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

Economic Efficiency of Orange Fleshed Sweet Potato (OFSP) Varieties by Farmers in Anambra State, Nigeria. (Stochastic Frontier Production Function Approach); Implication to Public Health in Rural Nigeria

Ume, S I[1], Onunka, B N[1], Ochiaka, CD[2], Achebe, U[3]

[1]Department of Agricultural Extension and Management. Federal College of Agriculture Ishiagu, Ivo Local Government Area Ebonyi State, Nigeria,
[2]Department of Agricltural Economics and Extension. Enugu State University of Science and Technology. Enugu State, Nigeria
[3]National Root Crop Research Institute (NRCRI), Igbariam Sub-station. Anambra State, Nigeria.

Corresponding Author Ume, S I

ABSTRACT

Economic efficiency of orange fleshed sweet potato (OFSP) Varieties by Farmers in Anambra State, Nigeria was studied using one hundred and twenty farmers. The sampled farmers were selected using purposive and multistage random sampling techniques. A structured questionnaire was used to collect data for the study. Normalized profit function and factor analyses were used to address the objectives of the study. The result shows that level of education, household size, poor access to extension services; farm size and access to credit were the determinant factors to the economic efficiency of the crop production. The constraints to the crop production were high labour cost, high cost of vines and high cost of fertilizer. There is need to enhance farmers' access to education programmes, extension services, inorganic fertilizer and labour saving device.

Keyword: Economic Efficiency, Orange Fleshed Sweet Potato (OFSP), Varieties, Farmers, Stochastic Frontier Production Function, Public Health Rural Nigeria

INTRODUCTION

Micronutrients related diseases are threats that are prevalent more among household in sub Saharan Africa whom starchy foods dominate their food intake and are resource poor to purchase processed food (supplementation) (World Health Organization (WHO), 2011). In effect, such people according to FAOSTAT, (2017) are predisposed to micronutrients (iodine, iron, vitamin A and zinc) deficiencies with wide range of non-specific physiological impairments, resulting in abridged resistance to infections, metabolic disorders, and delayed or impaired physical and psychomotor development. These symptoms as reported by Onunka, Ume, Ekwe and Silo, (2017) are more prominent among pregnant and nursing mothers and children less than 5 years. The public health consequences of micronutrient malnutrition as opined by FAO, (2013) are possibly enormous, and are specifically noteworthy when it comes to designing strategies for the prevention and control of diseases such as HIV/AIDS, malaria and tuberculosis, and diet-related chronic diseases.

However, one of the most effective ways of liberating at-risk people is through development of selective breeding of sweet potato with high-carotene germplasm (Low; et al; 2009, Shasha, 2011, Ukpabi, Ekeledo, and Ezigbo, 2012, Nwankwo and Bassey, 2013).The Federal Government of Nigeria in collaboration with National Root Crop

Research Institute (NRCRI) developed orange fleshed sweet potato (OFSP) and introduced them into Nigeria farming system (Ukpabi and Ekeledo, 2009).The *UMUSPO4 (*Solo Gold), *UMUSPO3* ('Mothers Delight'), and *UMUSPO1,* ('King J') were the common orange-fleshed sweet potato (OFSP) variety found in the study area, they added. The singular features of this variety are short cropping season, year-round source of dietary vitamin A, high dry matter when compared to other sweet potato, tolerant to sweet potato diseases but easily attacked by pests because of the sugar taste as result of carotene content (NRCRI, 2017)

Generally, OFSP is carbohydrate food for man and consumed in varied pattern, included the leaves, roots and vines are edible (Onunka, et al, 2017). In addition, the fresh roots can be boiled, steamed, baked, and fried into chips and eaten, pounded or mixed with yam as porridge and or eaten with vegetable soup, roasted and eaten with oil or sauce and made into porridge. The roots can processed into starch and use for industrial purpose and can be used in livestock feeding (Sweet Potato Knowledge, 2012)

