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Estimating Technical Efficiency of Fluted Pumpkin Production in Itu Local Government Area of Akwa Ibom State, Nigeria

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Abstract: *The study analyzed the technical efficiency in fluted pumpkin production in Itu Local Government Area of Akwa Ibom State, Nigeria. A multistage random sampling technique was adopted in the selection of 30 fluted pumpkin farmers from 4 villages in Itu Local Government Area. Out of the 120 questionnaires distributed, 90 were returned and used for the analysis. Information that was required centered on the socio-economic characteristics of farmers and other relevant inputs like fertilizers, chemicals, manure etc. Descriptive statistics which include frequencies and percentages were used in analyzing the socio economic characteristics of the farmers. Technical efficiency was analyzed using the stochastic frontier production function. The maximum likelihood estimate technique was employed in estimating the function while the t-test statistics was used in testing their statistical significance. The findings of the study reveal that fluted pumpkin farmers are not100% technically efficient due to factors such as lack of access to extension services and credit facilities. Based on these findings, recommendations on how to strengthen the effectiveness of extension services to improve fluted pumpkin production are made. Some of the recommendations are the areas of technological innovation, and proper agricultural financing to help the farmers to improve their efficiency levels.*

1. INTRODUCTION

Agricultural resources which are relatively scarce and limiting in production can be said to possess high economic value. Farm resources or farm production inputs are factors of paramount concern among farmers, since no meaningful agricultural production can take place without them. Relatively, the processes of resources utilization for food and fibre production, under conditions of rapid economic development, rural communities are faced with some problematic decisions of what, how and when to produce and utilize scarce resources. Specifically, there is the problem of deciding on how much of the available factors or resources to be devoted for future growth as well as how much to satisfy current consumption needs (Parikh et al, 1995).

According to Ogunfowara and Olayide (1981), resources are not efficiently used or allocated under the small scale farming because of traditional style of production. This is largely attributable to the fact that most of the farmers are of low educational status. Thus, irrespective of the large quantities of available factors existing in the African continent, they are largely under developed due to lack of pre-requisite skills by the peasant farmers. Consequently, the problem of resource allocation and utilization have assumed critical dimension in the traditional agriculture among the small scale farmers. Nwaru (2001) also observed that, the problem of acute shortage of rural resources and complexity of modern technologies have grossly contributed to inefficiency in resource use, and low productivity in vegetables production which in turn is responsible for inefficiency in resources use (Abang, Idiong and Akpan, 2004).

It is widely held that efficiency is at the heart of agricultural production. This is because; the scope of agricultural production can be expanded and sustained by farmers through efficient use of resources (Ali, 1996, and Udoh, 2005). For this reasons, efficiency has remained an important subset of empirical investigation particularly in developing economies where majority of the farmers are resources poor.

Studies on crop production are mostly restricted to food and cash crops that are believed to be high income earners. Okoye et al (2007) in a study on determinants of allocative efficiency in small-holder Cocoyam production in Anambra state used Trans log Stochastic Frontier cost function, found out that age and education were negatively and significantly related to allocative efficiency at 1%, farm size

coefficient have a negative relationship with efficiency and also significant at 5%. Fertilizer use and credit access was found to be significant and directly related to allocative efficiency at 5% and farm experience at 10% levels of probability. No significant relationship was found between allocative efficiency and factors such as extension visit, family size and membership of cooperative societies. In another study, Amaza (2000) studied the influence of education and extension contact on food crop production in Gombe state, Nigeria using a Stochastic production function with Maximum likelihood Estimation as a tool. The results show that coefficients of farming experience and animal traction (6.22 and 5.37) respectively are positive and statistically not significant even at 10% level. Education has a positive coefficient (0.33) and statistically significant to efficiency at 5% level. Extension contact variable as an efficiency factor has a positive coefficient (3.34) and statistically significant at 10 percent level. Crop diversification variable has a negative value (-20.76) and significant at 10% level. As diversification decreases and fewer crops are grown, efficiency increases.

