DETERMINANTS OF TECHNICAL EFFICIENCY BY GENDER AMONG COCOYAM FARMERS IN ANAMBRA STATE

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ABSTRACT
The study was designed to investigate the determinants of technical efficiency in cocoyam production across gender in Anambra State, Nigeria. The study presents the results of analysis of data collected on 160 male and female cocoyam farmers across two Agricultural zones. A multi-stage randomized sampling technique was used to select the zones. Descriptive statistical tools such as percentages, frequencies, means and tables were used in analyzing farmer's socio-economic characteristics. The result showed that women constituted a greater percentage (68.75%) of those involved in cocoyam production in the state, which comprises those within the age range of 41 to 50 years. Most of the farmers were married with large household sizes, educated, experienced with small land holdings. The Maximum Likelihood Estimation (MLE) technique was used in estimating the determinants of efficiency of male and female farmers using the Cobb-Douglas form. The result of estimation showed that the coefficients of male and female farmers for the production variables used were all positive. The coefficients for cocoyam setts, labour and fertilizer use were significant. The coefficients of determinants of technical efficiency show that age was positively signed and significant at 10% level for the male and female farmers each. The coefficient for education was positively signed and significant at 5% and 1% level for the male and female farmers respectively. The coefficient for household size and farming experience was positively signed and significant at 10% and 1% level respectively for the male farmers. The coefficient for farm size was negatively signed and significant at 5% and 1% level for the male and female farmers respectively. The results therefore call for policies aimed at provision of free education especially to the girl child and encouraging the youths and new entrants to increase production of cocoyam.

Keywords: Technical Efficiency, Cocoyam Production and Gender

INTRODUCTION
Nigeria is an agrarian society with about 70% of over 140 million population engaged in agricultural production (CBN, 2003). Food crops constitute the largest component of the crops. In Nigeria of about 140 million people; men constitute about 50.4% and women 49.6% (N.P.C, 2006). Both gender are responsible for producing the nation's food and one of the major problems confronting mankind in recent times is food crisis (Ndukwu *et al* 2010). The Females are more constrained than their male counterparts in terms of access to credits, agricultural inputs, and information technology and so on. Some crop are sex stereotyped like yam production majorly done by men, while others like sweet potatoes and cocoyam production are

regarded as women's especially in the southeastern Nigeria (Ndukwu *et al* 2010). Dimelu *et al* (2009) reported that women are involved in crop production generally and cocoyam production in particular.

Cocoyam originated from Asia and about forty (40) species are mostly grown in West Africa (Asumugha and Mbanaso, 2002). Further estimate in Nigeria, showed a figure of 3.45 million metric tones out of 9.97 million metric tones of world output of cocoyam per annum (FAO STAT, 2013). Cocoyam (*Xanthosoma* sp and *Colocasia* sp) is an important staple food in the plant family, cultivated in South Eastern and South Western part of Nigeria (Onyenweaku *et al*, 2005; Ojiakor *et al*, 2007; Chukwu *et al*, 2009). It is a food security crop variously grown by resource poor farmers especially women who often intercrop it with yam, maize, plantain, banana, vegetable (Ikwelle *et al*, 2003). In the traditional farming system women "own" and plant cocoyam after the men have planted their yam, hence it is regarded as a women's crop (Igbokwe, 2004). Technical difficulties involved in managing cocoyam especially the pest losses usually not encountered in the rival crops have made cocoyam comparatively less attractive especially among farmers thereby affecting productivity. Giving the importance of cocoyam and receding cultivation. it becomes compelling to examine its productive efficienct in other to identify opportunities for improvements in terms of cultivation and efficient use of available resources.

This study analyzed the determinants of technical efficiency by gender in cocoyam production in Anambra State of Nigeria using the stochastic frontier production function. Effiong and Nwaru (2002) pointed out that the hub of efficient resource husbandry is the manipulation of available scarce resources and technical know how to achieve the highest possible benefits within a given natural and socio economic environment. Nwaru (2001) also stated that rural resource farmers must come to a dynamic and innovative level where they can create, establish and nurse economic activities with greater source through mobilizing and allocating available rural resources more efficiently.

