RESEARCH ARTICLE

International Journal of Agriculture, Environment and Food Sciences 2023; 7(4): 853-863
DOI: https://doi.org/10.31015/jaefs.2023.4.16

Economic efficiency of smallholder okra (*Abelmoschus species*) production in Kaduna State, Nigeria: Implication for poverty alleviation

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Citation: Alabi, O.O., Ihegwuagu, N.E., Isah, H., Abiloro, A.C., Simpa, O.J., Haruna, O.E., Aluwong, J.S. (2023). Economic efficiency of smallholder okra (*Abelmoschus species*) production in Kaduna State, Nigeria: Implication for poverty alleviation. . International Journal of Agriculture, Environment and Food Sciences, 7 (4), 853-863

Received: *August 07, 2023*
Accepted: *October 04, 2023*
Published Online: *December 26, 2023*

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Available online at
https://jaefs.com/
https://dergipark.org.tr/jaefs

Abstract
This study evaluated economic efficiency of smallholder okra (Abelmoschus species) production in Kaduna State, Nigeria: Implication for poverty alleviation. A multi-stage sampling technique was used to select 120 smallholder okra farmers. Primary sources of data were used. Data were analyzed using farm budgetary technique, financial analysis, stochastic production frontier model, allocative efficiency model, economic efficiency model, Tobit dichotomous regression model, and principal component model. The results show that the mean age of smallholder okra farmers was 43 years. Averagely, okra farmers had 1.8 hectares of farm land. The gross margin and net farm income of okra production per hectare was estimated at 619,325.77 Naira and 559, 194.76 Naira respectively. This signifies that the smallholder okra production was profitable. The mean technical, economic, and allocative efficiency scores were 0.7918, 0.5338, and 0.8345 respectively. The socio-economic factors influencing economic efficiency of smallholder okra production include: age (P<0.01), educational level (P< 0.10), marital status (P< 0.01), household size (P <0.01), farm size (P<0.01), and member of cooperative organization (P<0.05). The major constraints encountered by okra producers were lack of farm inputs, lack of credit facilities, and high cost of labour. The study recommended that farmers should be provided with improved variety of seeds, chemicals, credit facilities, and fertilizer inputs in order to increase their productivity and efficiency.

Keywords: Economic Efficiency, Smallholder, Okra Production, Kaduna State, Nigeria

