TECHNICAL EFFICIENCY OF COCOYAM PRODUCTION IN DUNUKOFIA LOCAL GOVERNMENT AREA, ANAMBRA STATE, NIGERIA

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Abstract

This study examined the technical efficiency of cocoyam farmers in Dunukofia Local Government Area of Anambra State, Nigeria. The objectives were to describe the socioeconomic characteristics of cocoyam farmers, determine the technical efficiency of cocoyam production and the factors influencing technical inefficiency and to identify the constraints faced by cocoyam farmers in the study area. Data were collected using structured questionnaire and interview scheduled. Multistage sampling procedure was used to select a sample size of 102 cocoyam farmers. Data collected were analysed using descriptive statistics and the stochastic frontier analysis. A four-point Likert rating scale was also used to measure data collected. The results of the socioeconomic characteristics indicate that 59.8% of cocoyam farmers were females while 40.2% were males. The average age and farming experience of farmers were 45 years and 12 years respectively with a mean household size of 6 persons. Technical efficiency of the farmers ranged from 1.1% - 65.9% with a mean of 16.6%. A return to scale of 1.43 showed that production was in stage 1 of the production process. Only labour and planting material were significant variables that contributed positively to output of cocoyam. Gender, household, level of education and farming experience had significant effect on technical inefficiency. The major constraint encountered by the farmers was high cost of hiring labour. It was recommended that farmers should depend on family labour to reduce cost of labour.

Keywords: Cocoyam production, Return to scale, Technical efficiency, Technical inefficiency

INTRODUCTION

Root and tubers crops are among the most important group of staple foods in many tropical African countries (Osagie, 1998) and they constitute the largest source of calories for the Nigerian population (Olaniyan, Manyoung & Oyewole, 2001). The major root and tuber crops in Nigeria are cassava, yam and cocoyam. Currently Nigeria is the largest producer of cocoyam in the world in terms of volume of production with the annual output of 5,068,000 metric tons/annum (which represents 37% of the world of cocoyam) as against the potential of 160million metric tons/annum (Awoke & Obeta, 1998, Food and Agriculture Organization (FAO), 2006). The production figure according to Dimelu, Okoye, Agwu, Aniedu, and Akinpelu, (2009) indicated the potentialities of cocoyam for food security, income generation and nutritional enhancement in the country cannot be overemphasised. Moreover, (Okoye & Onyenweaku, 2007; Central Bank of Nigeria (CBN), 2002) noted that the global average yield of cocoyam is only about 600kg/ha. Cocoyam ranks third in importance after yam and cassava of major economic value in Nigeria (Udealor, Nwadukwe & Okoronya, 1996). In comparison to the roots and tubers, cocoyam has high food energy yield per unit area. More so, Cocoyam has potentials to thrive in marginal soil, tolerates erratic rainfall and survives many years through small dormant tubers (National Research of Crop and Root Institute (NRCRI), 2006, Ezedinma, 2006). Several studies have shown that the production and productivity of cocoyam in Nigeria is dwindling in recent year as yield less than 18 metric tonnes per hectare,

thus limiting the ability of the crop to perform its' traditional role in economic development (Ekunwe, Egware & Akahomen 2015).

Cocoyam production in Nigeria failed substantially in attaining the potential output level because of the following constraints which includes; cocoyam production is labour intensive with most of the operations carried out manually at the production level (Iwueke, 1999; Awoke & Okorji, 2003). Lack of improved varieties and cultural practices, long period of maturation, inadequate technical know-how among cocoyam growing farmers, land scarcity, labour scarcity, technical difficulties involved in managing cocoyam especially the post-harvest losses have made cocoyam to be less attractive. Efficiency is the quality of production with no waste of time or money. It can be further classified into technical, allocative and economic efficiency. This study mainly researches on the technical, efficiency of cocoyam production, that is the effectiveness with which inputs is used to produce a given output in cocoyam production. Technical efficiency is the effectiveness with which a given set of inputs is used to produce an output. Technical efficiency is the ratio between actual and potential output of a production unit. It is defined as the ability of the farmer to produce at the maximum output (frontier production), given qualities of inputs and production technology. For a farm to be technically efficient it has to produce at the frontier or "best level" (Shanmugam & Venkataramani, 2006). The broad objective of this study was to estimate technical efficiency of cocoyam production in Dunukofia Local Government Area of Anambra State, Nigeria. The specific objectives were to: describe the socioeconomic characteristics of cocoyam farmers, determine the technical efficiency of cocoyam, determine the factors influencing the technical inefficiency of cocoyam farmers and identify the constraints faced by cocoyam farmers in the study area.