METHODOLOGY

The study area

The study was carried out in Anambra State. The State is made up of 21 Local Government Areas. It is located between latitudes $6^0\ 45^1$ and $5^0\ 44^1$ N and longitudes $6^0\ 36^1$ and $7^0\ 20^1$ E of the area with meridian. The State is divided into four Agricultural zones namely, Aguata, Awka, Anambra, and Onitsha. The zones are further delineated into 24 extension blocks and 120 circles (Nkematu, 2000, ANSEP 2000). Anambra State is bounded to the North by Kogi State, to the South by Imo and Abia States, to the East by Enugu State and to the West by Delta State. Yam and cassava-based mixed cropping enterprises dominate small scale farm holdings in the State besides rice production in Ayamelum, Ogbaru, Anambra East and West Local Government Areas. Other crops gaining prominence in the area include potatoes and cocoyam (Okoye and Onyenweaku, 2006). Still other crops grown in the State are maize, okro, amaranthus, melon, pumpkin, perpes and garden eggs which are intercropped with base crops.

Sampling procedure

A multi-stage sampling technique was used in selection of Agricultural Zones, blocks, circles and contact farmers. In first stage, Aguata and Awka Agricultural Zones were purposively

selected. In the second Stage, two (2) circles each were selected from the blocks giving a total of (eight) 8 circles. And finally, in the third stage, 20 contact farmers (comprising male and female) were randomly selected from the circle giving a total of one hundred and sixty (160) contact farmers.

Data collection

Primary data were collected in 2010 with the aid of structured questionnaire and includes variables as; age, sex, household size, educational background, farming experience and farm inputs like fertilizer, labour use farm size, capital assets, and credit and extension services.

Analytical procedure

In estimating the technical efficiency, the Cobb Douglas functional form of the stochastic frontier model was estimated thus;

Yi = F(Xi:) exp(v-ui); = 1,2,3……..n ……(1)

Yi = Denotes output of the i-th farm. Xi = Is a vector of functions of actual input quantities used by the i-th farm. β = is a vector of parameters to be estimated. vi-ui = is the composite error term (Aigner et al., 1977, Meusen and Van Den Broeck, 1977). Where u = is a non-negative random variable, associated with technical inefficiency in production. vj = is a random error which is associated with random factors not under the control of the farmers. The functional form of this model used in estimating the level of technical efficiency in the Cobb-Douglas form (Bravo-Ureta and Evenson, 1994) is;

In Yj = βo+ β1In X1 + β 2In X2 + β 3InX3 + β4In X4 + β5InX5 + vi-ui----------(2)

Where In = represents the natural logarithm, the subscript i represents the i-th sample farmer. Yj = Cocoyam Output in kg of the i-th farm. X_1 = Quantity of fertilizers used in kg. X_2 = Depreciation in capital inputs (in naira). X_3 = Labour in man-day used in production. X_4 = Farm size measured as total land area in hectares. X_5 = Quantity of cocoyam setts planted in kg. β o = Intercept. β_1 - β_6 = Coefficients estimated.

Determinants of technical efficiency

In order to determine factors contributing to the observed technical efficiency in cocoyam production, the following model was formulated and estimated jointly with the stochastic frontier model in a single-stage maximum likelihood estimation procedure using the computer software frontier version 4.1 (Coelli, 1994).

$TE = a_0+a_1b_1 + a_2b_2 + a_3b_3 + a_4b_4 + a_5b_5 + a_6b_6 + a_7b_7 + a_8b_8 + a_9b_9$ -----(3)

Where,

TE is the technical efficiency of the i-th farmer, a_1 in marital status, a dummy variable which takes the value of unity for a farmer who is single and zero otherwise, a_2 is age in years, a_3 is household size, a_4 is farmers' level of education in years and a_5 is farmers' level of farming experience in years. Others are; a_6 is no of extension contacts made in a year by the farmer, a_7 is membership of farmer associations/cooperative societies, a dummy variable which takes the value of unity for members and zero otherwise, a_8 is farm size in hectares and a_9 is credit access a dummy variable which takes the value of unity if the farmer has access to credit and zero, otherwise.

