	0.514	0.223	0.433
Planting material	β_2	-025	0.084	-297.629***
Labour input	β_3	0.460	0.221	2.499**
Fertilizer	β_4	-356	0.654	-1.837*
Depreciation	β_5	0.239	0.113	0.472
Farm size^2	β_6	0.369	0.301	0.815
Planting material^2	β_7	-0.002	0.268	-7.462***
Labour input^2	β_8	0.820	0.324	3.46***
Fertilizer^2	β_9	0.225	0.188	1.196*
Depreciation^2	β_{10}	-314	0.366	-857.923***
Farm size x labour used	β_{11}	.026	0.326	0.797
Farm size x fertilizer used	β_{12}	0.677	0.066	10.257***
Farm size x plan2ting material	β_{13}	0.578	0.317	1.823*
Farm size x depreciation	β_{14}	0.247	0.179	1.379*
Labour x fertilizer	β_{15}	0.840	0.355	2.366**
Labour x depreciation	β_{16}	2.124	1.421	1.494*
Fertilizer x depreciation	β_{17}	0.145	0.088	1.647*
Diagnostic statistic				
Log-likelihood function		279.112		
Total variance	(σ^2)	1.3021	0.4002	3.253
Variance ratio		0.884	0.032	416.1904***
Likelihood ratio test (LR)		.50211		

Source: Computed from Frontier 4.1 MLE/Field Survey, 2019
Note: *, **, * indicates statistically significant 1.0, 5.0 and 10.0 % respectively.**

The coefficient of labour input (0.460) was significant at 5.0% level of probability. It has a positive sign, indicating that increases in labour input, would lead to decrease in technical inefficiency. Agricultural production in many developing countries of the sub Saharan Africa is nearly zero mechanized; hence human labour is very important in realizing the farmers' production goals. Unfortunately, in recent time, because of migration of youths to urban areas in search of white collar jobs, agricultural labour has been very expensive and constitutes more than 75% of the farmers' cost of production (Onyenweaku, Igwe and Mbanasor, 2004). Fertilizer had indirect coefficient (-356) and was highly significant. This implied that a 1.0% increase in fertilizer would lead to decrease in technical inefficiency to the tune of 35.6%. The proper use of fertilizer and on time is capable of enhancing farmers' productivity. However, the sign identity of the coefficient could be related to farmers' poor access to the resource because of among others high cost and unavailability of the resource (Ume, Ezeano, Eluwa and Ebe, 2016). The second order coefficient of labour inputs^2 and labour and depreciation^2 were positive and significant at 1.0% and 5.0% alpha level respectively. These implied that, 1.0% and 5.0% increase in the interaction of labour input^2 and labour and depreciation^2 would lead to increase in technical efficiency to the tune of 0.820% and 2.124 %respectively.

Furthermore, farm size^2, fertilizer^2 and fertilizer and depreciation^2 had direct relationship with technical inefficiency and significant at different probability levels respectively.

The coefficient of total variance (σ^2) was 1.3021, while the variance ratio was 0.884, which is the ratio of the variance of farm specific technical efficiency to the total variance. This meant that 88.4% of the variation in output of the improved cassava is due to the disparities in technical efficiency.

Determinants of Technical Inefficiency

The signs of the coefficient of inefficiency variables are essential in explaining the level of perceived production efficiency among pro vitamin A cassava varieties farmers. A negative sign connotes that the variable has the outcome of decreasing technical inefficiency whilst a positive sign has the effect of increasing it. The result of analysis of determinants of technical inefficiency as contain in Table 4 showed that the coefficient of age had negative relationship with farmers' technical inefficiency and significant at 5.0% probability level.

Table 4: Maximum Likelihood Estimation of the Trans - log Stochastic Production Function

Efficiency factor	Parameter	Coefficient	Standard Error	t-value
Constant	σ_0	0.778	0.041	18.976***
Age	σ_1	-0.0408	0.285	-2.143
level of schooling	σ_2	0.912	0.261	3.494***
Household size	σ_3	0.812	0.271	2.996**
Farming experience	σ_4	0.866	0.220	3.936**
Farm size	σ_5	- 0.039	0.012	- 3.25***
Extension visit	σ_6	-1.483	0.898	1.651*
Credit access	σ_7	-0.508	0.041	-12.390***
Membership of organization	σ_8	-0.761	0.662	-1.150*
Marital status	σ_9	0.774	0.842	0.919

Source: Field Survey, 2019

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

This implies that aged respondents tend to be more technical efficient than their youth counterpart. This could be acquired through many years of experimentations and evaluation of different production technologies (Onyenweaku, et al, 2004; Edeh and Awoke, 2009). The findings of Ewuziem, et al, (2009) and Ume, Onuh, Jiwuba and Onunka; (2016) were in variance. They opined that youthful farmers tend to be more enterprising, adoptive and motivational individuals, therefore, more efficient than the aged farmers.