Nevertheless, low production and productivity of this important OSFP variety have been well documented (Nwankwo and Bassey; 2014; FAO, 2014; Nwankwo, Ikoro, Akinbo, Okeagu, 2019). The deteriorating trend in the crop production perhaps could be correlated to low efficiency, hence affecting the crop capability to abridge the severity of hidden disease scourge and poverty alleviation through increased income. Efficiency as reported by Ume, Kaine and Ochiaka, (2020) is a very important factor of productivity growth especially in sub-Saharan Africa farming systems that often characterized of low resources and likelihood of emerging and adopting improved innovation are fast deteriorating in recent time. Nevertheless, to improve the farmers' productivity, requires that their resources must be used more efficiently with attention paid on attaining production goal without waste (Gugol and Suhag, 2008), optimal resources combination (Awoke, 2001) and profit maximization attainment (Forsund *et al.,* 1980). The important of the need to increase productivity efficiency as asserted by Eze and Akpa, (2010) is critical, especially as a feasible accompaniment to any set of policies to motivate crop production or stimulate resource management. Empirical studies on economic efficiency of orange fleshed sweet potato (OFSP) varieties by farmers in the study area is not known to the best knowledge of the researcher. The study would help in formulation and implementation of polices that would enable the farmers to improve on their resource use and input combination in order to maximize their output and minimum inputs. In addition, the study could act as a guide to scholars interested in the subject area and as learning device to students. The specific objectives are to: describe the socioeconomic characteristics of the farmers, estimate the farmers' economic efficiency and constrains to the crop production in the study area

Theoretical Framework of Stochastic Profit Function

Baltese and Coelli (1995) expressed Stochastic frontier profit function model as

$$\pi = f(P_L, ZK) \exp(V, U) \quad \text{.........................} \quad (2)$$

Where π is the normalized profit of the j^{th} farm defined as total revenue (TR) less variable cost divided by the farm specific output price.

F (f) represents an appropriate function (e.g. trans-log etc)

Pij is the price in the I^{th} variable input faced by the j^{th} farms divided by the price of the output.

Zkj is the level of the K^{th} fixed factors of the j^{th} farm.

Vj is a random variable which is assumed to be N (O, G) i.e. half normal distribution.

If UJ = O, the farm lies on the profit frontier obtaining maximum profit given the prices it faces and level of fixed factors.

If U > O, the farm is insufficient and loses profit because of inefficiency.

Profit function relates to maximum profits at a given prices of products and inputs so as to other exogenous variables such as fixed inputs or agro climatic and social variables. Profit function unlike the production approach combines both technical and allocative concepts in a profit relationship and any errors in production decision is translated into lower revenue for the producer, hence lower profit efficiency (Ali, 1996). Profit function has advantage of avoiding the simultaneously bias that occurs in the estimation of production function (Rahman, 2003). Two profit functions can be distinguished, depending on either or not market force is taken into account, the standard profit function and the alternative profit function.

The standard profit function assumes a perfectly competitive. Given the input (w) and output price vectors (p), the firm maximizes profits by adjusting the amount of input and output. Thus, the profit function can be expressed implicitly as

$\pi = f(P, W, V, U)$ and in logarithm terms in

$\pi + \theta = \ln F(P,W) + (V-U)$ ………...........(3)

Where θ is a constant added to the profit of each firm in order to attain positive values, enabling them to be treated logarithmically. Thus, alternative profit function is defined as $\pi_a = \pi_a$ (Y, W, V, U) in which the quantity of output (Y) produced replaces the price of output (P) in the standard profit function.

Normalized profit function was developed by researchers from profit function with advantage of being handy for theoretical and econometrical view point. This is because it reduces the number of explanatory variable by one and provides wider choice of the functional form. Normalized profit function is related to relative price not actual price of inputs and output as profit function uses (Effiong and Idiong, 2005).

The normalized profit function can be derived as follows:

Farm profit measured in terms of gross margin (GM) which equals to the differences between total revenue (TR) and total variable cost (TVC).

GM= $\sum TR - TVC = \left(\sum PQ - Wx\right)$ ………............ (4)

To normalize the profit function: gross margin (II) is divided on both sides of the equation by P, which is the market price of the output (cocoyam).

$\frac{\pi}{P} = \sum \frac{(PQ - Wx)}{P} = \frac{Q - Wx}{P} = f(X, Z) - \sum P_1 X_1$ …... (5)

Where;

TR = Total revenue,

TVC = Total variable cost,

P = Price of output

X = quantity of optimized input used

Z = price of fixed inputs used

$P_1 = {}^W/_P$ = normalized price of input X_1

While F (X, Z) represents production function (Rahman, 2003).

Factor analysis Model

Factor analysis model was employed to identify the constraints to potato production. The principal component factor analysis with varimax –rotation and factor loading of 0.40 was used. The constraints observed by processors were grouped into four factors using varimax rotation and factor loading of 0.40. The principal component factor analysis model is stated thus;

$Z_1=W_{11}X_1+W_{12}K_2+W_1nFn$…………….. (6)

$Z_2=W_{21}X_2+W_{22}K_2+W_2nFn$…………...... (7)

$Z_3=W_{31}X_3+W_{32}K_2+W_3nFn$…………….. (8)

$Zn=Wn1X_3+Wn_2K_2+WnnFn$…………... (9)

Where;

Z1=cn=observed variable /constraints to potato production pdts.

