Cost Efficiency of Yam Production in Oguta LGA of Imo State, Nigeria

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ABSTRACT

The study applied a stochastic frontier cost function to analyze cost efficiency of yam farmers and ascertained variation in cost efficiency due to inefficiency effects on yam production in the study area. Data were collected with the aid of a well-structured questionnaire from 35 randomly selected yam farmers from 5 purposively selected communities. Data were analyzed using descriptive statistics and stochastic cost function. Results showed that the mean age of yam farmers was 41 years and more males (91.4%) were involved in yam production. Cost of land, yam seed, hired labour, agrochemicals and transportation were significant factors that are determinants of total cost associated with yam production in the study area. That is, 1% increase in the cost of land, yam seed, hired labour, agrochemicals and transportation will increase total production cost by approximately 0.69%, 0.49%, 0.29%, 0.57% and 0.40% respectively with the value of the sigma squared (δ^2) being 0.820 indicating a good fit. The maximum likelihood estimates for the Stochastic cost function used in explaining the inefficiency parameters for yam farmers showed that the coefficient of credit availability, farming experience, extension contact all had the a priori expected signs and statistically significant showing that an increase in any of them decreases cost inefficiency. The mean cost efficiency was 0.63, meaning that an average yam farmer in the study area has the scope for increasing cost efficiency by 37%. It was concluded that farmers are not cost efficient from their cost efficiency indices.

Key words: Production, Cost, Efficiency, Yam, Farmers

INTRODUCTION

Yam belongs to the genus “Dioscorea” and family “Dioscoreaceae”. It is an important tuber crop of the tropics and some other countries in East Asia, South America and India (Swamy 2024). Yam (Dioscorea spp) is among the oldest recorded food crops and ranked second after cassava in the study of carbohydrates in West Africa (Ariyo, 2020). Although yams are grown throughout Africa, Nigeria is said to be the world’s largest producer of yam, accounting for over 70-76 percent of the world total output. Nigeria alone in 1985 produced 18.3 million tonnes of yam from 1.5 million hectares, representing 73.8 percent of 28.8 million tonnes of yam produced in Africa (Merem, Twumasi, Fageir, Olagbegi, Wesley, Coney, Babalola, Thomas, Hines, Hirse, Ochai, Nwagboso, Crisler, Leggett, Offiah, Emeakpor, 2024). According to Okparauka, Achinewhu, Akausu, Ejiofor & Ojimelu, (2025), the yam tuber is a good source of energy derived mainly from their carbohydrate content, since it is low in fat and protein. Vitamin C has been found in unpeeled yam slices. There are over 600 species of yam worldwide but six species can be considered as the edible ones in the tropics according to Kanu,Onwusiribe, Okere, Agim & Kanu, (2024). These are white yam (Dioscorea rotundata) yellow yam (D. cayenensis), water yam (D.alata), trifoliate yam (D. dumentorum), arial yam (D. bulbifera) and Chinese yam (D. esculenta).Yam tubers are eaten boiled, roasted, fried and pounded and could be chipped, dried and produced into yam flour.

Cost efficiency (otherwise referred to as allocative efficiency) refers to the ability of a firm to produce at a given level of output using cost minimizing input prices (Joseph, Danwanka &Stephen, 2019). The analysis usually assumes that the firm-farm seeks to optimize a cost minimization objective function subject to resource constraints. Similarly, cost inefficiency arises when resource inputs are used in proportions which do not lead to profit maximization. In this situation the value of the marginal revenue product (MRP) is not equal to that of the marginal cost of that input. . The corresponding cost frontier of Cobb-Douglas functional form which is the basis of estimating the cost efficiencies of the farmers is specified as follows:

Ci = g (Pi,β)exp (Vi + Ui) ……………………….1

Where: Ci represents the total cost of inputs of the ith farms; g is a suitable function such as the cobb Douglas function; pi represent input prices employed by the ith farm in yam production and measured in naira; β is the parameters to be estimated, Vi is the systematic component which represents random disturbance cost due to factors outside the control of the farmers, Ui is the one sided disturbance term used to represent cost inefficiency and is independent of Vi. Ui provide information on the level of cost efficiency of the ith farm. Hence cost efficiency ranges between zero and one. The cost efficiency (CE) of an individual farm is defined in terms of the ratio of observed cost (Cb) to the corresponding minimum cost (Cmm) giving the available technology. That is:

CE = Cb = g (Pi, Yi,β) + (Vi + Ui) = exp(Ui) …………………2

Optimum cost efficiency is yet to be attained by yam farmers in Imo State as seen in the Supply and Demand gap in yam output. This may be connected to farmers socio economic factors as reported by Joseph et al. (2019). But these researchers failed to capture important socio economic factors like credit availability and primary occupation of farmers which this study seeks to address. When scarce resources are not efficiently utilized by resource poor farmers it could have a multiplier effect on their livelihood and incomes. This study therefore seeks to analyze the socio economic characteristics of yam farmers, cost efficiency of yam farmers in the study area and cost inefficiency of yam farmers (it is expected a priori that the coefficients of the socio economic variables will have negative signs) with the hypothesis that yam farmers are not cost efficient.

RESEARCH METHODOLOGY

i. Study Area

Oguta LGA is one of the serving 27 Local Government Councils in Imo State located in the town of Oguta with the composition of the districts of Oguta 1, Agwa, Orsu Obodo, Egwe, Nnebukwu, Egbuoma, Awa, Akabor, Mgbelle, Ezi Orsu, Nkwesi, and Izombe. The current estimated population of Oguta LGA is put at 186,703 inhabitants with the vast majority of the area's dwellers being members of the Igbo ethnic group. The LGA experiences two distinct seasons which are the dry and the rainy seasons with the total precipitation in the area put at an estimated 2400 mm of rainfall per annum. The LGA lies within Latitude: 5° 42' 34" N. Longitude: 6° 49' 55" E. The traditional occupation of the people in the area is farming.

ii. Sampling Technique

A purposive sampling technique was used to select 5 communities from the 12 communities in Oguta LGA. The reason for the purposive selection is because they produce yam in large quantities. These communities include: Oguta 1, Izombe, Agwa, Orsu Obodo and Ezi Orsu. This was followed by a random selection of 7 yam farmers from each of the community making it a total of 35 yam farmers.

iii. Data Analyses

Descriptive statistics involving the use of frequency distributions, percentages and means was

used in describing the socio-economic characteristics of the yam farmers as well as inferential statistics involving the use of stochastic cost function. Hypothesis was tested using the result of the cost efficiency indicies.

iv. Model Specification

Following Baba, Adedeji,& Waziri,(2023) stochastic cost function was employed to estimate the firm-level

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cost efficiency of yam farmers in the study area. The explicit Cobb-Douglas cost function for yam farmers is specified thus;

$$LnC_{ij} = \beta_0 + \beta_1 LnP_{1ij} + \beta_2 LnP_{2ij} + \beta_3 LnP_{3ij} + \beta_4 LnP_{4ij} + \beta_5 LnP_{5ij} + \beta_6 LnP_{6ij} + V_{ij} + U_{ij} \ldots\ldots.3$$

Where:

Subscript ij refers to the j^{th} observation of the i^{th} farmer.

Ln = Natural Logarithm

C_{ij} = Total production cost (₦/ha) of the i^{th} farmer

P_1 = Cost of Land (₦/ha)

P_2 = Cost of Yam Seed (₦/ha)

P_3 = Cost of Hired labour (₦/ha)

P_4 = Cost of inorganic fertilizer (₦/ha)

P_5 = Cost of agrochemicals (₦/ha)

P_6 = Cost of transportation (₦/ha)

β_0 = Constant

$\beta_1 – \beta_6$ = Parameters to be estimated

V_{ij} = the systematic component which represents random disturbance cost due to factors outside the control of the farmers

U_{ij} = disturbance term used to represent cost inefficiency and is independent of Vi.