Amaza et al (2005) used Stochastic Frontier production function with multiplicative disturbance term for the study on Determinants of Wheat production and technical efficiency in the Chad Basin Development Area, Nigeria. The study found out that farmers technical efficiency varied between 0.09 and 0.94 with a mean of 0.65. The coefficient of farming experience (-0.056) was statistically significant to technical efficiency at 10%. Coefficient of education variable was positive (0.071) that is, conform with apriori expectations but not significant even at 10% level. Credit access has a positive coefficient (0.288) but also not significant. The study concluded that the variation in the level of technical efficiency among the sampled farmers was largely influenced by the farmers farming experience in wheat production.

Udoh and Etim (2006) in estimating technical efficiency of waterleaf production in Nsit Ibom LGA of Akwa Ibom used Stochastic Frontier model with Maximum Likelihood analysis and found out that mean efficiency in waterleaf production is 0.65. The coefficient of education was significant and positive(0.4853) indicating that producers with more education appear to be less efficient in the use of resources, there is a positive relationship between main occupation and technical efficiency with coefficient of (-0.5546). Farming experience with coefficient (-0.6323) indicates that specialization developed overtime, which eventually leads to improved methods of production will increase efficiency.

There is less information on the economics of production of minor crops even when they substantially augment household income. It is the observation made on the resources availability, resources allocation and scarcity of the resources in relation to human wants, the difficulty of tapping the resources or controlling them in production process as well as the accessibility of the resources that the study is intended to explore answer to the question: "Are the small scale fluted pumpkin farmers in Itu Local Government Area technically efficient.

This paper tends to analyze the efficiency of resources use in fluted pumpkin production in Itu local Government Area. Specifically, the study intends to determine the technical efficiency and factors affecting efficiency of fluted pumpkin producers.

2. METHODOLOGY

The study was conducted in Itu Local Government Area of Akwa Ibom State, Nigeria. Itu is located within latitude $6^{0}40^{1}$and $6^{0}20^{1}$ N and Longitude $9^{0}30^{1}$and $5^{0}47^{1}$E. It occupies a total land area of 606.099 square kilometers with the population of about 127,856 people (NPC, 2006) which are predominantly Ibibio. Itu is made up of 10 wards and 51 villages, and it is bounded by Odukpani Local Government Area of Cross River State and Ibiono Ibom, Uyo and Uruan local Government Areas of Akwa Ibom State.

The area in which the study was conducted is riverine, well known for the cultivation of fluted pumpkin usually along the river banks. Inhabitants of this area are engaged in the cultivation of okro, pepper, cocoyam, etc. and fishing activities. Many of the farmers in the area are involved in food crops sole cropping system.

A multi stage sampling technique was for the study. First, 4 villages that are notably involved in fluted pumpkin production in the study area were purposively selected thereafter, 30 fluted pumpkin farmers were then randomly selected from each of the 4 villages. A total of 120 respondents were used in the study. In analyzing the data, the Stochastic Frontier Model was used to determine the technical efficiency of fluted pumpkin production and the factors affecting their efficiency. General representation of the production function specified in the study is as shown in equation 1:

$Yi = f(Xi:\beta)\exp(Vi-Ui)\ i = 1,2,..N$ (1)

Where;

Yi = output of ith farm (kg)

Xi = corresponding vector of inputs

β = Vector of unknown parameter to be estimated

F = denotes an appropriate functional form.

Vi = Symmetric error component that account for random effects and exogenous shock

Ui< 0 = is one sided error component that measures technical inefficiency.

The study ultimately utilized the multiple regression technique based on stochastic frontier to determine resource use efficiency using the Cobb-Douglas functional form which is presented in equation 2 below.

$$LNQ = \beta_0 + \beta_1 LnX_1 + \beta_3 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_8 LnX_8 + Vi\text{-}ui \quad (2)$$

Where;Q (Output) = Quantity of fluted pumpkin (kg)

β_0 = Constant term

X_1 = land (ha)

X_2 = planting Material (kg)

X_3 = Hired Labour (man days)

X_4 = Family Labour (man days)

X_5 = Capital (Naira& depreciation)

X_6 = Fertilizer (kg)

X_7 = Manure (kg)

X_8 = Agro-chemical (litres)

And efficiency equation given as;

$$e\text{-}vi = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + zi \quad (3)$$

Where;

e = error term

vi = Symmetric error component that accounts for random effect and exogenous shock.