RESULTS AND DISCUSSION

The results in Table 1 show the socio-economic characteristics of the respondents by gender in the study area. The results show that 74% and 72.93% of the male and female farmers

respectively were married while only 26% and 27.27% of the male and female farmer were single. This implies that the area was dominated by cocoyam farmers who were married.

Only 8% and 8.18% of the male and female farmers were less than 31 years of age. Further results showed that 46% and 60.35% of the male and female farmers fell within the age range of 31-50yrs. Also 46% and 26.36% of the male female farmers were more than 50yrs of age. This implies that the study area was dominated by farmers who are still in their most productive years, strong and agile. Nwaru (2004), Ndukwu *et al* (2010) and Dimelu *et al* (2009) found out that the ability of a farmer to bear risk, be innovative and be able to do manual work decreased with age.

About 40% and 62.73% of the male and female farmers respectively had households of 1-5 persons while 52% and 37.27% of the male and female farmers respectively had households of 6-10 persons. Only 2% of the male farmers had households greater than 10 persons. Effiong (2005), Idiong (2005) and Dimelu *et al* (2009) reported that a relatively large household size enhanced the availability of labour.

The result also shows that only 4% and 4.54% of the male and female farmers respectively had no form of formal schooling. About 54% and 45.45% of the male and female farmers respectively attained primary level of education. About 38% and 46.34% of the male and female farmers respectively attained secondary level education. Only 4% and 3.64% of the male and female farmers respectively attained tertiary level of education. The finding indicates that relatively literate farmers dominated the study area. Educated farmers are expected to be more receptive to improved farming techniques, while farmers with low level of education or without education would be less receptive to improved farming techniques (Okoye *et al;* 2007;Okoye and Onyenweaku, 2007 and Ajibefun and Aderinola, 2004).

With respect to farming experience, only 18% and 13.64% of the male and female farmers respectively had 1-5years of farming experience. Also the results showed that 48% and 51.81% of the male and female farmers had between 6-15yrs of farming experience each. Further studies showed that 34% and 34.54% of the male and female farmers respectively had more than 15yrs of farming experience. This implies that the study area was dominated by experienced farmers. Nwaru, (1993), Dimelu *et al* (2009) and Okoye *et al* (2008) reported that farmers count more on their experience than educational attainment in order to increase in their productivity.

About 20% and 18.18% of the male and female farmers respectively had no form of contact with extension. More so, 62% and 66.35% of the male and female farmers respectively had 1-4 number of extension contacts. Further studies indicated that 4% and 2.73% of the male and female farmers had respectively had 5-6 number of extension contacts while 6% and 12.73% had more than 6 extension contacts for the male and female farmers respectively. Good extension programmers and contacts with producers are key factor in technology dissemination and adoption (Bonabana-Wabbi, 2002).

The results in the table indicate that 52% of the male farmers belonged to one form of social organization or the other while 48% of male did not. About 49.09% of the female farmers also belong while 50.91% do not. Acquisition of information about a new technology through the membership of social arganisations demystifies it and makes it more available to farmers

(Bonabana-wabbi, 2002). Information reduces the uncertainty about technology's performance hence may change individual's assessment from purely subjective to objective over time

About 86% and 74.54% of the male and female farmers respectively owned between 0.1-0.6ha of land. The results also show that 14% and 25.45% of the male and female farmers respectively owned between 0.7-1 ha of land. This implies that the areas were dominated by small-holder farmer. Farm size can also encourage farmers to intensify agricultural production. Hazarika and Subramanian (1999) are of the opinion that if farm size is small, farmers are able to combine their resources better.

About 4% and 5.45% of the male and female farmers respectively had an income less than ₦21,000. Further results showed that 24% and 27% of the male and female farmers respectively also had between ₦21,000 – ₦40,000 only, The result also shows that 4%, 28% and 10% of the male farmers had between ₦41,000 – ₦60,000, ₦61,000 – ₦80,000 and ₦81,000 – ₦100,000 respectively in the study area. The result also shows that 2.73%, 25.45% and 33.64% of the female farmers had between ₦41, 000 – ₦60, 000, ₦61, 000 – ₦80, 000 and ₦81, 000 – ₦100, 000 respectively. The high income cocoyam production by the female farmers may be as a result of the years of experience spent in cocoyam production. This is in consonance with Okoye *et al* (2008) who have similar view.