Cost inefficiency

The Cost inefficiency effects U is defined by

$$U_i = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 + Z_6 \qquad \ldots\ldots\ldots\ldots\ldots 4$$

Where: U_i is the cost inefficiency of the i^{th} farmer, $Z_1 – Z_6$ represent credit availability, primary occupation, household size, extension contact, farming experience and formal education respectively.

RESULTS AND DISCUSSION

Table 1: Socio Economic Characteristics of yam Farmers

Age	Frequency	Percentage (%)
21 -30	5	14.3
31 – 40	8	22.9
41 – 50	20	57.1
51 – 60	2	5.7

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Mean **41 Years**		
Marital Status		
Single	3	8.6
Married	29	82.8
Divorced	0	0
Widowed	3	8.6
Gender		
Male	32	91.4
Female	3	8.6
Primary Occupation		
Farming	33	94.3
Civil Service	0	0
Trading	2	5.7
Household Size (No. of Persons)		
1 -5	9	25.7
6- 10	25	71.4
11 – 15	1	2.9
Mean	**7 persons**	
Farm Size (Ha)		
0.5 – 1	26	74.3
1.5 – 2	8	22.8
> 2	1	2.9
Mean **1ha**		
Farming Experience (Years)		

1 -5	8	22.9
6 -10	17	48.6
11 -15	6	17.1
16 – 20	4	11.4
Mean	**9Years**	
Formal Education		
No formal Education	5	14.3
Primary Education	9	25.7
Secondary Education	18	51.4
Tertiary Education	3	8.6
Credit Availability		
Access to credit	3	8.6
No access to credit	32	91.4
Extension Contact		
None	26	74.3
Once yearly	4	11.4
Twice Yearly	3	8.6
Quarterly	2	5.7

Field Survey Data, 2025

Table 2: Maximum Likelihood Estimate of the Stochastic Cost Function

Variable	**Parameter**	**Coefficient**	**t-ratio**
Cost Factors			
Constant	β_0	15.093	5.344*
Cost of Land (P_1)	β_1	0.694	3.187*
Cost of Yam seed (P_2)	β_2	0.489	2.764*
Cost of hired labour (P_3)	β_3	0.291	2.957*
Cost of Inorganic fertilizer (P_4)	β_4	0.038	0.628

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Cost of agrochemicals (P_5)	β_5	0.573	4.781*
Cost of Transportation (P_6)	β_6	0.402	3.961*
Sigma Squared		0.820	0.187
Log likelihood		-104.312	
Chi-Square		74.689	
Inefficiency effects			
Constant	δ_0	- 0.336	-6.424*
Credit availability (Z_1)	δ_1	-0.147	-2.933*
Primary Occupation (Z_2)	δ_2	-0.628	-2.22**
Household Size (Z_3)	δ_3	-0.022	-0.012
Extension contact (Z_4)	δ_4	-0.326	-2.024**
Farming Experience (Z_5)	δ_5	-0.115	-2.573*
Formal Education (Z_6)	δ_6	-0.081	-0.654
* Significant @ 1% **Significant @ 5%			

Field Survey Data, 2025.

Table 3: Cost Efficiency of sampled yam farmers

Cost Efficiency Class	Frequency	%		
0.41-0.51	11	31.4		
0.52-0.62	8	22.9		
0.63-0.73	6	17.1		
0.74-0.84	6	17.1		
0.85-0.95	4	11.4		
Total	35	100		
Mean		0.63		
Maximum		0.95		

Minimum		0.41		

Source: Field Survey Data, 2025.

The socio-economic characteristics of the respondents are presented in Table 1 above. The result shows that 57.1% of the yam farmers were between the ages 41-50, 22.9% were between ages 31-40 with mean age of 41 years. This simply shows that yam production in the area is mainly done by young and vibrant farmers which further confirms the findings of Esiobu, Osuagwu, Ohaemesi, Onyike, Nnamdi,& Igwenagu,(2025). Marital status of the respondents is necessary in the study according to Ololade, Olagunju, Adejumo, & Okegbade, (2018) because it determines the family size and also the availability of labour from the household for yam production. Family labour would be more where the household head is married and vice versa. Majority (82.8%) of the yam farmers are married while few (3%) were single and widowed respectively. This result shows that the yam farmers have greater responsibility that would make them more committed to yam production in order to take care of members of their household.