δ_0 = Intercept

Z1 = Access to extension services(no of contacts)

Z2 = Age (yrs)

Z3 = Access to credit facility

Z4 = Farming experience (yrs)

zi = Error term assumed to be randomly & normally distributed

δ_1- δ_4 = Efficiency parameters

3. RESULTS AND DISCUSSION

The socioeconomic characteristics are considered first. The characteristics considered are: age, sex, marital status, Educational Qualification, Occupation (Primary and secondary), and household size of the respondents. The results are presented in the table and discussed below:

3.1. Age of Respondents

Table1. *Percentage Distribution of Respondents by Age*

Age group (yrs)	Frequency	Percentage %
<21	2	2.22
21-35	23	25.56
36-50	44	48.89
51-65	17	18.89
>65	4	4.44
Total	**90**	**100.00**

Source: *field data 2013*

From the above table, the ages of the sampled pumpkin farmers range from <21 to >65years with the majority (48.89%) of the farmers being between the age bracket of 36-50 years followed by 25.56% between the ages of 21-35 years, and only 18.89% of the respondent fall between 51-65 years. The least number of respondent is found in age bracket <21 years which is 2.22% and 4.44% of the farmers is older than 65years. The predominance of younger people in fluted pumpkin production could be because of the labour intensive nature of its production which requires young and energetic farmers.

3.2. Sex

Women are found to make up the bulk of fluted pumpkin producers is study area. About 77.78% of the sampled farmers are women. This is shown in table below:

Table2. *Percentage Distribution of Respondents by Gender*

Gender	Frequency	Percentage %
Male	20	2.22
Female	70	77.78
Total	**90**	**100.00**

Source: *Field survey, 2013*

The above findings is in line with the findings of Umoh (2006) in assessing the technical efficiency of resources use in Urban farming in Akwa Ibom State. Nigeria He observed that, women constitute the highest percentage of fluted pumpkin farmers in the area. Also several studies indicate that, women constitute up to 60% of Africa Agricultural workforce, Sigot(1995) reports that women in Africa are responsible for an estimated 70% of total food production throughout the continent.

3.3. Marital Status

Table3. *Percentage Distribution of Respondents by Marital Status*

Marital Status	Frequency	Percentage %
Married	61	67.78
Single	8	8.89
Widow	19	21.11
Divorced	2	2.22
Total	**90**	**100.00**

Source: *Field Survey, 2013*

From the above table, about 67.78% of the sampled farmers were married followed by widow which constitutes about 21.11% of the farmers. Only 8.89% were single and 2.22% were divorced. From this result, it could be asserted that, the study area have high cultural values, hence percentage of married households.

3.4. Educational Qualification

Table4 shows that 54.44% of the sampled farmers had primary education, 26.67% had secondary education and 10% had tertiary education, thus showing that, the majority (91.11%) of the farmers are literate. Only 8.89% had no formal education. This is shown in the table below.

Table4. *Percentage Distribution of Respondents by Educational Qualification*

Level	**Frequency**	**Percentage %**
No formal education	20	8.89
Primary education	49	54.44
Secondary education	24	26.67
Tertiary education	9	10.00
Total	**90**	**100.00**

Source: *Field Survey, 2013*

Based on the above result, Ajibefun et al (2002) andUmoh (2006) made similar observations while assessing the socio-economic factors affecting poultry farmers in the Ejigbo Local Government Area of Osun State, Nigeria. Etim andUdoh(2008) also made similar observations in analyzing the profitability level of waterleaf production in Akwa Ibom State, Nigeria. This could augurwell for extension services in transferring research results for sustainable food production.

3.5. Secondary Occupation of Respondents

Table 5 revealed that 28.9% were farmers and traders, and 20% of the sampled farmers accounted for other occupations like fishing, sewing, Hair dressing etc. This is presented in the table below:

Table5. *Percentage Distribution of Respondents by Occupational type*

Occupation	**Frequency**	**Percentage %**
Farming	26	28.89
Trading	26	28.89
Civil service	18	20.00
Others	20	2.22
Total	**90**	**100.00**

Source: *Field Survey, 2013.*

based on the figures in the above table, 77.78% of the respondents (farmers) had an additional occupation to supplement their family's income level while 22.22% depend only on their primary/major occupation.