W_1=bn = factor loading or correlating coefficients.

F_1= Fn =unobserved underlying challenging factors facing / production.

MATERIALS AND METHODS

Anambra State of Nigeria was the study area and is located between latitude 5038 'N and $6^0$47 'E of Equator and longitude $6^0$36 'N and $7^0$21 'E of Greenwich Meridian. Anambra State has population figure of 4.184 million people (National Population Commission, (NPC), 2006). The state has annual rainfall range of 1600 mm-1700 mm, mean temperature of 27 ^{oC} and average relative humidity of 68 %. The inhabitants are agrarians with major food crop such as cassava, yam, cocoyam, maize, rice, sweet potato, vegetables and fruits. They also rear animals and engage in off-farm employments

Sampling Procedure and Sample Size

Purposive and multi-stage random sampling techniques were used to select Agricultural zones, Local Government Area, community and respondents. First, three Agricultural zones, were purposively selected because of intensity of the improved sweet potato. The selected zones were Anambra, Awka and Onitsha. Second, two LGAs were purposively selected from each of the selected zones.The selected LGAs were Anambra west and Anambra East for Anambra Zone, Onitsha North and South for Onitsha zone, while for Awka zone, Awka North and South. These brought a total of six LGAs. Third, two communities were selected from each of the LGAs and twelve communities were randomly selected. Finally, ten farmers were selected randomly from the each of the selected twelve communities. This brought to a total of one hundred and twenty respondents for detailed study.

Method of Data Collection

Well-structured questionnaire was used to collect data for the study.

Method of Data Analysis

Normalized trans log profit function model and factor analysis were used to address the objectives of the study..

Model Specification

Normalized Trans-log profit Function Model

The normalized trans-log profit function model is stated as below

$$\ln\pi_1=\beta_0+\beta_1 \ln r_1+\beta_2 \ln r_2+\beta_3 \ln r_3+\beta_4 \ln r_4+\beta_5 \ln r_5+0.5\beta_6 \ln r_1^2+0.5\beta_7 \ln r_4^2+0.5\beta_8 \ln r_5+0.5\beta_9 \ln r_2+0.5\beta_{10} \ln r_1 \ln r_2+0.5\beta_{11} \ln r_1 \ln r_4+0.5\beta_{12} \ln r_2 \ln r_5+0.5\beta_{13} \ln r_2 \ln r_3+0.5\beta_{14} \ln r_2 \ln r4+0.5\beta_{15} \ln r_2 \ln r_5+0.5\beta_{16} \ln r_3 \ln r_4+0.5\beta_{17} \ln r_3 \ln r_3+0.5\beta_{18} \ln r_5 \ln r_5+Vi-Ui \quad (21)$$

Most importantly, model that explained better the relationship between the independent and dependent variables by having the highest sigma squared and lower variation ratio was chosen.

The economic inefficiency effects, U is defined as

$$a_0 + a_1 w_1 + a_2 w_2 + a_3 w_3 + a_4 w_4 + a_5 w_5 + a_6 w_6 + a_7 w_7 + a_8 w_8 + a_9 w_9 + a_{10} w_{10} \quad (22)$$

Where: w_1 = Ahd (yrs), w_2 = Edu (yrs), w_3 = Gde (dummy), w_4 = Famexp (yrs), w_5 = Famize (ha), w_6 = Extnit (No), w_7 = Cress (dummy) w_8 = Meorg (dummy), w_9 = Hods (No), m10 = Marst (Dummy), a_0 = constant, $a_1 - a_9$ = coefficient to be estimated

N/B Ahd =Age of Household, Edu = level of education, Gde = Gender, Famexp = Farming experience, Famsize = Farm size, Extnit = Extension visit, Cress = credit access, Meorg = Membership of organization; (Meorg), Hods = household size, Marst = Marital status,

Table 1: Description of variables used in the Economic Efficiency

Variable	Measurement	Expectation
Age	Age of the household head (years)	-
Educational level	Years of school attendance (years)	+
Household size	Number of dependents (number of people)	+
Farm size	Size of the farm (Flock size)	_
Extension service	Visit from extension workers (1 yes, if no)	+
Membership of Organisation	Membership of organ.; 1; otherwise, 0	+
Access to credit	Access 1; otherwise; 0	+