The distribution of yam farmers according to gender shows that yam production in the study area is dominated by males (91.4%) while only 8.6% (3) were females. It has been reported by researchers like Onyemekonwu, Chisonum, & Onyemekihian,(2023) that yam production is gender sensitive and requires innate physical exertion of carefully selected force.

It is expected that the occupation of the respondents should have a positive relationship with their production activities. This assumption is that the respondents in farming-related occupation should be more involved in farming. In line with the above assumption, most (94.3%) of the yam farmers indicated that farming was their major occupation while only 2% combined yam production with trading.

It is assumed that a business which is labour-intensive requires big household size that could provide the labour needed at a least cost. A household is defined as a group of persons who commonly live together and take their meals from a common kitchen. The distribution of yam farmers according to household size shows that 71.4% (25) of the yam farmers had household size of between 6-10 persons while 25.7% (9) had household size of between 1-5 persons with mean household size of 7 persons. This goes to show that the yam farmers would have adequate hands to work in their farm which also conforms with the findings of Lorzua, Ikwuba, Aan, & Nwafor (2020).

Farm size forms a good yard stick for determining the size of production and so farm size analysis from Table 1 shows that majority of the yam farmers have approximately 1ha to farm on with 74.3% of them having between 0.5 – 1ha to farm on while 22.8% have between 1.5 – 2ha to farm on. This result simply shows that yam production is done on a small scale which further strengthens the findings of Anugwo & Egwue, (2024).

The result on formal education shows that secondary education ranked the highest (51.4%) followed by primary education (25.7%). This indicates that yam farmers in the study area have had some level of formal education which will enable them adopt new innovation easily to improve efficiency in resource pricing and allocation as there exist a positive relationship between education and adoption of new innovation according to (OECD, 2016).

Credit availability is paramount in any production system because it helps in facilitating production. From the result of the study, majority (91.4%) of the yam farmers had no access to credit which is likely to hinder yam production in the study area in large quantity. This result however was in contrast with the findings of Akporawo, Emaziye & Osemedua (2022).

The result from the yam farmers on extension contact shows that no visible extension contact is seen in the study area (74.3%) while 11.4% agreed that extension agents visit them once yearly. This implies that majority of the yam farmers in the study area do not have access to recent technologies on the best practices which has a serious implication on their productivity, This is in tandem with the findings of Udemezue, Mbanason ,&Obiajulu, (2022).

The maximum likelihood estimate of the stochastic cost function is presented in Table 2. All parameter estimates have the expected sign, where cost of land (P_1), yam seed (P_2) cost of hired labour (P_3), cost of agrochemicals (P_5) and cost of transportation (P_6) are statistically significant at 1%, meaning that these factors are important determinants of total cost associated with yam production in the study area. The cost elasticities with respect to all input variables used in the production analysis are positive, implying that an increase in the costs of land, yam seed, hired labour, agrochemicals and transportation increases total production cost. That is, 1% increase in the cost of land, cost of yam seed, cost of hired labour. Cost of agrochemicals and cost of transportation will increase total production cost by approximately 0.69%, 0.49%, 0.29%, 0.57% and 0.40% respectively. This result further strengthens the findings of Joseph et al. (2019).The value of the sigma squared (δ^2) was 0.820 and is statistically significant at 1% level. This also indicates a good fit and correctness of the distributional form assumed for the composite error term in the model.