METHODOLOGY

The research was conducted in Dunukofia Local Government Area (LGA) of Anambra State, Nigeria. Dunukofia LGA has a total population of 96,517 persons (National Population Commission of Nigeria (NPC), 2006) and a projected population of 127,700 persons (National Bureau of Statistics (NBS), (2016). It occupies an area of 66.0 km2 with a density of 1.935/km^2 (NPC, 2006). Dunukofia LGA lies north to south-westward along the Enugu-Onitsha old road, from kilometer 50 to kilometer 20 (measured to Onitsha). It is bounded on the west by Ogbunike, Umunya and Awkuzu (Oyi Local Government Area) with Abba (Njikoka Local Government Area). The Major occupation of the people is farming. Some crops commonly grown include yam, cocoyam, cassava, maize, tomatoes, plantations, banana, and vegetables amongst others. However, they engage in other occupation such as civil service, trading and artisanship. Dunukofia LGA has two distinct seasons of dry and rainy periods; the average rainfall is between 1800mm and 240mm. The rainfall is distributed through March to November. The climate of the area is comparatively good with a mean temperature of 30°C during the hottest period of February to April and 21°C during the cold period of December (Anambra State Blue Print (ASBP), 2008). Dunukofia is made up of the following communities; Ukpo (headquarters), Ifitedunu, Umunnachi, Umudioka, Ukwulu and Nawgu.

A two-stage sampling procedure was adopted in selecting cocoyam producers in the study area. The first stage was a purposive sampling of the six communities from the area of the study. The second stage involves a simple random sampling of 20 cocoyam farmers from each of the communities. Thus, a total of 120 cocoyam farmers were used as the sample size. However, only

102 cocoyam farmers completed the research instrument. The selected cocoyam farmers depend on the sampling frame from the selected communities as provided by the Agricultural Development Programme (ADP) of the LGA. Primary data were collected using structured questionnaire and interview scheduled

Descriptive statistics such as frequency counts, mean and percentage, Stochastic Frontier production function as specified by the Cobb-Douglas production and a five- Point Likert rating scale was used to achieve the objectives.

Model Specification

Stochastic Frontier Production Function

The stochastic frontiers production function for cocoyam production adopted in this study as specified by the Cobb-Douglas functional form comprising of four independent variables and is defined as

$$Log\ Y = \beta_0 + \beta_1 LogX_1 + \beta_2 LogX_2 + \beta_3 LogX_3 + \beta_4 LogX_4 + (V_i - U_i) \ \ldots\ldots equ\ (1)$$

Where:

Log=Natural logarithm

Y= value of cocoyam produced in kg

X_1= farm size in hectare

X_2= seed cocoyam in kg

X_3= labour in man-day

X_4=fertilizer/manure in kg

$ß_o$, $ß_1 – ß_4$ = Regression coefficients

Vi= Random variables assumed to be independent of Ui, normally distributed with zero mean and constant variance, represents the stochastic effects.

Ui= non-negative random variables assumed to be independent of Vi, represents the technical inefficiency of the farm.