3.6. Household Size of Respondents

Table6. *Percentage Distribution of Respondent by sizes of Household*

Number of person	Frequency	Percentage %
1-4	29	32.22
5-8	54	60.00
9-12	7	7.78
Total	**90**	**100.00**

Source: *Field survey, 2013*

From the table above, majority (60%) of the sampled pumpkin farmers had households whose sizes range from 5-8person, 32.22% had 1-4 persons, while only 7.78% had households whose sizes ranged from 9-12 persons. This result agrees with the findings of Etim and Udoh (2008) who observed the majority average household size with a range of 5-8 persons. These household sizes are on the recommended average of 4 per family in Nigeria.

3.7. Technical Efficiency in Fluted Pumpkin Production

The maximum likelihood (ML) estimates of the parameters of the stochastic production frontier were obtained using the program frontier 4.1. The result is presented in the table below.

Table7. *Maximum Likelihood estimates of the Cobb-Douglas Stochastic production function for fluted pumpkin in Itu Local Government Area.*

Variable	**Parameter**	**Coefficient**	**Std. error**	**t-value**
Constant	β_0	21.935	11.987	1.8299*
Land size (ha)	β_1	334.94	1.7375	192.78***
Planting material (kg)	β_2	0.0493	0.0031	1.5778
Hired labour (Mandays)	β_{a3}	0.0029	0.0014	2.1377**
Family labour(Mondays)	β_4	0.0032	0.0013	2.4818**
Capital depreciation	β_5	0.0082	0.0042	1.9619*
Fertilizer (kg)	β_6	0.9948	0.2666	3.7313***
Manure (kg)	β_7	-0.1645	0.1077	-1.6292*
Agrochemical (litres)	β_8	-87.509	2.693	-32.4947***
DIAGNOSTIC STATISTICS				
Sigma square	∂^2	33.078	1.0008	33.053***
Gamma	Λ	0.9026	0.5173	1.7449*
Log-likelihood LR Test	-0.5910 0.7031			

Source: Derived from data analysis model estimated by frontier 4.1 MLE

Note: *** = significant at 1%*

** = significant at 5%*

* = significant at 10%*

The ML estimates of the specified Cobb-Douglas Stochastic production function for pumpkin reveals a statistically significant (1%) sigma square coefficient of 33.078. This indicates a good fit and correctness of the specified distribution assumption of composite error term for the model. The gamma ratio of 0.9026 is significant at 10% level. This means that about 90.26 of disturbance in the system is due to technical inefficiency, while 9.74% is due to normal stochastic error. This confirms the presence of one sided error term in the specified model. Thus, this further validates the appropriateness of the specified stochastic model and the choice of maximum likelihood estimation.

3.8. Mmaximum Likelihood Estimates

The estimated production function reveals that land size, hired labour, family labour, capital, fertilizer, manure, and agrochemical significantly affected farm level production of fluted pumpkin in the study area. The findings indicate that the use of land (334.94) in the production of fluted pumpkin in Itu area is in stage 1 in the classical production surface. This indicates that more land size should be allocated to fluted pumpkin cultivation, as a unit increase in land size would result in about 334.94kg increase in fluted pumpkin. This is consistent with the observation that increase size of land would result in increase revenue and net income of farmers in the study area. This result agrees with the findings of Amaza (2000) and Eyo et al (2001). With respect to coefficient of hired labour (0.0029), family labour (0.0032), capital (0.0082) and fertilizer (0.9948), fluted pumpkin farmers in Itu area operatedin stage 11 in the classical production surface. This shows the importance of labour in fluted pumpkin in the area which might be because all agronomic practices involved in pumpkin production are done manually with hand tools (hoes and matches), thus conforming the labour intensive nature of the crop. Umoh(2006); Olayemi and Amaza (2001); Etim and Udoh(2008) also had similar findings. This implies that a unit increase in these inputs will only bring about marginal increases in output. Elasticity of production with respect to manure (-0.1645) and agrochemical (-87.509) are negative and this implies that the use of these inputs is in stage 111. At this stage, diminishing return will begin in production. Which implies that 1% increase in manure and agrochemical would reduce fluted pumpkin production 0.1645kg and 87.509kg respectively.