The maximum likelihood estimates (MLE) for the Stochastic cost function used in explaining the inefficiency parameters for yam farmers is presented in Table 2. The coefficients of variables had a priori expected signs and significant at 1% and 5% respectively. The coefficient of credit availability variable is estimated to be negative and statistically significant at 1% level, indicating that increased credit availability to farmers decreases cost inefficiency in yam production. According to Bawa & Miftahu (2023), borrowed funds used in agricultural production is expected to bring about efficient utilization of such funds so that farmers could realize the output that would sufficiently offset the credit facility and still be left with marketable surplus. The coefficient of faming experience is estimated to be negative and statistically significant at 1% level indicating that as farmers gain more experience in yam production, cost inefficiency reduces because they will have adequate knowledge on how to allocate inputs in order to maximize output. The coefficient of extension variable and primary occupation is estimated to be negative and statistically significant at 5% level, indicating that increased extension services to farmers tend to decrease cost inefficiency in yam production. The training and advisory services of extension agents helps farmers in making sound production and marketing decisions as well as getting the right technologies needed in the production of yam which helps in enhancing cost efficiency as well. In the same vain, primary occupation is also important to help the farmers concentrate more on yam production than to have divided attention. This in turn will increase cost efficiency. The cost efficiency indices which measure the cost of resources is presented in Table 3. The cost efficiency of the sampled farmers ranged from 0.41 to 0.95.The mean cost efficiency is estimated to be 0.63, meaning that an average yam farmer in the study area has the scope for increasing cost efficiency by 37% in the short run under the existing technology as noted by Ismail & Mahmud(2023). Household size and formal education were not statistically significant determinants of cost inefficiency in this study. The non-significance of household size may be explained b y the fact that larger households may include many children or elderly members who do not contribute to farm labour or that yam production relies more on hired labour than family labour. The non-significance of formal education suggests that experience (which was significant) may be more important than formal education for cost efficiency in yam production or that the education levels in the sample (predominantly secondary education) may not vary sufficiently to detect an effect.

Test of Hypothesis

From the result of the cost efficiency indices, yam farmers are not cost efficient (0.63) leading to the acceptance of the null hypothesis.

Limitation of the Study

This study is based on a sample of 35 yam farmers from five communities in Oguta LGA. While the sample size is adequate for basic statistical analysis, stochastic frontier models typically benefit from larger samples ($n \geq 50$-100) to achieve stable parameter estimates. The small sample size limits the generalizability of findings to the broader yam-farming population of Imo State. Future research should employ larger samples across multiple local government areas to validate these findings.

CONCLUSION

This study assessed cost efficiency in yam production in Oguta LGA, Imo State, using stochastic frontier cost function analysis. The results show that the mean cost efficiency is 0.63, indicating that the average yam farmer operates at 63% cost efficiency and has the potential to reduce production cost by 37% under current technology. Significant determinants of total production cost include land, yam seed, hired labour, agrochemicals, and transportation costs. Credit availability, extension contact, farming experience, and primary occupation significantly reduce cost inefficiency, while household size and formal education show no significant effect. The findings confirm that yam farmers in the study area are not cost efficient, accepting the null hypothesis.

RECOMMENDATION

From the results above, the following recommendations are made:

- Extension workers should be motivated by both Local, State and Federal Government to reach out to yam farmers in rural areas in terms of training on how to improve cost efficiency and output through modern technologies in yam production.
- Credit should be made available to yam farmers through government-backed soft loan programs with flexible repayment terms tied to harvest cycles.
- Farming experience reduces inefficiency. Organizing workshops, demonstration plots, and peer learning programs can accelerate knowledge transfer, especially for younger or less experienced farmers.
- Primary occupation as farming improves efficiency. Incentives should be provided by the State Government to encourage full-time engagement in yam production rather than part-time farming.
- Land, seed, hired labour, agrochemicals, and transportation are major cost drivers. Farmer cooperatives can pool resources to negotiate better prices for inputs and reduce transportation costs.
- Poor rural roads increase transportation costs. Government investment in rural infrastructure will lower costs and improve market access.
- Current technology allows room for 37% cost reduction. Introducing improved yam varieties, mechanization, and efficient input use can help farmers close this gap.
- Since household size and formal education showed no significant effect, interventions should focus more on practical training and financial inclusion rather than relying solely on demographic factors.

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