RESULTS AND DISCUSSIONS

Table 2: The Average Statistics of OFSP Farmers

Variable	Mean Values	Minimum Values	Maximum Values
Age(Years)	40	26	78
Farm Size(Ha)	0.38	1	1.5
Household Size(No)	6	4	16
Educational Level (Years)	8.2	0	0
Labour (Manday)	48.4	32.6	72.3
Extension Visits(No)	25	18	56
Output (Kg)	268.4	103	368

Source; Field Survey; 2019

Table 2 shows that the average age of OFSP farmer was 40 years. This implies that OFSP farmers were relatively young, hence can easily surmount stresses and strains involved in attainment of efficiency in the crop production, for high yield to ensue. Nwankwo and Bassey; 2013 finding gave credence to above affirmation. They opined that youthful farmers have long planning horizon and access to information aimed at improving their production efficiency. Furthermore, an average farmer had household size of 6 persons. This could connote that the farmers have access to labour, particularly the use of family labour in order to upset labour requirement for the farming especially during farming season when the wage rate is very expensive (Ume, Onuh, Jiwuba and Onunka, 2016)

Furthermore, an average ORFP farmer cultivated 0.38hectares of land. This implies that the farmers in the study area operated in small holding. Eze and Akpa, (2010) reported that farming in most sub-Saharan Africa is usually in small land holding with singular characteristic of being scattered, hence giving no room for mechanization and modernization. In addition, an average farmer of the improved cassava had 25 extension visits in a year. Extension services, as revealed by Ume, Onunka, Nwaneri and Okoro, (2016) aids in dissemination of information and technical assistants to farmers in order to improve their efficiency in farming, for high profit to accrue. Additionally, the number of years spent in schooling by an average OFSP farmer was 8.2 years. This signifies that the farmers had formal education, thus have more inclination of being prudent in resource use and combination in farming for high profitability to result (Onunka, et al; 2017). Moreover, an average of the farmer employed a man day of labour of 48.4 in production of average output of 264.4kg. Labour, especially family labour as asserted by Ume, et al; (2016) is very important among subsistence farming as most of their farms are nearly zero mechanized.

Estimation of Economic Efficiency

Table 3 of normalized translog stochastic production function revealed that the coefficients of prices of OFSP vines and fertilizer were statistically significant and positively signed. The wage rate (labour) and price of fertilizer had elasticity of 3.442 and 6.322 respectively, which signifies that the enterprise operated in stage one of the classical production function, hence there is need to intensify the procurement of fertilizer and wage rate (labour) in order to increase farm production.

In contrary to the sign identity of fertilizer, Ume, et al; (2020) attributed to high cost and unavailability of fertilizer resource to withdrawal of fertilizer subsidy by Federal government, therefore letting forces of market demand and supply to determine the price of the resource. More so, on wage rate and economic efficiency relationship, Kadurumba and Ume (2012) study on palm oil, reported positive relationship. They opined that increase in wage rate would attract more labour and the need to run shift could ensue, which invariably lead to increased output with attendant enhanced profit levels. It is worthy to note that all the interactions of fertilizer were significant at different risk levels. In addition, all wage relations with other input factors with exclusion of farm size were not significant. The coefficient of farm size was positive and statistically significant at 10.0% risk level. This finding confirms to a prior expectation and implies that 1.0% increase in farm size would increase the profit structure of the enterprise by 1.221%. This result was in synonymous with the finding of Okeke (2000), who posited that insignificant competition between infrastructural development in most rural areas of sub Saharan Africa and land for farming could be attributed to the behavior of the variable. The total variance parameter determines goodness of fit and the correctness of the specified distributional assumption of the composite error term. The estimate of variance ratio (γ) was 0.865, indicating that 86.5% of the disturbance in the system was due to inefficiency, one-sided error and therefore 13.5% was due to stochastic disturbance with two sided error supported by a high positive value.

