GENDER AND RELATIVE ECONOMIC EFFICIENCY IN SWEET POTATO FARMS OF IMO STATE, NIGERIA: A STOCHASTIC FRONTIER APPROACH.

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ABSTRACT
This study employed the stochastic frontier cost function to measure the level of economic efficiency and its determinants in small-scale sweet potato production in Imo State, Nigeria on gender basis. A multi-stage random sampling technique was used to select 120 sweet potato farmers (64 females and 56 males) in the State in the year 2008. The parameters of the stochastic frontier cost function were estimated using the maximum likelihood method. The result of the analysis showed that the mean economic efficiency for the female farmers group was higher (82%) than their male (71%) counterpart. Wage rate, price of fertilizer, capital and land rent positively affected cost of sweet potato production for both farmer groups. Credit access was positive and significantly related to economic efficiency for both farmer groups. Age and farm size were significant, but negatively related to economic efficiency in the male farmer group, while age and level of education were significant and positively related to economic efficiency in the female farmer group. No significant relationship found between economic efficiency and extension visit, farming experience and co-operative membership for both farmer groups.

Keywords: stochastic frontier, gender, sweet potato, economic efficiency.

INTRODUCTION

In Nigeria of about 140 million people, men constitute about 50.4 % and women 49.6 % (N.P.C. 2006). Both sexes are responsible for producing the nation's food and one of the major problems confronting mankind in recent times is food crisis. Gender has often been misunderstood as being about the promotion of women only, but it focuses on the relationship between men and women, the roles, access to and control over resources, division of labour and needs. Men and women are affected differently in their operation in factors like markets and socio-economic environments. Women are more constrained than their men counterparts in terms of access to credits, agricultural inputs, information technology etc. some crop production are even classified as man's, like yam production, while others like sweet potato and cocoyam production are regarded as woman's especially in the Southeastern Nigeria. Tewe *et al*., (2003) reported that women are involved in crop production generally and sweet potato production in particular.

Sweet potato (*Ipomoea batatas*) is a creeper of the *Convolvulaceae* family. It originated from Central America and is widely grown as important staple food in most parts of the world. Presently, Nigeria is number one producer of sweet potato in Africa with annual output of 3.46 million metric tons (FAO, 2006) and globally the second largest producer after China. The crop is grown for both human and animal consumption. Sweet potato is the only crop among the root and tuber crops that has a positive per capita annual rate of increase in production in Sub-Saharan Africa (Tewe *et al*, 2003). It is the only member of the genus *Ipomoea* whose roots are edible and is one of the world's most important food crops due to its high yield and nutritive value (Data and Eronico, 1987). According to Chukwu (2001), within the root crop belt of Nigeria, especially the South-East agro-ecological zone, sweet potato has joined the league of life saving-crops as cassava. It blends well with rice, cowpea and plantain in most diets (Ejechi *et al*., 2009). Fawole (2007) reported that sweet potato remains one of the three most important root crops in the world. In spite of these important aspects, less research has been done on sweet potato than on the other roots crops. The other major root crops, for instance, have had ongoing systematic studies for decades. Therefore, there is a dearth of information on the economics of sweet potato production in Nigeria.

The objective of this study was to measure the level of economic efficiency and its determinants in sweet potato production in Imo State, Nigeria across gender, using the stochastic frontier. Economic efficiency here is the ability of a farmer to produce a predetermined quantity of output at a minimum cost for a given level of technology.

METHODOLOGY

Study Area

The study was conducted in Imo State of Nigeria. Imo State is bounded in the North by Anambra State, in the East by Abia State and South by Rivers State. The state comprises 27 L. G. As, each with several communities and villages. It has three Agricultural zones, namely Okigwe, Owerri and Orlu Agricultural zones. Imo State covers an area of 5100 sq. km with a population of about 3.934 million people (N.P.C. 2006). Agriculture is the major occupation of people of the state. Almost all the families farm either as primary or secondary occupation. The ecological zone favours the growing of roots and tubers, cereals, vegetables and nuts, which are normally grown on small-holder plots (Nwaru, 2004). Farming practices in the state involve the use of hand tools and other simple implements.