INTRODUCTION

Vegetables are a staple food whose production has increased continually in most countries of the world, including Nigeria. The major vegetables grown in Nigeria include onion, tomato, okra, pepper, *amaranthus*, carrot, and melon etc. They are the most lucrative agricultural enterprises for small and marginal farmers, as it forms the main source of farm income for small and resource-poor farmers (FAO, 2015 and FAO, 2016). There is an increase in demand for the vegetable crop. Okra (*Abelmoschus esculentus* L. Moench) was domesticated in West and Central Africa but is now widely cultivated throughout the tropics, primarily for local consumption (Schipper, 2000). Okra production ranks third in Nigeria after tomato and pepper in terms of consumption and production area. The economic importance of okra cannot be over- emphasized. Its rich source of carbohydrates, proteins, and vitamin C, as well as amino acids in high quantity (Law-Ogbomo *et al.*, 2013; Ijoyah & Dzer, 2012). Hence, it plays a vital role in the human diet (Farinde *et al.*, 2007). In addition, okra has attributes that are used for other purposes and its leaves, buds, and flowers are edible. Also, its seeds, when dried, can be used to produce oil, vegetable curd, and coffee additives or substitutes, among other things (Adeboye *et al.,* 2009). The farming households who are the bedrock of agricultural production are the ones most affected by food insecurity and poverty in Nigeria (Kurwornu *et. al.,* 2013). West Africa Insight (2010) reported that over 53 million Nigerians lived in hunger and they represent about 30% of the country's total population of roughly 150 million. Poverty entails inadequate income and absence of basic necessities such as education, health service, food, clean water and sanitation that are necessary for human survival and dignity (World Bank, 2007b). It denies its victims the most basic needs (food, water, clothing and shelter) for survival. World Bank (2012) viewed a poor person as one who is under-nourished and cannot care for himself. Also, National Bureau of Statistics (NBS, 2012) reported that 60.9% of the population was living in absolute poverty, and about 70% of Nigerians lived below the Poverty line of $1.25/day. This according to World Bank (2007[a]) is the minimum cash and non-cash expenditure needed to be made by a person or household in order to be able to consume the minimum number of calories (food) plus a small number of essential non-food items such as housing, clothing and health care. Food security on the other hand is reported to be a situation where all people, at all times, have access to sufficient, safe and nutritious food to meet dietary needs and food preference for an active and healthy life (FAO, 2007). The bulk of Agricultural production in Nigeria takes place in the rural areas and ironically, the level and incidence of poverty and food insecurity is very pronounced in the areas (NPC, 2004). With the recognition by the Nigerian government of the multi-sectoral and multi-dimensional nature of poverty, which causes hunger, malnutrition, illiteracy, disease, life of misery and squalor, low life expectancy, socio political instability and bribery and corruption, a number of coordinated programs and policies have been formulated to combat poverty in all ramifications. The Federal Government of Nigeria has also taken a number measures to reduce the level or incidence of poverty in Nigeria. Some of these measures and programs include the National Economic Empowerment and Development Strategy (NEEDS) and National Poverty Eradication Program (NAPEP). Increased agricultural efficiency could be achieved by improving input application techniques for a given production technology (Ogundari & Ojo 2007). There are two aspects to efficiency measurement: Firstly, the technical efficiency, and secondly, the allocative efficiency. The technical efficiency defines the capacity of the farmers to engage productive resources to achieve the maximum output obtainable (Ali & Khan 2014). Allocative efficiency defines the farmers' ability to optimize the use of individual inputs – where the ratio of the marginal value product (MVP) equates with the unit price of a particular input (Ogundari 2008). It is explained whether the farmer is involved in wasteful/ inadequate application of resources or not. The product of these two (2) efficiency components defines the economic efficiency. The concepts of both the technical and allocative efficiencies relate with the fact that production variables such as the land, seed, labour and chemicals (fertilizer, herbicides, and insecticides), feed, fingerlings, etc., as well as the soil and edaphic factors alone do not define the levels of output. Certain human factors also have effects on the production level of the farm firm. Given the same level of inputs and environment, a technically more efficient farmer's output is closer to the production frontier than a technically less efficient one. In the same manner, a more allocative efficient farmer combining of resources and minimizes wastage/ under-utilization better and is therefore farther away from the cost frontier than a less allocative efficient one. That is, the closer to the frontier (which has maximum value of 1 in the case of technical efficiency), the better the farmer. On the other hand, the closer a farmer's cost efficiency estimate is to the minimum estimate of one (1), the more efficient he or she is, where allocative efficiency is assumed. Technical and allocative efficiencies are key variables in poverty estimation and consideration since production output closer to the frontier yields more output (and consequently more income). Allocative efficiency leads to minimization of resource wastage and liberates resources for expansion of production base or consumption. The nexus between efficiency levels and income poverty among Okra farmers in Kaduna state, Northwestern Nigeria has not received much attention in the literature.

Objectives of the Study

The broad objective is to evaluate economic efficiency of smallholder okra (*Abelmoschus species*) production in Kaduna State, Nigeria: Implication for poverty alleviation. The specific objectives were to:

(i) determine the socio-economic profiles of smallholder okra farmers,

(ii) analyze the cost, returns and profitability of smallholder okra production,

(iii) determine the technical (TE), economic (EE) and allocative efficiency (AE) scores of smallholder okra production,

(iv) evaluate the socio-economic factors influencing economic efficiency (EE) of smallholder okra

production, and

(v) determine the constraints facing smallholder okra farmers in the study area.

Methodology

This research study was conducted in Kaduna State, Nigeria. The state occupies between Longitudes 06⁰ 15ˡ and 08⁰ 50ˡ East and Latitudes 09⁰ 02ˡ and 09⁰ 02ˡ North of the equator. The State has total land area of 4.5 million hectares. The state vegetation is divided into 2, they are: - the Northern guinea savanna and the Southern guinea savanna. There are 2 seasons in the State, they are: the dry season and the wet seasons, the wet season starts from April to October, and the dry season is between October to March, in between the dry and wet seasons is the brief harmattan period which span from November to February. The mean rainfall stood at 1,482mm, the temperature of the state ranges from 35^{0}C - 36^{0}C, which can be as low as 10^{0}C to 23^{0}C during the harmattan period. The population of the State in 2021 stood at 8.9 million people. They are involved in farming, crops grown include: pepper, okra, maize, sorghum, ginger, rice, yam, millet, cassava, and tomatoes. Animal reared include: goats, cattle, sheep, poultry and rabbit. A multi-stage method of sampling was used. About 120 smallholder okra farmers were selected. Data obtained were of primary sources and were collected using a well-designed and also a well-structured questionnaire. The questionnaire was administered to smallholder okra producers using well trained enumerators.