As specified by Coelli (1995), the farmer specific technical inefficiency is defined by the function:

$U_i = \sigma_o + \sigma_1 Z_1 + \sigma_2 Z_2 + \sigma_3 Z_3 + \sigma Z_4 + \sigma_5 Z_5 + \sigma_6 Z_6$…….. equ (2)

Where:

U_i= Technical inefficiency

Z_1 = Gender (male = 1 and female = 0)(dummy variable)

Z_2 = Age (years)

Z_3 = Marital status (dummy variable- married = 1, otherwise = 0)

Z_4 = Household size (in person)

Z_5 = Education (number of school years)

Z_6 = Farming experience (years)

$\sigma_o + \sigma_6$ = Inefficiency parameter

The vital parameters estimated in this stochastic function include the sigma squared (σ^2), gamma ɣ and the maximum - likelihood ratio test. The σ_o^2 indicates the goodness of fit of the model used. The gamma gives the proportion of the deviation of the cocoyam output from the production frontier caused by technical inefficiency. If the value of ɣ is equal to zero, it means U_i is absent from the model and hence all deviations from the frontier are attributed to noise. If the value of ɣ is equal to one, it means all deviations from the frontier are due to technical inefficiency. The maximum-likelihood ratio test was used to test for the significant presence of technical inefficiency effects in the farmer's production.

The σ_o^2 and ɣ are respectively expressed as:

$\sigma_o^2 = \sigma_v^2 + \sigma_u^2$…… equ (3)
Where
σ_v^2 = variance of the error term due to noise
σ_u^2 = variance of the error term resulting from technical inefficiency
$\gamma = \sigma_u^2 / \sigma_v^2$
$o \leq \gamma \leq 1$
The Likert's five point scale model with 3.0 as cut off mark will be adopted in achieving objective 5 which is the constraints of cocoyam production in the area of study. The Likert weight scale 5= very serious, 4= serious, 3=moderately serious, 2=least serious and 1=not serious

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Cocoyam farmers

The result of the socioeconomic characteristics of the cocoyam farmer in Dunukofia LGA is presented in Table 1

Table 1: **Socioeconomic Characteristics of Cocoyam Farmers in Dunukofia, LGA in Anambra State**.

Variables	**Items**	**Frequency (n=102)**	**Percentages**	**Mean**
Age	20-29 years	3	2.9	
	30-39 years	20	19.6	45 years
	40-49 years	45	44.1	
	50-59 years	31	30.5	
	60-69 years	3	2.9	
Gender	Male	41	40.2	
	Female	61	59.8	
Marital status	Single	7	6.9	
	Married	92	90.2	
	Divorced	3	2.9	
Household size	1-5 person	41	40.2	
	6-10 person	59	57.8	6 persons
	11-15 person	2	2.0	
Level of education	No formal education	9	8.9	
	Primary education	33	32.3	9 years
	Secondary education	49.0	49.0	
	Tertiary education	9.8	9.8	
Farming experience in cocoyam	2-6 years	31	30.4	
	7-11 years	27	26.5	12 years
	12-16 years	17	16.6	
	17-21 years	13	12.7	
	22-26 years	13	12.8	
	27-31 years	1	1.0	

Farm size	0.03-0.13	34	33.3	
	0.14-0.24	8	7.8	0.3 hectare
	0.25-0.35	19	18.6	
	0.36-0.46	11	10.7	
	0.47-0.57	19	18.6	
	0.58-0.68	7	6.8	
	0.69-0.79	2	2.0	
	0.80-0.90	2	2.0	

Source: Field Survey, 2018.

The table shows that 44.1% of the cocoyam farmer's fall within the ages of 40-49, while 19.6% falls within 30-39 years. The average age of the farmers was 45 years. This result shows that the cocoyam farmers were in their middle and active age. This implies that the farmers are adults who have experience in farming and are dependent. This finding agrees with the findings of Emodi, Obiora and Okere (2014), who reported that farmers within the age range of 41-50 are adult farmers and are not within the dependency ratio in the society.

The result also reveals that 59.8% of the farmers were females while 40.2% of the farmers were males. This explains that females (women) are more involved in cocoyam production in the study area. This result is in consonance with the finding of Ugbajah (2013), who reported that women are involved in cocoyam production in Dunukofia LGA.