Also, the coefficient of level of schooling of the household head was positive to technical inefficiency and significant at 1.0% alpha level. This implies that, farmers who have spent many years schooling are more inefficient technically compares with the less educated ones. This may pattern to the fact that the more educated farmers are in many developing countries, the more they have more preference for 'white collar job' than farming as vocation. This could be attributed to the notion often construed by this class of people that farming is a vocation for aged people, who should reside in the villages to make living from there. However, Onunka, et al; 2018) was not synonymous They posited that educational attainment of the farmer lessens his\her technical inefficiency by being prudent in use of resources in addition to increases his/ her ability to understand and evaluate new production technologies.

As expected, the farming experience had a positive coefficient and as such had a direct influence on technical inefficiency of the farmer. The estimated coefficient was 0.866 and statistically significant at 1.0% risk level. This infers that, pro vitamin A cassava farmers that had spent long years in the vocation are more inefficient technically compares with less experienced producers. This may be due to the fact that the more experienced farmers often rely more on their technical know-how in furthering their production frontier than information on improved know-hows from research and disseminated to them by the extension agent. Numerous studies (Ede and Awoke, 2009; Asefa, 2012, Amaechina and Ebo, 2013) did not concur to the above assertion. They opined that long years of farming experience by the farmer enriches his/her managerial and decision making abilities in respect to farm operations. These could tantamount to soaring level of skills in employment of resources for optimal productivity, they added.

The estimated coefficient (-0.039) of farm size was highly significant at 1% probability level and had a negative coefficient. This infers that farmers with small farm holdings are more inefficient technically liken to farmers with large farm size. This might be related to the fact that farmers with small farm size have more propensity to prudent management of their resources to achieve high productivity more than the ones with large farm holding (Addai and Victor, 2014). Farm size as posited by Onu, et al; (2001) played an important role in farm success because it reflects the availability of capital and access to credit to enhance farmers' efficiency.

Furthermore, the result in Table 3 shows that coefficient of extension services had negative associated with farmers' technical inefficiency at 5% level. This suggests that farmers that had no access to extension services tends to be more technical inefficient than their counterparts that have access to extension services. This is a situation where farmers that had poor extension outreach usually rely of their technical know-how and local inputs varieties in farming leading to low farm productivity(Ume, et al; 2016). However, literatures show that farmers with adequate access to extension services have more propensity of having access not only to information on improved technologies and technical assistants by the change agent but sources of improved inputs. These extension services access benefits might enhance their managerial capability, hence more technical efficient than those farmers without access. This finding reinforced the prior research result attained by Ewuziem, et al; (2009) and Nkematu; (2005). As well, membership of cooperative society coefficient is negatively connected to the pro vitamin A cassava farmers' technical inefficiency at 5% alpha level. The implication is that farmers who are cooperators enjoy capacity building by the organization, access to farm inputs at subsidized prices and cross fertilization of ideas and information among members, thus boosting their technical efficiency more the non-cooperator farmers(Amaza and Olayemi; 2001; Amaechina and Ebo, 2014). Nevertheless, a positive sign identity of the coefficient can ensue, especially where the cooperator as asserted by Okoye and Onyenweaku, (2007) are consumed with the activities of the cooperative society to the detriment of their farming vocation. Furthermore, it is expected that the more farmer had access to credit, the more efficient he/she becomes in farming. This could be because through access to credit, farmers could be able to procure farm inputs such as labour even during peak of farming season when cost of labour is very exorbitant and out of reach of many farmers in implementing cultural activities involved in pro vitamin A cassava production (Onunka, et al; 2017). The coefficient of access to credit was negative and had direct relation to technical inefficiency. Ume, et al (2016) in rice production among farmers in Ezza South LGA of Ebonyi State of Nigeria. They reasoned that the sign identity could be ascribed to diversion of agricultural loans by farmers to attain to non-farming matters

Technical inefficiency indices of improved cassava farmers

The frequency distribution of technical inefficiency of farmers engaged in pro vitamin A cassava production was presented in Table 5.

Table 5: 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 best 10	43.4	
Mean of the worst 10	75.8	

Source: Computed from Field Survey, 2019

Table 4.4 indicated that the improved farmers mean efficiency was 56%, which implied that there was a large scope for increasing the production by 44%, by adopting the techniques and technology employed by the best practice cassava farmers. According to Onyenweaku, et al (2003) farmers who had efficiency values above the mean score were frontier farmers, while those who had values below it were non-frontier farmers. As such, the percentage of the frontier farmers was 59.76 percent, while non-frontier cassava producers represented 38.39 percent. The implication of the result was that the average improved cassava farmer required 41.1%s $(1\text{-}0.56/0.95)^{100}$ cost saving to attain the status of the most efficient the cassava farmer as sampled best ten category, while the least performing farmer needed 75.8% $(1\text{-}023/0.95)^{100}$ cost saving to become the most efficient cassava producer among the worst 10 sampled farmers.