Research Design

A descriptive and cross-sectional research design was employed with the aim of describing the socio-economic profiles of okra producers, and to evaluate technical (TE), economic (EE), allocative efficiency (AE) scores and socio-economic factors influencing economic efficiency of okra production.

Sampling Techniques and Sample Size

A multi-stage sampling technique was adopted for this study. In the 1st stage, purposive sampling procedure was used to select Kaduna State based of the numerous numbers and concentration of okra producers in the area. The 2nd stage involved random selection of 4 area councils using ballot box method. In the 3rd stage, 3 villages were selected randomly from each local government area based on the intensity of okra producers. In the 4th stage, from sampling frame of 171 okra farmers, proportionate and simple random sampling technique was used to select the desired sample size of 120 okra farmers. This study employed the formula advanced by Yamane (1967) in the determination or estimation of the sample size. The formula is stated thus:

$$n = \frac{N}{1+N(e^2)} = 120 \ldots\ldots\ldots (1)$$

Where,

n = Desired Sample Size

N = Finite Size of the Population

e =Maximum Acceptable Margin of Error as Determined by the Researcher

Methods of Data Collection

The data for this study was collected through the use of a well-designed and well-structured questionnaire. The data collected were cross sectional data from primary source, the data collected from the smallholder okra producers were socio-economic profiles of the farmers, prices of production inputs, quantity of inputs used and constraints faced by farmers in the course of okra production in the study area. Data were analyze using the following descriptive and inferential statistics:

Descriptive Statistics

Data collected from field survey on smallholder okra farmers were summarized through the use of mean, frequency distributions, and percentages. Descriptive statistics was used to summarize the socio-economic profiles of smallholder okra farmers as stated in specific objective one (i)

Farm Budgetary Technique

Gross margin (GM) and net farm income (NFI) analysis of okra production was estimated using the following models:

$$GM = TR - TVC \ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots (2)$$
$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} P_j X_j \ldots\ldots\ldots\ldots\ldots\ldots (3)$$
$$NFI = TR - TC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots. (4)$$
$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \ldots\ldots\ldots. (5)$$

Where;

P_i = Price of Okra ($\frac{₦}{Kg}$),

Q_i = Quantity of Okra (Kg),

P_j = Price of Variable Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Variable Inputs (Units),

TR = Total Revenue obtained from Sales from Okra (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

The farm budgetary technique was used to analyze the profitability of smallholder okra production as specifically stated in objective 2 (ii).

Financial Analysis

According to Alabi *et al*. (2020), gross margin ratio is defined as:

$$Gross\ Margin\ Ratio = \frac{Gross\ Margin}{Total\ Revenue} \ldots\ldots\ldots\ldots. (6)$$

According to Olukosi & Erhabor (2015), operating ratio (OR) is defined as:

$$Operating\ Ratio = \frac{TVC}{GI} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

The financial analysis was used to analyze the profitability of okra production as stated specifically in objective 2 (ii).

Stochastic Production Frontier Model

According to Alabi *et al*. (2022), the stochastic production frontier model is stated as follows:

$$Y_i = f(X_i, \beta_i)e^{v_i - u_i} \ldots\ldots (8)$$

The stochastic production frontier model was used to estimate the technical, economic and allocative efficiency scores as stated specifically in objectives 3 (iii).

Allocative Efficiency Model

Allocative Efficiency (AE) is computed as follows:

$$AE = \frac{1}{CE} \ldots\ldots (9)$$

$$AE = \frac{EE}{TE} \ldots\ldots (10)$$

$$EE = AE \times TE \ldots\ldots (11)$$

Where,

AE=Allocative Efficiency

TE=Technical Efficiency

EE=Economic Efficiency

CE=Cost Efficiency

Tobit Dichotomous Regression Model

The dichotomous response model is defined as follows:

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U_i \ldots\ldots (12)$$

$$Y_i = \begin{cases} 1 \; if \; Y_i^* \geq 1 \\ Y_i^* \; if \; 0 < Y_i^* < 1 \\ 0 \; if \; Y_i^* \leq 0 \end{cases}$$