Table 3. Normalized Trans log Stochastic Frontier Profit Function

Production Factor	Parameter	Coefficient	Standard Error	t-value
Constant term	β_0	6.401	0.699	13.009***
Price of OFSP vines	β_1	3.680	0.683	4.936***
Price of fertilizer	β_2	6.322	0.590	10.715***
Wage rate/labour	β_3	3.442	0.409	8.416***
Farm size	β_4	1.221	0.430	2.845**
Depreciation	β_5	0.168	0.072	2.333
Prices of vines^2	β_6	-0.2405	0.0467	-5.1510***
Prices of fertilizer ^{2}	β_7	0.250	0.108	2.320**
Wage rate ^{2}	β_8	6.862	0.802	8.556***
Farm size ^{2}	β_9	0.557	0.843	0.660
Depreciation ^{2}	β_{10}	- 0.087	0.141	- 0.638
Price of vines x fertilizer	β_{11}	0.285	0.027	10.556***
Price of vines x wage rate	β_{12}	0.301	0.078	3.859***
Price of vines x farm size	β_{13}	-0.267	0.024	-11.125***
Price of vines x depreciation	β_{14}	0.291	0.003	9.7***
Price of fertilizer x wage rate	β_{15}	-1.338	0.068	-19.676***
Price of fertilizer x farm size	β_{16}	4.956	0.592	8.372***
Price of fertilizer x depreciation	β_{17}	-0.051	0.084	0.607***
Wage rate x farm size	β_{18}	- 0.608	0.412	1.476***
Wage rate x depreciation	β_{19}	0.336	0.405	0.829
Farm size x depreciation	β_{20}	0.009	0.045	0.2
Diagnostic statistics				
Log-likelihood function		76.062		
Total variance (σ^2)		3.008	0.498	6.040***
Variance ratio (γ)		0.865	0.0480	18.020
Log-likelihood test		78.700		

Source: Computed from Frontier 4.1 MLE Field Survey, 2019
***, **, * significant at 1.0%, 5.0% and 10.0% levels of probability respectively

Determinants of Economic Efficiency

The economic efficiency of OFSP production using normalized translog stochastic production function is presented in Table4

Table 4: Sources of Economic Efficiency in OFSP production

Variable	Parameter	Coefficient	Standard error	t-value
Intercept	a.	23.130	4.934	4.688***
Age of farmer	a_1	-0.347	0.126	-2.754
level of schooling	a_2	0.841	0.165	5.097
Household size	a_5	-0.507	0.276	1.837
Extension visit	a_6	0.763	0.235	3.247
Credit access	a_7	-0.115	0.108	1.065
Membership of cooperative	a_8	0.966	0.212	4.557
Farm size	a_9	0.764	0.342	2.234

Source: Computer from Frontier 4.1 MLE/Field Survey, 2019
***, **, * significant at 1.0%, 5.0% and 10.0% levels of probability respectively

The coefficient of the age of farmer was positively signed and significant at 5% alpha level. The advance in the age of the respondents, leading to decrease in their innovativeness and adoptability of individuals could be attributed to the sign of the coefficient. Several studies (Eze and Akpa, 2010; Kadurumba and Ume, 2013; Ume, et al; 2020) harmonized to above finding, while Efiong and Idiong, (2005) and Okike, (2000) were in contrast. They opined that aged farmers are usually an embodiment of experience through experimentations and observation, thus enhancing their farming efficiency through efficient technical and allocative efficiency. Moreover, the positive sign of the coefficient of education implies that high educational status facilitates farmers' efficiency as it makes one to be more objective in evaluating innovations and prudent in resource use for high production and productivity (Okike, 2006). However, the finding of Kadurumba and Ume, (2013) was in disapproval to the above assertion. They purported that educated people have flair for white collar job than farming vocation, thus this could affect their efficiency and effectiveness. In addition, the statistical test of the coefficient of extension service was positively related to farmers' efficiency and significant at 1% alpha level. Extension services aid in dissemination of information and technical advice to farmers aimed at enhancing their efficiency as asserted by Rahman, (2003). The findings of Ali, (1996) and Awoke, (2001) did not concur to the sign identity of the coefficient. They deduced that wide ratio of extension to farmers and poor attitude of the extension agents in discharging their duties were among the reasons for the behavior of the variable.

Furthermore, not in conformity to *apriori* expectation, household size had a negative coefficient and statistically significant at 5% probability level. Iheke, (2006) cited that the excessive use of family labour in the farmer's farm beyond the point where the marginal value product of labour is equal to the wage rate as the critical reason for the behaviour of the variable in the model. Moreso, Okike (2000) reported that in a situation where the family size is large, probably made up of aged and very young people (dependents), a small proportion of farm labour would be derived from it, hence, inefficiency effect is expected to be greater. Conversely, Ume, et al (2017) opined that large household members of labour age ensure ease of proxy to labour, especially during the peak of planting season, hence lessening labour cost. Additionally, the coefficient of farm size was statistically significant at 10% and had positive influence on economic efficiency. The finding of Hazarika and Subramanian (1999) concurred to the assertion. They related the sign behavior of the variable to the fact that farmers have high propensity to manage their farm resources effectively when the farming scope is relatively small than big ones. This finding of (Awoke, 2001) did not comply to the above statement. They posited that big farmers have higher economic efficiency than smaller farmers. More so, the coefficient of membership of farmers' organization was positively signed and significantly related to economic efficiency at 1.0% alpha level. This result concurred with *apriori expectation.* Studies (Okike, 2000, Effiong and Idiong, 2005, Eze and Akpa, 2010, Onunka, et al; 2017) revealed that members of cooperatives have more access to manpower development and access to production inputs, which could enhance the allocative and technical efficiency.