Table 1 also shows that 90.2% of the farmers were married, 69% were single and 2.9% were divorced. Married people tend to have higher household size that affects the supply of labour than singles. This result implies that the study area was dominated by cocoyam farmers who were married. This agrees with the study of Ifeanyi-Obi, Togun, Lamboll, Adesope and Arokoye (2017) who reported that 92% of cocoyam farmers were married in South East Nigeria.

The table shows that household size fell between 6 and 10 (57.8%) with the lowest household size within 11-15 persons (2.0%). The mean household size was 6 persons. This implies that the respondents maintain average household size. These results agree with Ifeanyi-Obi, et al. (2017) who reported the mean of household size was as 6 persons in South East Nigeria. .

Table 1 also shows that the farmers were grouped into four categories based on their educational level; no formal education, primary, secondary and tertiary education. The table shows that 49.0% of the farmers had secondary education while 8.9% of the farmers had no formal education. The mean year of schooling was 9 years. This implies that majority were literate and this can help them to adapt easily to certain agricultural innovations. This finding is in agreement with Ifeanyi-Obi, et al. (2017) who reported the mean of years spent in school as 10 years.

The farmer's expertise in cocoyam farming was also presented in Table 4.1. The table indicates that 56.9% of the farmers fall within 2-11 years; while 29.3% fell within 17-26 years of farming experience the least which is 27-31 years (1.0%). The mean farming experience for cocoyam was 12 years. This implies that the cocoyam farmers have been in production of cocoyam for a long time, and they must have acquired experiences to boost productivity rate. This finding is in agreement with Nzeh, Akogwa, Ugwu and Nzeh (2014) who reported that the farming experience of cocoyam farmers was 10.4 years.

The result shows that 47.9% of the cocoyam farmers had farm size ranging from 0.25-0.57 hectare. The average farm size was 0.3 hectare. This indicates that majority of the farmers were small scale farmers; this result is in agreement with the findings of Donye and Barabi (2012), who reported

that majority of farmers in developing countries are in rural areas and are characterized by small-scale and heavy fragmentation.

Maximum Likelihood Estimates of Cocoyam Production in the Study Area.

The results obtained from the Stochastic Production function as shown by the Maximum Likelihood Estimate (MLE) for Cocoyam production in Dunukofia L.G.A is presented in Table 2 below. The result shows the variables of production parameters, inefficiency parameters and diagnostic parameters. The coefficients are statistically significant at 1% level and 5% levels. The coefficients of planting materials, labour and fertilizer have positive signs and are significant at 1% showing positive relationship with output, this agrees with the findings of Nwakor, Anyaegunam, Olojide, and Nzekor (2016) who reported that fertilizer increases output positively.

Table 2: Maximum Likelihood Estimates of Cocoyam Farmers in Dunukofia, LGA in Anambra State

Variables	Coefficient	Standard-error	t-ratio
Production parameters			
Constant	3.2115509	1.1929672E	2.6920697***
Farm size (ha)	-0.1295669	0.16269456	-0.79628128
Planting materials (kg)	0.44190835	0.10329443	4.2781431***
Labour (man-days)	1.0701924	0.34319918	3.1182837***
Fertilizer (kg)	0.044151946	0.042911157	1.0289153
Inefficiency parameters			
Constant	3.8369614	1.0435802	3.6767289***
Gender	-0.56055959	0.26048252	-2.1520046**
Age	-0.00971653	0.019383055	-0.50129013
Marital status	0.55055526	0.5098209	1.0798994
Household size	0.19085082	0.0844971	2.2586663**
Level of education	-0.07237247	0.029194176	2.4790038***
Farm experience	-0.13993906E	0.025315129	-5.5278825***
Diagnostic parameters			
Sigma-squared	1.1480578	0.18717921	6.1334683***
Gamma	0.40646254	0.34614544	1.1742536

Source: Field Survey, 2018; *** = significant at 1% level, ** = significant at 5% level.

The result of the implied that a 1 percent increase in labour usage will lead to 1.070 percent increase in cocoyam yield. Also, 1 percent increase in planting materials will lead to 0.441 percent increase in cocoyam production. From the results of the Stochastic Frontier Production, farm size had negative effects on yam yield with an elasticity of -0.129 and is not significant at 1% or 5% levels. The sigma squared is significant at 1 percent level (1.148) giving credibility to the goodness of fit model. The gamma estimate was 0.406 and was not statically significant at either 5 or 1 percent levels.