Y_i^* = Latent or Unobserved Variable

Y_i = Efficiency Score Representing Economic Efficiency (Number)

X_1 = Age (Years),

X_2 = Educational Level (Years),

X_3 = Marital Status (1, Married; 0, Otherwise)

X_4 = Farming Experience (Years)

X_5 = Household Size (Number)

X_6 = Access to Credit Facilities (Naira)

X_7 = Farm Size (Hectares)

X_8 = Member of Cooperatives Organizations (1, Member; 0, Otherwise)

U_i = Error Term,

$\beta_1 - \beta_8$ = Regression Coefficients,

β_0 = Constant Term,

This was used to achieve specifically objective 4 (iv) which is to evaluate socio-economic factors influencing economic efficiency (EE) of smallholder okra production.

Principal Component Analysis

The constraints facing small-scale okra farmers and militating against okra production were subjected to principal component analysis. This was used to achieve specifically objective 5 (v).

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Smallholder Okra Farmers

The results in Table 1 indicate that 36% of Okra farmers were female, while 64% were males. This is an indication that okra farming was a male dominated business. This may not be unconnected with the limited access of women to productive resources in many cultures and traditions. This is in consonance with the findings of Haruna *et al.* (2007). Table 1 also shows that 29% of Okra farmers were single, 10% were divorced, and 61% were married. Simonyan & Omolehin (2012) observed in their study on gender differentials in technical efficiency among maize farmers that marital status had positive coefficient and was significant in influencing the productivity of the male farmers. Table 1 also revealed that 28% of the respondents were between the age ranges of 31 to 40years, 18% were between the age ranges of 41 to 50 years, while 23% were between the age ranges of 51 to 60 years. The mean age okra producer was 43 years, the role of age of farmers is very critical in agricultural production. In their estimation of technical and allocative efficiency analysis of Nigerian rural farmers, Asongwa *et al*. (2011) reported that the age of farmers had a positive effect on technical inefficiency effects. The result further explained that 68% of the okra producers had one form of formal education or the other, while 32% had no formal education. According to Imonikhe (2004), education would significantly enhance farmers" ability to make accurate and meaningful management decisions, it could also enhance the knowledge of improved techniques such as how to read and interpret recommended practices and packages. The result in Table 1 also shows that 58% of the okra producers had households' range of 1-5 persons, 21% of the farmers had household size between the ranges of 6 to10 persons, while 21% of the respondents had household size between the ranges of 11 to15 persons, in addition, the mean household size was 6 persons. The implication of this is that farming households have a good source of family labour for farm business by providing the needed cheap and available manpower all-round the year. Amos (2007) in his study of productivity and technical efficiency of smallholder cocoa farmers in Nigeria reported that family size was a significant variable which greatly influence the technical efficiency of farmers. The result further indicates that 57% of the okra producers had extension contacts, while 43% of the respondents had no extension contacts. According to Umar *et al.* (2007), higher extensions contact was reported to increase the adoption of improved farm production technologies. They further observed that the frequency of extension contact is very essential as it guides the farmers from awareness to the adoption stage. The result in Table 1further shows that 27% of the respondents had farming experience of 1-5 Years, 23% had farming experience of 6-10 years, 33% had 11-15 years' experience, while16% had 16-20 years farming experience. Adebayo (2006) in the study of resource use efficiency of pastoralists in Adamawa state observed that the longer a person stays on a particular job, the better the job performance tends to be. The result also indicates that 67% of the respondents were members of cooperative organizations, while 33% of the respondents were not members of cooperative organizations. The membership of a cooperative organization enables farmers to interact with one another, share their experiences and assist themselves in bulk purchase of inputs. Similarly, Gashaw *et al.* (2013) and Folorunso & Bayo (2020) reported that membership of cooperatives enhances efficiency by easing access to productive inputs and facilitating extension linkage compared to those who were not members. Also, the result in Table 1 shows that 56% of the respondents had farm size range of 1.1 – 2.0 ha, 28% had farm size range of 2.1-3.0 ha and 17% of the respondents had farm size range of 3.1 – 4.0 ha. Based on Olayide (1980) classification of farms; 0.1 - 5.0 hectares (small-scale); 5.1 - 10 hectares (medium-scale); and 10 hectares and above (large-scale). Since the majority of respondents had farm holdings between 0.1 and 5.0 hectares, it means that they are smallholder, smallscale farmers. This is consistent with the findings of Onuche & Oladipo (2020) whose findings revealed the bulk of the farm households that majority of the respondents operated on farmland sizes between 1–2 ha suggesting the smallholder nature of agriculture in the area.