The maximum likelihood estimates of the stochastic production frontier function for male and female farmers in Anambra State are presented in Table 2. The coefficients for fertilizer were positive and significant at 10% and 5% levels of probability for the male and female farmers respectively. The coefficient of cocoyam setts was also positive and significant at 5% and 1% levels of probability for the male and female farmers respectively. The results also showed that the coefficients for labour were positive and significant at 10% level of probability for the male and female farmers respectively. The coefficient for capital input was also positive and significant at 1% level of probability for the male farmers only while the coefficient was not significant for the female counterparts. These results are expected and in accordance with *apriori* expectations. Any increase in these variables will lead to a corresponding increase in cocoyam output. The coefficients for farm size were positive but not significant.

The estimated variance (σ^2) was statistically significant at 10% and 1% levels of probability for the male and female farmers respectively. This indicates goodness of fit. The gamma (γ) is estimated at 0.77 and 0.97 for the male and female farmers respectively and is significant at 5% and 1% level of significant respectively. This indicates that 77%and 97% of the total variation in cocoyam output for the male and female farmers respectively was due to technical inefficiencies.

Result of determinants of technical efficiency shows that the coefficients of age for male and female farmers were negative and significant at 10% level of probability each. This implies that any increase in age will lead to a decrease in efficiency. This result agrees with Okoye *et al* (2007) and Okoye (2008) who found out that ageing farmers would be less energetic to work. The coefficients of households' size for male farmers were positive and significant at 10% level of probability. This shows that male headed household with large family size are likely to be more technically efficient than their counterparts with smaller family size. Large household size is a source of labour for most farm operations, as noted by Effiong and Idiong (2005).

The coefficients of education for male and female farmers were positive and significant at 5% and 1% levels of probability. This implies that increase in education will lead to increase in technical efficiency. Education might be regarded as a factor for increased efficiency, this agrees with Kadurumba *et al*, (2010). The coefficients for farming experience were positive and significant at 1% level of probability. This agrees with apriori expectations that increase in years of farming experience leads to increase in technical efficiency. This also agrees with Okoye *et al*, (2007); and Onyenweaku and Nwaru, (2005) who found out that farming experience had a direct relationship with technical efficiency. The coefficients of farm size were negative and significant at 5% and 1% level of probability for the male and female farmers respectively. This indicates that increase in farm size will lead to decrease in technical efficiency and agrees with Hazarika and Subramanian (1990) who found out that if farm size is small, farmers are able to combine their resources efficiently.

CONCLUSION

The study analyzed the determinants of technical efficiency across gender in Anambra state. Both men and women engaged in cocoyam production, but majorly dominated by women in the study area. It could be concluded from this study that all factors related to technical efficiencies call for policies aimed at incorporation of all the significant variables, especially those that will encourage the younger farmers of their tendency to allocate the bulk of their landholdings to cocoyam production. There is need for policies that will enhance free education especially to the girl child.

Table 1: Distribution of Male and Female Cocoyam Farmers According to Socio-Economics Characteristics