Sampling and Data Collection

A multi-stage sampling technique was employed for the study. In the first stage, Okigwe and Owerri Agricultural zones were randomly selected. These selected zones were further stratified into L. G. As. In the second stage, Ihitte Uboma and Okigwe L. G. As were selected from Okigwe zone, while Owerri North and Ohaji Egbema L. G. As were selected from Owerri zone. These selected L. G. As were purposively done based on sweet potato production performance. In the next stage, two communities were randomly selected from each L. G. A. making a total of eight communities sampled. The lists of sweet potato farmers were collected with the help of the Agricultural extension agents assigned to the communities. This was done to form the sampling frame. Fifteen sweet potato farmers comprising seven males and eight females were randomly selected from each community making a total of a hundred and twenty farmers sampled for the study.

Field enumerators were recruited and trained to assist in data collection. Data collected were through primary and secondary sources. The primary data collected were through well-structured questionnaire administered on the farmers for the year 2008 cropping season using the cost-route approach. However, relevant secondary data were sourced from the Imo State ADP, journals and other periodicals.

Analytical Procedure

Descriptive statistics were used to discuss the socio-economic characteristics of the farmers, while the Cobb-Douglas cost functional form, using the stochastic frontier was used to estimate the economic efficiency of the farmers. This model was expressed thus:

$$\text{In } C_i = \alpha_0 + \alpha_1 \text{In} P_1 + \alpha_2 \text{In} P_2 + \alpha_3 \text{In} P_3 + \alpha_4 \text{In} P_4 + \alpha_5 \text{In} P_5 + \alpha_6 \text{In} Y^* + v_i - u_i \quad \ldots.(1)$$

where:
In = natural logarithm
C_i = total production cost by the i-th farmer in Naira
P_1 = wage rate in (₦)/manday
P_2 = price of planting materials (vine) in (₦)/kg
P_3 = price of fertilizer in (₦)/kg
P_4= capital (₦) (measured by depreciation charges on farm tools and equipment, interest on borrowed capital, rent on land)
P_5 = land rent in (₦)/ha
Y* = output of sweet potato in kg/ha
α's = Coefficients estimated
V_i = Symmetric error term, which accounts for random variations in output due to factors beyond the farmer.
U_i= Non-negative random variable, representing inefficiency in production relative to the stochastic frontier.

Determinants of Economic Efficiency

In order to determine factors contributing to the observed economic efficiency in sweet potato production, the following model was estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure using the computer software Frontier Version 4.1.

$$EE_i = b_0 + b_1 Z_1 + b_2 Z_2 + b_3 Z_3 + b_4 Z_4 + b_5 Z_5 + b_6 Z_6 + b_7 Z_7 + b_8 Z_8 \quad \ldots\ldots\ldots (2)$$

where EE_i = Economic Efficiency of the i-th farmer

Z_1 = Age of the farmer (in years)
Z_2 = Household size (in number)
Z_3 = Farm size (in hectares)
Z_4 = Level of education (in years)
Z_5 = Farming experience (in years)
Z_6 = Access to credit (access = 1; otherwise = 0)
Z_7=Membership of co- operative/association (member = 1; otherwise = 0)
Z_8 = Extension visit (number of visits)
b_0 = Intercept
b_1 - b_8 = Parameters estimated

RESULTS AND DISCUSSION

Average Statistics of male and female Sweet Potato farmers:

The average statistics of the sampled sweet potato farmers is presented in Table 1. On the average, a typical male sweet potato farmer is 45 years of age with 7.33 years of formal education, about 9 years of farming experience, household size of about 7 persons, cultivated 0.41 hactare of land, employed 28.56 mandays of labour and produced an output of 138.91kg of sweet potato per annum.