Frequency Distribution of Economic Efficiency

The Trans log stochastic frontier profit function yielded the following varied economic efficiency ranges as contained in Table.

Table 5: Distribution of Economic Efficiency Indices for OFSP Farmers

Economic Efficiency Range	Frequency	Percentage
0.00 – 0.20	12	10.
0.21 – 0.40	27	22.5
0.41 – 0.60	30	25.
0.61 – 0.80	15	12.5
0.81 – 1.00	36	30.
Total	**120**	**100**
Maximum economic efficiency	0.98	
Minimum economic efficiency	0.14	
Mean economic efficiency	0.62	
Mean of worst 10		36.7
Mean of best 10		85.7

Source: Computed from Field Survey, 2019

Table 5 shows that the minimum economic efficiency of OFSP farmers in the study area was 0.14, which specified gross under-utilization of resources, while the maximum economic efficiency was 0.98. This by implication, reveals that best economically efficient farmer was almost operating on the frontier. Furthermore, the percentage of the frontier farmers was 45.33% which indicated that they were more or less profit maximizes while the non-frontier represented 48.66% of the sampled farmers. There was wide gap between the economic efficiency level of best farmers and worst farmers. To bridge the gap, the average best farmer needed a cost saving of 36.7% $(1\text{-}0.62/0.98)^{100}$ to attain the frontier while the least of the worst 10 farmers required a cost saving of 85.7% $(1\text{-}0.14/0.98)^{100}$ to become the best efficient farmer in their group. None of the farmers operated on the frontier and this result concurred with Okike (2000) and Idiong, (2006) who stipulated that the more than the profit maximizing level of the input was employed if the efficiency is less than one.

Varimax-Rotated Factors against Constraints to Potato Production

Table 6 revealed that three factors were used based on the response of the respondents, included Factor 1= economic/institutional factor, Factor 2 = infrastructural factor and Factor 3 = socio-financial factor. Only variable with factor loading of 0.40 and above at 10% overlapping variance were used in naming the factor. The variables that loaded more than one factor were discarded. Variables that loaded more than one factor like land problem was discovered. In naming the factors stated that each factor is assigned a denomination centered on the set of characteristics it consists of (Ume, et al; 2016).

Table 6 Varimax-Rotated Factors Against Constraints to Production of OFSP in the Study Area.

Variable	Factor 1	Factor 2	Factor 3
Land Problem	0.414	0.466	0.490
Poor access to credit	0.433*	-0.043	0.174
High labour cost	0.213	0.404*	-0.134
Poor extension contact	0.419*	-0.008	0.140
Poor soil Fertility	0.195	-0.252	0.477*
High cost and adulteration of pesticides	0.114	0.421	0.049
high cost of improved potato vines	0.056	0.400	0.013
High cost of Transportation	0.018	0.032	0.412

Source: computed from SAS 2019

Limitations under the economic /institutional factor include poor access to credit (0.426) and extension services (0.419*) the poor access to credit by the farmers could be related to among others high interest rate as charge by the lending agencies (Awoke, 2001). Access to credit as revealed by FAO, (2005) aids in boosting farmers' purchase of production inputs at right time and for hiring labour in order to increase their farm output. In addition, extension services was perceived as constraint to farmers as most change agents were reluctant in doing their jobs because of poor motivation by government agencies concerned (Omoruyi, 1991).