Profitability of Okra Production of Smallholder Farmers

The result in Table 2 shows the profitability analysis of okra production. The result indicates that the total cost of production (TCP) incurred per hectare was ₦145,674.25. The variable cost includes: cost of seeds (₦5,674.56) representing 3.8% of the TCP, fertilizer input (₦24,783.45) representing 17.9% of the TCP, insecticides(₦10,567.00) representing 7.2% of the TCP, herbicides (₦15,675.87) representing 10.8% of the TCP and labour costs(₦68,842.36) (land clearing and preparation, planting, weeding, fertilizer application, chemicals application, harvesting, transportation, and loading and offloading) representing 47.3% of the total cost of production. Table 2 also indicated that the total revenue (TR) generated per hectare was ₦765,000. The result also indicated that the total variable cost (TVC) was ₦125,543.24 per hectare representing 86.2% of the TCP. Finally, the budgetary analysis per hectare indicated that okra farming was profitable as shown by gross margin (₦145,674.25) per ha and NFI of (₦550,194.76) per ha. The GMR and OR were 0.81 and 0.16 respectively, indicating that the 81% of the gross revenue accruing to okra production constituted the GM, while 16% of the gross income was committed to the TVC of okra production. The operating ratio was less than unity, lower OR was preferable. This report is similar to the findings of Busari & Okanlawon (2015) and Folorunso *et al.* (2023). The implication of this on the poverty status of okra farmers is that increased and sustained profitability of this enterprise will enable farming households have economic access to basic amenities and thereby aid in poverty alleviation.

Farm Level Technical, Allocative and Economic Efficiency of Smallholder Okra farmers

The frequency distribution of the allocative efficiency (AE), technical efficiency (TE), and economic efficiency (EE) estimates of smallholder okra farmers as obtained from the stochastic frontier analysis is presented in Table 3. The frequencies of occurrences of the predicted TE, AE and EE in decile range indicate that the highest number of okra farmers had TE, AE and EE between 0.81 – 1.00. The sample frequency distribution indicates a clustering of TE, AE and EE in the region of 0.81 – 1.00 efficiency ranges, representing 48.3%, 66.7% and 31.7% respectively. The implication of this is that the farmers were technical inefficiency, allocative efficient and inefficient economically. That is, the farmers were inefficient in deriving maximum output from input, given the available resources. The minimum TE, AE and EE of the okra farmers as found in Table 3 are 0.0265, 0.01583 and 0.08401 respectively, while the maximum TE, AE and EE of the respondents are 0.98912, 1.00 and 0.9563 respectively. This means that on the minimum, smallholder okra farmers were 8% economically efficient, while on the maximum, the okra farmers were 96% economically efficient. The result of the Cobb-Douglas production frontier further indicate that technical efficiency varied widely among the sampled okra farmers, with minimum and maximum values of 0.01583 and 0.98912 respectively. The wide variations in technical efficiency estimates is an indication that most of the okra farmers were still using their resources inefficiently in the production process and there still exists wide opportunities for improving on their current level of TE. This result suggests that the farmers were not utilizing their production resources efficiently, indicating that they were not obtaining maximum output from their given quantities of inputs. On the other hand, the predicted allocative efficiency varied widely among the sampled farmers, with minimum and maximum values of 0.0265 and 1.00 respectively. The wide variations in allocative efficiency estimates is an indication that most of the farmers still allocate their resources inefficiently in the production process and there

Table 1. Socio-Economic Profiles of Smallholder Okra Producers

Variables	Frequency	Percentage	Mean
Gender			
Male	77	64.2	
Female	43	35.8	
Marital Status			
Single	35	29.2	
Divorced	12	10.0	
Married	73	60.8	
Age (Years)			**43**
31 – 40	33	27.5	
41 – 50	22	18.3	
51 – 60	27	22.5	
Level of Education			
Non-Formal	38	31.7	
Tertiary	40	33.3	
Secondary	20	16.7	
Primary	22	18.3	
Household Size (Units)			**6**
1 – 5	70	58.3	
6 – 10	25	20.8	
11 – 15	25	20.9	
Extension Contact			
Yes	69	57.5	
No	51	42.5	
Farming Experience (Years)			
1 – 5	32	26.7	
6 – 10	28	23.3	
11 – 15	40	33.3	
16 – 20	20	16.7	
Memberships of Cooperative			
Yes	80	66.7	
No	40	33.3	
Farm Size (Hectares)			**1.8**
Less than 1.0	67	55.8	
1.1 - 2.0	33	27.5	
2.1 – 3.0	20	16.7	
3.1 – 4.0			
Total	**120**	**100.00**	