Technical Inefficiency Parameters

Table 2 above shows the observed level of technical inefficiency of the farmers. The negative coefficient indicates that the variables have the effect of reducing technical inefficiency and

increasing technical efficiency while the positive coefficient has the effect of increasing technical inefficiency and decreasing technical efficiency.

The result shows that the coefficients of marital status and household size were positive. However, marital status was not significant at 5 percent level or 1 percent level. Household size was significant at 5 percent level which indicates that an increase in household size will lead to an increase in technical inefficiency and a decrease in technical efficiency.

The level of education contributed negatively to technical inefficiency and was significant at 1 percent level; this indicates that an increase in the level of education will lead to a decline in technical inefficiency and increase in technical efficiency. This implies that the farmer with more years of schooling tend to be more efficient due to their ability to acquire technical knowledge.

Also, gender and farming experience contributed negatively to technical inefficiency leading to a decline in technical inefficiency and increasing technical efficiency. This implies that experienced farmers are more efficient than less experienced famers. This result agrees with Ekunwe and Orewa (2007) who reported that experienced farmers are expected to have higher level of technical efficiency than less experienced farmers.

Distribution of Technical Efficiency

The result of the data analysis for technical efficiency distribution of the Cocoyam farmers in the study area is presented in Table 3 below.

Table 3: Distribution of Technical Efficiency in Dunukofia LGA, Anambra State

Range of Technical Efficiency	Frequency
1-10	62
11-20	10
21-30	7
31-40	8
41-50	7
51-60	4
61-70	4
71-80	Nil
81-90	Nil
91-100	Nil
Mean	16.6

Minimum mean: 1.1%. Maximum mean: 65.9%

Source: Field data, 2018

The distribution table of technical efficiency tells that majority of the farmers in Anambra State can be said to be technical inefficient. The technical efficiency ranges from 1.1% to 65.9% with a mean of 16.6%. The range shows that 62% of the farmers fall within 1-10% range of technical efficiency. This imply that majority of the farmers were technical inefficient showing low efficiency in production in the study area.

Return to Scale in Dunukofia Local Government Area of Anambra State

The result of the returns to scale of cocoyam production in the study area is presented in Table 4.

Table 4: Results showing Return to Scale

Factor	Elasticity
Farm size (ha)	-0.1295669
Planting material(kg)	0.44190835
Labour (man-days)	1.070190835
Fertilizer (kg)	0.044151946
Return to Scale	1.43

Source: Field Survey Data, 2018

This indicates what would happen to cocoyam output as inputs are increased simultaneously. The results of the data analysis from the stochastic estimate showed that cocoyam production is at stage I of the production process with returns to scale of 1.43. This indicates negative return to scale. This explains why the farmers are technically inefficient

Mean Distribution of Constraints Affecting Cocoyam Farmers in Dunukofia, L.G.A

The result of the constraints affecting cocoyam farmers and production is represented on Table 5 below.