CONCLUSION AND RECOMMENDATION

Based on the study, the following conclusions were deduced;

The production factors that affect technical inefficiency of Pro Vitamin A Cassava Varieties Farmers in South East, were labour input, planting materials and fertilizer, while the efficiency factors were level of education, farming experience, farm size and household size

In line to the conclusions, the following recommendations were drawn

(i) There need for federal Government of Nigeria revisit Land Tenure Decree of 1977, as this could help to enhance farmers, particularly genuine ones access to land to boost their production and productivity

(ii) There is need for government and non-governmental Organization (NGO) to liaison with appropriate research institutes to develop and disseminate to the farmers labour saving devices such as hand driven plough in order to optimizing their outputs at minimal cost.

(iii) There is need for mass production of improved cassava cuttings by out growers of NRCRI at every community in order to ensure easy access to the farmers

(iv) The need to enhance farmers' to educational programmes through adult education, workshops and seminars in order to boost their prudency in resource use

(v) Farmers with long years of farming experience should be encouraged to remain in farming by providing to them farm inputs at subsidized cost.

REFERENCES

1. Abdulai, S., Nkegbe, P. K and Donkoh, S. A. Assessing the technical efficiency of maize production innorthern Ghana: The data envelopment analysis approach. Cogent Food and Agriculture, 2018;4, 1512390.doi: 10.1080/23311932.2018.151239
2. Abedullah, S. K., and M. Khalid. Analysis of technical efficiency of rice production in Punjab (Pakistan): Implications for future investment strategies. *Pakistan Economic and Social Review*, 2007; 231-244.
3. Addai, K. N., and O. Victor. Technical efficiency of maize farmers across various agro-ecological zones of Ghana. *Journal of Agriculture and Environmental Sciences*, 2014;3(1), 149-172.
4. Adzawla, W., Fuseini, J. and Donkoh, S. A.Estimating technical efficiency of cotton productionin Yendi Municipality, Northern Ghana. Journal of Agriculture and Sustainability; 2013, 4(1), Pp.115-140.
5. Alemu, E, Bamlaku A., Nuppenau, E A and H. Boland. Technical efficiency of farming systems across agro-ecological zones in Ethiopia: An application of stochastic frontier analysis. *Journal of Agriculture and Environmental Sciences*, 2008; 3(1), 149-172.
6. Amaechina, E. C., and Eboh, E. C. Resource use efficiency in rice production in the lower Anambrairrigation project, Nigeria. Journal of Development and Agricultural Economics, 2016; 9(8), 234-242.
7. Amaza, P. S. and Olayemi, J. K. Technical efficiency in food crop production in Gombe State, Nigeria. *The Nigeria Agricultural Journal2001; 32(2): 140-151.*
8. Anyaegbunam, H.N, Okoye, B.C, Asumugha, G.N, and Madu, T. A translog stochastic frontier function analysis of plot size and cost inefficiency among small holder cassava farmers in South-east ecological zone of Nigeria. *Agriculture Journal.2001; 40*(9): 23-25.
9. Anyanwu, K.C. Influence of cassava variety and storage. Published by Federal Department of Agricultural Research, Ibadan, Nigeria. 2006; Pp69-73, second edition.
10. Asefa S. Analysis of technical efficiency of crop producing smallholder farmers in Tigray, Ethiopia. *'Munich Personal RePEc Archive (MPRA), Paper*,2012; 45p
11. Battese, G.E. and Coelli, J.J. A model for technical efficiency effect in stochastic frontier productions function for panel data. *Journal of Empirical economics*; 1977; 20:325-332.
12. Bravo-Ureta, T. and Pinheiro, C. Technical, economic and allocative efficiencies of peasant farming. Evidence from Dominic Republic: *Development Economics 1997; xxxv (1)*: 48-67.
13. Bravo-Ureta, T. and Vander, B. Technical economics and allocative efficiency in peasant farming evidence from the Dominican Republic. *The Development Economics1997; 35:48-50.*
14. Coelli, L.J. A guide to frontier 4.1. A computer program for stochastic frontier production and cost function estimation. Department of Econometrics, University of New England Armidale, Australia.1994; 45p
15. Edeh, H.O and Awoke, M.U. Technical inefficiency analysis of improved cassava farmers in Abakaliki Local Government Area of Ebonyi State: A Stochastic frontier approach. *Agricultural Journal*. 2009;4 (4), 171-174.
16. EFFIONG,J.B, Effiong GB and Udo, U A Socioeconomic Determinants of production of Pro Vitamin A Cassava Varieties by Farmers in Etim Ekpo Local Government Area, Akwa Ibom State, Nigeria Global Journal of Pure and Applied Sciences; 2015: 105-111
17. Egesi CP and Ilona P.Biofortification: Towards bridging agriculture and nutritional divide in Nigeria. The 39th National Conference and AGM of the Nigeria Institute of Food Science and Technology, Owerri., 201545p
18. Egesi CN, Njoku D, Olojede OA, Kulakow P (2015). Breeding for increased Vitamin A content in Cassava: Progress and Perspectives. 39th National Conference and AGM of the Nigeria Institute of Food Science and Technology, Concorde Hotel, Owerri.
19. Etuk, U. R and Umoh, I. U. Adoption Pattern of Pro-vitamin A Technology among farmers in Akwa Ibom State, Nigeria. Nigerian Journal of Agriculture,