3.9. Factors Affecting Technical Efficiency in Pumpkin Production

Table8. *Determinants of Technical Efficiency of pumpkin farmers in Itu*

Variable	Parameter	Coefficient	Std. error	t-value
Constant	δ_0	16.7382	5.6854	2.944***
Access to extension agent	δ_1	91.6196	29.6541	3.0896***
Age	δ_2	-0.7411	0.2672	-2.7734***
Credit facilities	δ_3	54.836	18.496	2.9648***
Farming experience	δ_4	0.6281	0.2516	2.4961**

Source: *derived from data analysis 2010 using frontier 4.1 MLE.*

From the above table, the coefficient of access of extension services, credit facilities and farming experience has positive significant impact on technical efficiency of fluted pumpkin farmers access to extension services, credit facilities and farming experience increase, the technical efficiency also increases. Farmer's increased in experience and access to extension services would likely exposed them to improve technologies and also promotes and also promote easy adoption. The coefficient of age is negative, and this could be attributed to the conservative nature of older farmers toward innovation adoption. This implies that pumpkin farmers became older, the technical efficiency in resources use decreases. This result agrees with the findings of Amaza (2000); Parikh et al (1995); Udoh (2005)

Table9. *Percentage Distribution of Technical Efficiency indices of fluted pumpkin farmers*

Efficiency class	Frequency	Percentage (%)
0.001 – 0.100	1	1.11
0.101 - 0.200	0	0.00
0.201 – 0.300	0	0.00
0.301 – 0.400	0	0.00
0.401 – 0.500	2	2.22
0.501 – 0.600	2	2.22
0.601 – 0.700	2	2.22

0.701 – 0.800	9	10.00
0.801 – 0.900	17	18.89
0.901 – 1.000	57	63.33
Total	**90**	**100.00**
Maximum technical Efficiency 0.1164 Maximum Technical Efficiency 1.0000 Mean technical Efficiency 0.8758		

Source: *From data analysis, 2013. Model estimated by using frontier 4.1 MLE*

The above table shows that fluted pumpkin farmers in Itu L.G.A.exhibit varied technical efficiencies ranging from 0.1164 to 1.000 with a mean efficiency of 0.8758. The efficiency distribution shows that only small portions of fluted pumpkin are not produced because of inefficient use of specified farm resources (12.42%). About 63.33% of farmers were close to efficiency frontier, while very few farmers (1.11%) were very far from frontier. Therefore given the available technology and resources the farmers still need an average technical efficiency of about 12.42% to reach the frontier efficiency in the study area. This implies that the farmers could increase the scope of their production to narrow the existing gap.

4. CONCLUSION AND POLICY IMPLICATION

The results show that all the inputs used in the production were statistically significant except planting materials. Analysis of the determinant of technical efficiency were statistically significant. Individual farm technical efficiency scores shows that 63% of the farmers are technical efficient. They perform at an average technical efficiency of 87%. The finding also reveals that, inadequate funds, incidence of pest/diseases, natural factors (such as temperature, erosion, rainfall etc.) and scarcity and high cost of inputs were the major problems faced by the farmers in the study area.

The research findings that 63.33% efficiency means that farmers still have room to increase their efficiency to the optimum (100%) by addressing those factors militating against efficiency such as Access to extension. Hence, for any meaningful agricultural development in the areas, this study calls for efficiency policy formulation and implementation, effective extension services, proper agricultural finance and availability of agro-chemical and fertilizer at a reduced and subsidized rate.

Based on the findings of this research work, the following recommendations were made:

Finance assistance in the form of soft loans should be given to the farmers in the study area to help them increase their production level. Inputs such as fertilizer and agro-chemical should be made available to the farmers at a reduced and subsidized rate. Provision of adequate and supportive services of government with a view of improving farming technique and technological innovation. More land should be allocated to fluted pumpkin farmers in the area so as to increase their revenue and net income. Water channels should be constructed in the area to control some of the natural factors such as erosion, flood etc.

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