Variables that loaded under factor 2 (infrastructural factor) included; high cost of labour (0.433), high cost of fertilizer (0.404), high cost and adulteration of pesticides (0.421), high cost of improved potato vines (0.400). High cost of labour has forced many farmers to curtail maximally their production frontier. The drift of abled bodied youths for 'white collar' job may be responsible for the dearth of labourers, leading to high wage rates charged by few available ones. Additionally, pesticide has problems of being substandard in most developing countries in sub-Saharan Africa, hence leading to low efficacy when applied in farms, as reported by Ukpabi, Ekeledo and Ezigbo, (2012). Furthermore, fertilizer

as reported by Ume, et al; (2017) is very scarce and when available is expensive at farm level to procure and apply to boost crop yield. In effect many farmers cultivate their farms without this important yield booster, thus reaping meagrely. More so, high cost of the improved potato vine was reported by the farmers. This problem is orchestrated by fewer of the improved cassava multiplication farms in the study area as well most of the vines used in other previous years by the farmers were consumed by fire or lost to Fulani cattle rearers. This has resultant effects of many of the farmers from discontinuing the use of the varieties (Nwankwo and Bassey, 2013).
Under Factor 3 = socio-financial factor, High cost of transportation (0.402), poor soil fertility (0.422) Poor road network, high fuel and pump price could be responsible for high cost of transportation in the study area as reported by Onunka, *et al*; (2017). Also, poor soil fertility problem is capable of dwarfing crop yield and this has been variously reported by researchers as occasioned by poor farming practices employed by the farmers and soil erosion (Nwankwo, et al, 2019).

CONCLUSION AND RECOMMENDATION

The farmers' educational level, membership of organization, farm size and extension services were the determinants to economic efficiency in the study area. Also, constraints to ORSP production in the study area were poor soil fertility, high costs of transportation, high cost of fertilizer and pesticides substandard nature.
Based on the conclusion, the following recommendations were offered
(i) There is need to enhance farmers' level of education through workshops, seminars and adult education.
(ii) Extension agents should be adequately motivated by prompt payment of their salaries and other out of pocket expenses incurred while discharging their functions.
(iii) Farmers should be encouraged to form cooperatives to enable them have easy access to farm resources from government and non-governmental Organization(NGO) in order to boost their production and productivity.
(iv) The need for government to revisit fertilizer subsidy programme to enable farmers have access to fertilizer at moderate cost in at farm level in order to increase their farm output.
(v) There is need for government agencies concerned to help in the multiplications of the ORFP vines through establishment of multiplication centres in every community in the study area to enhance farmers' access.
(vi) There is need for labour saving devices to be developed through research and disseminated to farmers in order to reduce cost of labour.

REFERENCES

1. Ali, A. Quantifying the socio economic determinants of sustainable crop production. An application to wheat cultivation in the Tarui of Nepal Agricultural economics. 1996; 14:45-60.
2. Awoke, M.U. Resource use efficiency in multiple cropping system by small-holder farmers in Ebonyi state of Nigeria". 2001. Pp34 - 45. A Ph.D. thesis of Department of Agricultural Economics and Extension of Enugu state University of Science and Technology.
3. Effiong, E.O. and Idiong, C.I: Measurement and sources of economic efficiency in rabbit production in Akwa Ibom State, Nigeria. A stochastic frontier profit function approach. Nigeria Agricultural Journal 2006; 4(1):5-8.
4. Eze, C. T. and Akpa, C. E. Analysis of technical efficiency of National Fadama II facility on arable crop farmers in Imo State, Nigeria. Nigeria Agricultural Journal, 2010; 41(1): 109-115.
5. Food and Agricultural Organization (FAO) of the United Nation. An Assessment on the productivity of Sweet potato in Africa, 2014; 13; vol. 11, Pg.17.
6. FAO, FAO statistical data htt//www/fao.org, 2005.
7. FAOSTAT. farmer groups in Uganda to develop new sweet potato cultivars:

decentralization and building on traditional approaches. Euphytica; 159: 217-228. http://faostat.fao.org/site/336/default.asp, 2017.