Food and Environment. 2014; 10, (4): 135-138.

20. Ewuziem, J.E., Onyenobi, V.O. and Dionkwe, A. G. Technical Efficiency of farmers in Imo State, Nigeria. A trans log stochastic frontier production approach. *Nigeria Agric. Journal. 2009;* 40(1): 137-143.
21. Ezedimma C.I. Strategy for cassava subsection development in Nigeria proceedings of the 13th triennial symposium of the international society for tropical root crops (ISTRC) held in Tanzania 2006;pp 627-640.
22. Farrel, M. The measurement of productive efficiency. *Journal of Royal Statistical; 1957;* ACXX; 3: 25- 90.
23. F.A.O. Food and Agricultural Organization of the United Nation. An Assessment on the productivity of cassava in Africa 2013; vol. 11, 17-25.
24. Harvest Plus. Vitamin A Cassava; better crop and better Nutrition (www.harvest plus.org/content).2013
25. Nkematu J.A. Anambra State Agricultural development extension report for the 17th annual south east zonal research extension farmers input linkage system (REFILS) workshop at National Root Crop Research Institute Umudike. Nov 19th -3rd.2005; 123 - 145
26. National Population Commission. National Population Census for 2006. NPC, Abuja. www.NPC.gov.ne.2006.
27. NRCRI,: Annual report of National Root Crops Research Institute, Umudike, Umuahia2015;56p
28. Okoye, B.C. and Onyenweaku, C.E. Economic efficiency of small holder cocoyam farmers in Anamabra State, Nigeria: A Trans-log stochastic frontier cost function approach. *Mendwell Journals*; 2007; 4:535-546.
29. Onunka, B N, Ume, S I, Ekwe, P, K and Silo, B J, Attitude of farmers towards "pro-vitamin a" cassava production technologies in Abia state, Nigeria. Life Science Archives (LSA). 2017; 3; (3); 1050-1059.
30. Onu, J. I. C., Amaza, P. S. and Okunmadewa, F. Y. (2000). Determinants of cotton production and economic efficiency. *African Journal of Business and Economic Research, 1(2): 34 36*
31. Onyenweaku, C. E., Igwe, K. C. and Mbanasor, J. A. Application of stochastic frontier production function to the measurement of technical efficiency in am production in Nassarawa State, Nigeria. *Journal of Sustainable Tropical Agricultural Research.2004; 13:20-25.*
32. Uchendu FN (2013) The role of biofortification in the reduction of micronutrient food insecurity in developing countries. Afr J Biotechnol 12: 5559-5566.
33. Ume S.I, Ezeano C.I, Eluwa .A.N. and Ebe .F. Analysis of Technical Inefficiency in Rice Production among Farmers in Ezza South LGA of Ebonyi State of Nigeria (Application of Stochastic Frontier Production). *Archives of Current Research International, 2016; 4(3): 261-269.*
34. Ume,S I, Onuh, N C, Jiwuba, FO and Onunka, B N. Technical Efficiency Among Women Cassava Small Holder Farmers In Ivo Local Government Area Of Ebonyi State. 1-12, *Asian Journal of Agricultural Economics, Extension and Rural Sociology. 20166;(3)56- 73*

How to cite this article: Ume S.I., Uloh, EV, Onyeke, AC et.al. Technical inefficiency of pro vitamin A cassava varieties farmers in South East, Nigeria (using normalized trans-log production frontier function model); bridging agriculture and nutritional divide in rural areas of Sub-Saharan Africa. International Journal of Science & Healthcare Research. 2020; 5(3): 529-540.

******