Table 1: Average Statistics of male and female Sweet Potato farmers in Imo State

S/No	Variable	Mean Value		Maximum Value		Minimum Value	
		Male	Female	Male	Female	Male	Female
1	Age (yrs)	45.00	44.00	68.00	62.00	25.00	29.00
2.	Formal education (yrs)	7.33	8.18	19.00	16.00	0.00	0.00
3.	Farm size (ha)	0.41	0.36	0.76	0.68	0.01	0.01
4.	Farming experience (yrs)	9.00	8.30	16.00	17.00	1.00	1.00
5.	Household size (no.)	7.00	6.00	14.00	15.00	3.00	2.00
6.	Labour (mandays)	28.56	24.80	91.20	83.40	3.43	2.90
7.	Output (kg)	138.91	104.70	322.85	307.50	38.30	24.10

Source: Survey data, 2008

For a typical female sweet potato farmer, she is 44 years old, with 8.18 years of formal education, about 8.30 years of farming experience, household size of 6 persons, cultivated 0.36 hactare of land, employed 24.80 mandays of labour and produced an output of 104.70kg of sweet potato per annum.

b) Estimated Cost Function

The data in Table 2 shows the Maximum likelihood estimates of the cost frontier function for sweet potato production in Imo State. The Table indicates that the total variance is statistically significant at 1% level in both farmer groups, indicating goodness of fit and the correctness of the specified assumption of the composite errors terms distribution. On the other hand, variance ratio which was also significant at 1 % probability level in both farmer groups indicates that about 87% of the variability in the output of the men sweet potato farmers and 92% of the variability in the output of the women sweet potato farmers that are unexplained by this function is due to cost inefficiency.

The Table further indicates that the coefficients of all the variables have positive signs, apart from that of output in the male farmer group. Wage rate, price of fertilizer, capital and land rent were all significant, indicating their importance in determining the cost structure in sweet potato production by the farmers. The price of vine was positive but not significant in both farmer groups.

c) Sources of Economic Efficiency

The estimated determinants of economic efficiency in sweet potato production is presented in Table 2. The coefficient of level of education was statistically significant in both farmer groups, indicating direct relationship between level of education and economic efficiency. The implication is that farmers with higher educational level

tend to be efficient economically. This agrees with the findings of Okike (2000), Amaza and Olayemi (2000), and Okoye (2006). The coefficient of credit was positive and significantly related to economic efficiency in both farmer groups. This is in consonance with the findings of Effiong (2005), Idiong (2005) and Okike (2000). Effiong (2005) opined that the more credit a farmer uses, the more efficient he tries to use it to enhance revenue and profit.

The coefficient of age was negative in the male farmer group and positive in the female farmer group, but it revealed a significant effect on economic efficiency in both farmer groups. In the findings of Nwaru (2004), Ajibefun and Aderinola (2004), Idiong (2005) and Okoye (2006), age indicated an indirect relationship with economic efficiency, while in the findings of Dimelu *et al*. (2008), it showed a direct relationship with economic efficiency. Farm size had a negative coefficient but statistically significant in the male farmer group. This agrees with Hazarika and Subramanian (1999) who posited that if the farm size is small, farmers would be able to control their resources better.

Table 2: Maximum likelihood estimates of the Cobb-Douglas stochastic Production function for sweet potato farmers.