	Male		Female	
Variable	**Frequency**	**Percentage**	**Frequency**	**percentage**
Marital status				
Married	37	26.00	80	72.73
Single	14	74.00	30	27.27
Total	**50**	**100.00**	**110**	**100.00**
Mean	**0.74**		**0.73**	
Age				
< 31	04	08.00	08	8.18
31-40	07	14.00	27	24.45
41-50	16	32.00	45	40.90
51-60	08	18.00	17	15.45
>60	14	28.00	12	10.95
Total	**50**	**100.00**	**110**	**100.00**
Mean	**50.94**		**46.16**	
Family Size				
1-5	23	46.00	69	62.73
6-10	26	52.00	41	37.27
>10	01	2.00	-	-
Total	**50**	**100.00**	**110**	**100.00**
Mean	**5.38**		**4.9**	
Education				
No Schooling	02	4.00	05	4.54
Primary	27	54.00	50	45.45
Secondary	19	38.00	51	46.34
Tertiary	02	4.00	04	3.64
Total	**50**	**100.00**	**110**	**100.00**
Mean	**7.68**		**7.40**	
Farming Experience				
1-5 yrs	09	18.00	15	13.64
6-10 yrs	20	40.00	40	36.36
11-15 yrs	04	8.00	17	15.45
>15 yrs	17	34.00	38	34.54
Total	**50**	**100.00**	**110**	**100.00**
Mean	**14.08**		**13.51**	
Ext Contact				
None	14	28	20	18.18
1-2	21	42	56	50.90
3-4	10	20	17	15.45
5-6	02	4	03	2.73
>6	03	6	14	12.73
Total	**50**	**100.00**	**110**	**100.00**
Mean	**2.14**		**3.35**	
Cooperative				
Yes	26	52.00	54	49.09
No	24	48.00	56	50.91
Total	**50**	**100.00**	**110**	**100.00**
Mean	**0.52**		**0.49**	
Farm Size(ha)				
0.1-03	13	26.00	21	19.09
0.4-06	30	60.00	61	55.45
0.7-0.9	05	10.00	16	14.54
1ha	02	4.00	12	10.91
Total	**50**	**100.00**	**110**	**100.00**
Mean	**0.49**		**0.54**	
Income(~~₦~~)				
<21,000	02	4.00	06	5.45
21,000-40,000	12	24.00	19	17.27
41,000-60,000	02	4.00	03	2.73
61,000-80,000	14	28.00	28	25.45
81,000-100,000	19	10.00	37	33.64
Total	**50**	**100.00**	**110**	**100.00**
Mean	**72,430**		**83,100**	

Source; Field Survey, 2011

Table 2: Maximum Likelihood Estimates of the Cobb-Douglas Stochastic Production function for male and female farmers in Anambra State

Production Factors	Parameter	Coefficient	
		Male	**Female**
Constant term	β_0	8.6229	6.6324
		(7.4599)***	(12.3883)***
Fertilizer used(kg)	β_1	0.2159	0.1589
		(2.5366)**	(2.5352)**
Capital(N)	β_2	0.3704	0.0264
		(4.1169)***	(0.5182)
Labour (mandays)	β_3	0.1309	0.4288
		(7.2523)***	(11.4957)***
Farm size(Ha)	β_4	0.2332	-0.0942
		(1.4143)	(-0.7822)
Cocoyam sett (kg)	β_5	0.0425	0.0511
		(2.6354)**	(4.3486)***
Efficiency factors			
Constant term	a_0	2.5064	-0.3649
		(1.8274)*	(-0.4879)
Marital status	a_1	-0.0373	0.0236
		(-1.0209)	(1.2930)
Age(yrs)	a_2	-0.0579	-0.0374
		(-1.7091)*	(-1.8416)*
Household size	a_3	0.1940	0.0226
		(1.8615)*	(1.2401)
Education(yrs)	a_4	0.0362	0.03098
		(2.8928)**	(3.0303)***
Farming experience (yrs)	a_5	0.0332	0.0537
		(6.9864)***	(3.6457)***
Extension Contacts(Nos)	a_6	-1.0072	-0.0070
		(-0.8209)	(-0.4113)
Membership of coop Soc	a_7	-0.0016	0.2047
		(-0.0030)	(0.5505)
Farm Size	a_8	-0.0369	-0.5505
		(-2.5783)**	(-3.2829)***
Access to Credit	a_9	-0.2406	0.1864
		(-0.7997)	(0.5772)
Sigma squared	$\sigma 2$	0.3169	0.6044
		(2.0387)*	(4.8789)***
Gamma	γ	0.7752	0.9733
		(2.8361)**	(51.3708)
Log likelihood function		-30.4007	18.7118

Source: computed from frontier 4.1 MLS/survey data 2011
*,**,***, is significant at 10%,5%,1% level of significance
Figures in parenthesis are t - values

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