Source: Field Survey (2022)

still exists opportunities for improving on their current level of allocative efficiency. This result suggests that the farmers were not minimizing production costs, thus indicating that they were utilized the inputs in the wrong proportions, given the input prices. Also, the EE varied widely among the sampled farmers, with minimum and maximum values of 0.008401 and 0.9563 respectively. This wide variation in EE estimates is an indication that most of okra farmers were still economically inefficient in the use of resources for production and there still exists opportunities for improving on their current level of EE. This result further suggests that the farmers were not maximizing profit. The implication of this findings is that the more economically inefficient the okra farmers, the more the likelihood of the increased poverty status of the farmers. This is consistent with the findings of Onuche & Oladipo (2020) and Asogwa *et al.* (2011) who in their findings concluded that TE, AE and EE of small-scale farmers in Nigeria varied widely between minimum and maximum values and was an indication of their inefficiencies. Furthermore, the study revealed that for the minimum TE, AE and EE Okra farmers to become the most TE, AE and EE, they will need to realize about 98% output level closer to the production frontier (i.e. his or her output is closer to the maximum output obtainable from resources combined), 97% minimum wastage/underutilization of resources to be closer to the frontier, and 92% output and minimization of resource wastage/underutilization of resources in okra production to be able to achieve EE in okra production.

Relationship between Economic Efficiency and Farmers' Socio-Economic Factors

The relationship between EE and farmers' socio-economic factors was determined using Tobit dichotomous regression model, the result is shown in Table 4. The likelihood function was positive (6713.0616), while Chi-squared value (14029.12) is positive and significant at

Table 2. Profitability Analysis of Smallholder Okra Production per Hectare

Items	Amount (Naira)	% of Total Cost
Total Revenue	**765,000**	
Gross Income		
Variable Cost		
Seeds	5,674.56	3.8
Fertilizer Input	24,783.45	17.9
Insecticides	10,567.00	7.2
Herbicides	15,675.87	10.8
Labour Cost:		
(i) Land Clearing and Preparation	12,456.98	
(ii) Planting	7,765.90	
(iii) Weeding	13,674.76	
(iv) Fertilizer Application	8,574.65	
(v) Chemical Application	5000.00	
(vi) Harvesting	14,567.23	
(vii) Transportation	4,567.34	
(viii) Loading and Offloading	2235.50	
Total Labour Cost	**68,842.36**	**47.3**
Total Variable Cost	**125,543.24**	**86.2**
Fixed Cost		
Estimated Depreciation Value on Tools (Hoes, Machetes)	2,785.34	1.9
Rent on Land	17,34**5.67**	**11.9**
Total Fixed Cost	**20,131.01**	13.8
Total Cost	**145,674.25**	
Gross Margin (GM)	**619,325.77**	
Gross Margin Ratio (GMR)	**0.81**	
Net Farm Income (NFI)	**559,194.76**	
Operating Ratio (OR)	0.16	

Source: Field Survey (2022)

Table 3. Summary Statistics of Technical, Economic and Allocative Efficiency Scores

	Allocative Efficiency		Economic Efficiency		Technical Efficiency	
Efficiency Score	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
0.00 – 0.20	5	4.2	21	17.5	7	5.8
0.21 – 0.40	12	10.0	25	20.8	16	13.3
0.41 – 0.60	18	15.6	19	15.8	22	18.3
0.61 – 0.80	5	4.2	17	14.2	17	14.2
0.81 – 1.00	80	66.7	38	31.7	58	48.3
Mean	0.7918		0.53388		0.83450	
Standard Deviation	28355		0.30451		0.26183	
Minimum	0.0265		0.08401		0.01583	
Maximum	1.00		0.9563		0.98912	

Source: Field Survey (2022)

1% probability level, the pseudo R^2 is 66% implying an absolute relationship between the explanatory variables and EE and this signifies that 66% of the variations in the predictor variables was explained by the model. From the Table 4, variables; age of household, educational level, farming experience, marital status, household size, farm size and membership of cooperative organizations were statistically significant and would increase the likelihood of household being economically efficient in okra production.