Production factors	**Parameter**	**Coefficients**	
		Male	**Female**
Constant term	α_0	9.8456	9.3155
		(9.0719)***	(5.2228)***
Wage rate	α_1	0.4778	0.1377
		(2.1646)**	(6.9701)***
Price of vine	α_2	0.0262	0.0004
		(0.1732)	(0.0141)
Price of fertilizer	α_3	0.3653	0.0029
		(1.9370)*	(1.6947)*
Capital	α_4	0.0548	0.0542
		(9.5024)***	(6.5221)***
Land rent	α_5	0.1579	0.7648
		(1.8522)*	(10.7560)***
Output	α_6	-0.1205	0.0373
		(-0.7958)	(2.1284)**
Efficiency factors			
Constant term	Z_0	3.2631	0.0097
		(1.9209)*	(0.2649)
Age	Z_1	-0.1575	0.0003
		(-2.2813)**	(3.3134)**
Household size	Z_2	0.0389	-0.0014
		(1.0224)	(-5.2185)***
Farm size	Z_3	-0.4315	0.0002
		(-12.0015)***	(0.0007)
Level of education	Z_4	0.1776	0.0005
		(1.9250)*	(7.6538)***
Farming experience	Z_5	1.2848	-0.0006
		(1.4291)	(-0.2154)
Credit access	Z_6	1.6395	0.0039
		(2.7194)***	(3.8872)***
Co-operative membership	Z_7	-0.7963	0.0131
		(-1.2683)	(1.3682)
Extension visit	Z_8	0.0263	0.0088
		(0.0638)	(1.3698)
Diagnostic statistics			
Total variance	σ^2	0.2565	0.3703
		(3.2378)***	(5.2392)***
Variance ratio	γ	0.8683	0.9259
		(20.6915)***	(3.2289)***
LR Test		56.8755	4.0602
Log-likelihood function		4.1693	161.1035

Source: Computed from Survey data 2008, Note: *, **, * are significant levels at 1%, 5% and 10% respectively. Values in parenthesis = t-value.**

The coefficient for household size was statistically significant in the female farmer group but indirectly related to economic efficiency. This implies that the smaller the household size, the more economically efficient the farmer becomes. This agrees with the findings of Okike (2000). In a situation where the household size is large, probably made up of mainly aged and very young people, a small proportion of farm labour will be derived from it, then inefficiency effects are expected to be greater.

However, the coefficient of extension visit, farming experience and co-operative membership were not significant in both farmer groups, indicating no relationship between these variables and economic efficiency in sweet potato production in the study area.

d) Economic Efficiency Indices

The frequency distribution of economic efficiency in sweet potato production is presented in Table 3. The result indicates that the male economic efficiency indices ranged between 21% and 95% with a mean of 71%, while the female economic efficiency indices ranged between 22% and 96% with a mean of 82%. The Table further reveals that about 33.93% of the male and 76.56% of the female farmers had economic efficiency indices of 80% and above.

Table 3: Frequency Distribution of Economic Efficiency Indices

	Men		Women	
Economic Efficiency Index	**Frequency**	**Percentage**	**Frequency**	**Percentage**
0.20 – 0.29	3	5.36	1	1.56
0.30 - 0.39	3	5.36	4	6.25
0.40 - 0.49	5	8.93	2	3.13
0.50 - 0.59	1	1.78	1	1.56
0.60 - 0.69	7	12.50	1	1.56
0.70 - 0.79	18	32.14	6	9.38
0.80 - 0.89	12	21.43	20	31.25
0.90 - 0.99	7	12.50	29	45.31
Total	**56**	**100**	**64**	**100**
Maximum Economic Efficiency	0.95		0.96	
Minimum Economic Efficiency	0.21		0.22	
Mean Economic Efficiency	0.71		0.82	

Source: Computed from survey data, 2008

CONCLUSION

The results of this study indicate that economic efficiency in sweet potato production in Imo State is relatively high for both farmer groups. Individual technical efficiency levels for the male farmers ranged between 21% and 95% with a mean of 71%, while that of the female farmers ranged between 22% and 96% with a mean of 82%, suggesting that opportunities still exist for increasing productivity and income of sweet potato farmers in the State. The important factors directly related to economic efficiency for both farmer groups are age, level of education and credit. Coefficient associated with credit access came out strongly for both farmer groups. Therefore, policies aimed at improving farmers' access to credit will go a long way in increasing economic efficiency in sweet potato production in Imo State.

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