Table 5: The results of constraints affecting cocoyam farmer in the study area

Constraints	Strongly agree	Agree	Disagree	Strongly Disagree	Mean	Remark
Inadequate personal savings	29(28.4)	56(54.9)	16(15.7)	1(1.0)	3.13	Agree
Lack of cooperatives	22(21.6)	46(45.1)	32(31.4)	2(2.0)	2.86	Agree
Low output for sale	17(16.7)	41(40.2)	42(41.2)	2(2.0)	2.72	Agree
Low prices of produce	15(14.7)	34(33.3)	46(45.1)	7(6.9)	2.56	Agree
Poor government policy in borrowing	38(37.3)	47(46.1)	13(12.7)	4(3.9)	3.17	Agree
Unavailability of land	22(21.6)	44(43.1)	31(30.4)	5(4.9)	2.81	Agree
Unproductive land	15(14.7)	57(55.9)	28(27.5)	2(2.0)	2.83	Agree
High cost of renting land	38(37.3)	46(45.1)	14(13.7)	4(3.9)	3.16	Agree
Land tenure system	32(31.4)	44(43.1)	21(20.6)	5(4.9)	3.01	Agree
Rural-urban migration of labour	29(28.4)	60(58.8)	12(11.8)	1(1.0)	3.15	Agree
Unavailability of labour	22(21.6)	53(52.0)	27(26.5)		2.92	Agree
High cost of hiring labour	43(42.2)	51(50.0)	8(7.8)		3.34	Agree
High cost of cocoyam seeds for planting	16(15.7)	58(56.9)	23(22.5)	5(4.9)	2.83	Agree
Unavailability of cocoyam seeds	3(2.9)	21(20.6)	64(62.7)	14(13.7)	2.13	Disagree
High cost of fertilizer	25(24.5)	61(59.8)	12(11.8)	4(3.9)	3.05	Agree
Non availability of fertilizers	11(10.8)	14(13.7)	63(61.8)	14(13.7)	2.22	Disagree
Poor storage facilities for cocoyam	16(15.7)	55(53.9)	24(23.5)	7(6.9)	2.78	Agree
High cost of storage facilities for cocoyam	16(15.7)	36(35.3)	42(41.2)	8(7.8)	2.59	Agree
High cost of chemicals	9(8.8)	15(14.7)	64(62.7)	14(13.7)	2.68	Agree
Poor road network to farm	33(32.4)	54(52.9)	10(9.8)	5(4.9)	3.13	Agree
High cost of transportation	45(44.1)	44(43.1)	9(8.8)	4(3.9)	3.27	Agree
Inadequate extension agents/services	14(13.7)	32(31.4)	51(50.0)	5(4.9)	2.54	Agree

Few visits from extension agents in year	12(11.8)	48(47.1)	33(32.4)	9(8.8)	2.62	Agree
Low output from harvest from cocoyam	6(5.9)	36(35.3)	52(51.0)	8(7.8)	2.39	Disagree
Low price of cocoyam for sale	7(6.9)	28(27.5)	53(52.0)	14(13.7)	2.27	Disagree

Source: Field Survey, 2018
Midpoint = 2.50, any mean score <2.50 is Disagreement, Any mean score >2.50 Agreement. N/B: Values in parenthesis are percentages

Most interviewed farmers reported that the major constraints faced in cocoyam production is high cost of hiring labour with a mean of 3.34 which was followed by high cost of transportation with a mean of 3.27. However, unavailability of cocoyam seedlings was a minor constraint with a mean of 2.13 as the cocoyam farmers disagree that it has effects on production, this agrees with Onwubuya and Ajani (2012) who reported that major constraints to cocoyam production and processing were high cost of inorganic fertilizer, high cost of hired labour. However, unavailability of cocoyam seedling was not a major constraint. Other constraint includes poor government policy in borrowing with a mean of 3.17. Seremi, et al. (2008) stated that credit is a very important production resource which helps in transforming agriculture from subsistence to commercial type. The other constraints to cocoyam production were unavailability of land: this is in agreement with the findings of Talwan et al., (2009) that stated that 70% of the farmers have reported land scarcity. Rural-Urban migration of labour was also considered a major constraint with a mean of 3.15. Ajoku (2009) remarked that with the increase in population, rural-urban migration, labour is likely to be inelastic and expensive.

CONCLUSION

In conclusion, the study shows that cocoyam farmers are not technical efficient in the use of their resource. Production parameters such as farm size (ha) and fertilizer were not significant and were underutilized.

RECOMMENDATIONS

The following recommendations were made based on the findings of the study;

1. Farmers should depend on the large family size by encouraging members of the household to get involved in their family activities.
2. Agricultural credits should be made available and accessible to cocoyam farmers for increase farm size and for increased cocoyam production.
3. To achieve technical efficiency of cocoyam production in the study area, the farmers should be encouraged to maximize the use of underutilized and over utilized resource.

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