8. Forsund, F.R, Lovel, C.A.R. and Schmidit, L.T. A survey of frontier production function and their relationship to efficiency measurement. Journal of Economics, 1980; 5:15-17.
9. Gugol, S.K. and Suhag, K.S: Estimation technical efficiency on wheat farm in Northern India: A panel data analysis. Farming at the Hedge Journal, 2008; 5: 13-21.
10. Hazairka, C. and Subramanian, S. R. (1999). Estimation of technical efficiency in the frontier production model - an application.
11. Kadrumba, C. and Ume, S. I. (2012). Determination of profit efficiency among small scale traditional palm oil processing in Nigeria. A profit function approach. International Journal of Agriculture and Rural Development, 15(1): 793-799.
12. Low JW, Arimond M, Osman N, Cunguara B, Zano F and Tschirley D. A food-based approach introducing orange-fleshed sweet potatoes increased vitamin A intake and serum retinol concentrations in young children in rural Mozambique. J. Nutr. 2017; 137: 1320-1327
13. Mills JB, Tumhimbise GA, Jamil KM, Thakkar SK, Failla ML,and Tamumihardjo SA . Sweet Potato β-carotene bioefficacy is enhanced by Dietary fat and not reduced by soluble fibre intake in Mongolian gerbils. 2009; J. Nutr., 139(1): 44-50.
14. NPC (National Population Commission), (2006): Population census of Federal Republic of Nigeria: Analytical report at the national level. National Population Commission, Abuja.
15. NRCRI, (2006): Annual report of National Root Crops Research Institute, Umudike, Umuahia. 2006. 7p
16. Nwankwo I.I.M., Ikoro A.I., Akinbo O.K., Okeagu O.D., and Korieocha J.N. History Development and Impact of Orange Fleshed Sweet Potato Varieties in Nigeria Since 2012 - A Review. International Journal of Agricutural Research, Sustainability and Food Sufficiency (IJARFS).2019; 6(04) PP386-401
17. Nwankwo IIM and Bassey EE. Breeding Sweet potato for food in Nigeria. In: Contemporary issues in sustainable tropical Agriculture. Lawrence E., James, P.U., Nsikak-Abasi N.E., and Alice E.; Faculty of Agriculture, University of Uyo.2013
18. Omoruyi, S.A, Orhue, U.X. Akarobo, A.A. & Aghimien, C.I. Prescribed Agricultural Science for senior secondary school. ASD publishers Abuja.1999. 34p
19. 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.
20. Okike, I. (2000). Crop livestock interactions and economic efficiency of farmers in the Savannah Zones of Nigeria. Ph.D Thesis, Department of Agricultural Economics, University of Ibadan; 2000. 65p
21. Panta A, Espinoza C and Roza W. Health status testing and virus elimination in sweet potato Available at: Hp// research. cip. cigar.org/confluence/download/at tachment/ 1354/4. sweetpotato+ virus/ elmination. pdf?version=/clink checked 11march 2007
22. Rashman, S. (2003): Profit efficiency among Bangladesh rice farmers. Journal for Food Policy; 28: 483-405.
23. SASHA. Sweet potato Action for Security and Health in Africa. Integrating health and agriculture to maximize the nutritional impact of orangefleshed sweet potato: The Mama SASHA proof-of-concept in Western Kenya. Available http://sweetpotatoknowledge.org/projectsinitiatives/sasha; 2011
24. Sweet potato knowledge. www.sweetpotatoknowledge.orgMay,2012, accessed September 15th, 2013. Vitamin A deficiency: A South African experience. Paper presented at the VITAA Project.2012.
25. Ukpabi UJ, Ekeledo EN. Feasibility of using orange fleshed sweet potato as an alternative to carrot in Nigerian salad preparations. 2009; Agric. J., 4(5): 216-220
26. Ukpabi, U J, Ekeledo, EN and V. U. Ezigbo, VU. Potential use of roots of orange-fleshed sweet potato genotypes in the production of β-carotene rich chips in Nigeria African Journal of Food Science. 2012, 6(2), pp. 29-33.Available online http://www.academicjournals.org/ajfs
27. Ume,SI, Onuh, N C, Jiwuba, FO and Onunka, B N (2016). Technical Efficiency among Women Cassava Small Holder Farmers in Ivo Local Government Area Of Ebonyi State. Asian Journal of Agricultural

Economics, Extension and Rural Sociology. 2016; 1 - 12

28. Ume, S.I., Onunka B.N., Nwaneri T.C. and Okoro G.O (2016) Socio-economic Determinants of Sweet Potato Production among Small Holder Women Farmers in Ezza South Local Government Area of Ebonyi State, Nigeria. Global Journal of Advance Research. 2016; 3 (9); 972-883
29. Ume S.I.1, Kaine A.I.N. and Ochiaka C.D.(2020)Resource Use Efficiency of Yam Production among Smallholder Farmers and Effect to the Environment in the Tropics Sustainable Food Production 2020; 7 (1)1-16
30. WHO(2011).WorldHealthOrganization.(www.who.int/caccines/diseases/en/vitamin/science/scio2ml). Accessed on 27/4/2019

How to cite this article: Ume, SI, Onunka, BN, Ochiaka, CD et. al. Economic efficiency of orange fleshed sweet potato (OFSP) varieties by farmers in Anambra state, Nigeria. (Stochastic frontier production function approach); implication to public health in rural Nigeria. International Journal of Science & Healthcare Research. 2020; 5(3): 518-528.

******