Age

The age of the farming households was found to have a positive coefficient (22.16075) and significant at 1% level of probability and consistent with apriori expectation. This implies that an increase in age of respondents would increase the probability of an increase in EE by 22%. It is well-known that in general, the older the farmers the more the experience they have in the production process. This finding is consistent with Kolawole & Ojo (2007) who in their study of small-scale oat growers in Nigeria found age to be positively related to inefficiency.

Educational Level

The coefficient (0.5308782) of this variable was found to be positive and significant at 1% level and is consistent with apriori expectation. This means that an increase in educational status will increase the probability of EE by 53%. Education enhances the acquisition and utilization of new technologies by farmers Dey *et al.* (2001); Nwaru (2004); Effiong (2005); Onyenweaku *et al.* (2005). This implies that the greater number of years' people spent in school, the more likely will be the increase in their ability to produce to maximize their profit.

Marital Status

The coefficient of this variable was found to be positive (0.2466856) and significant at 1% level of probability. This means that marital status is an important variable in the probability of the farmers being able to maximize their profit. A change in marital status of the respondents will increase the probability of the respondents being able to maximize profit by 24%.

Farming Experience

The farming experience of okra farming households was found to have a positive coefficient (0.511709) and significant at 10% probability level. The sign of the variable is consistent with the apriori expectation. This means that an increase in the farming experience of okra farmers will result likelihood increase in the probability of profit maximization. This finding is in consistent with that of Onu *et al.* (2000) whose result showed a negative relationship farming experience and TE in cotton production in Nigeria.

Household Size

The coefficient of household size (32.08233) was found to be positive as expected and significant at 1% probability level. Household size determines the availability of family labour or large household size demands large amount of production to feed its members, that is as household size increases the demand for food increases. Increased in family size necessitates increase in household expenditures on food and other necessities/utilities which ultimately increase food insecurity. This implies that farming households have a good source of family labour for the farm business. This is a positive indication that there would be more availability of family labour for farm work. In his study of productivity and TE of smallholder cocoa farmers in Nigeria, Amos (2007) found that family size was a significant variable which greatly influenced the TE of farmers.

Farm Size

Small farm size is an impediment to agricultural mechanization because using farm machineries like tractors to control weeds will be difficult. The size of farm cultivated by farmers is a function of population pressure, family size, labour productivity, financial background and experience of the farmers (Imonikhe, 2004). The coefficient of farm size (0.3245578) was found to be positive as expected and significant at 1% level of probability. Farm size determines the availability of supply to the markets. Therefore, increase in farm size will increase the probability of an increase EE of okra production.

Membership of Cooperative Organization

The coefficient of membership of cooperative organization (0.443748) was found to be positive and significant at 5% level of probability. This means that cooperative membership is positively related with level of respondents' EE of okra production. This implies as okra farmers becomes member of cooperative memberships will lead to probably of an increase in the respondents' EE in okra production. Cooperatives provides a cheap and an alternative means of raising the required capital for farm operation and expansion, which will have a positive impact on the EE of the respondents. Memberships of cooperative organization increases the chances of low interest credit and bulk purchase of inputs as well as training which reduce the cost of production and hence increase EE of the okra farmers (Gashaw *et al.,* 2013).

Table 4. Maximum Likelihood Results of the Tobit Dichotomous Regression Model

Variables	Parameters	Coefficient	Standard Error	t-Value
Constant	β_0	6.651348***	1.733975	3.84
Age	β_1	22.16075***	6.972824	3.18
Educational Level	β_2	0.5308782*	0.2988978	1.78
Marital Status	β_3	0.2466856***	0.0354053	6.97
Farming Experience	β_4	0.511709*	0.2998081	1.71
Household Size	β_5	32.08233***	9.071002	3.54
Access to Credit Facilities	β_6	0.012775	0.018464	0.69
Farm Size	β_7	0.3245578***	0.033339	9.74
Member of Cooperative Organization	β_8	0.443748**	0.185651	2.39
Sigma	4.24e-15			
LR Chi^2	14029.12			
Pseudo R^2	0.6572			
Log Likelihood	6713.0616			

Source: Data Analysis (2022) *Significant at (P<0.10)., **Significant at (P<0.05), ***Significant at (P<0.01).

Table 5. Principal Component Model of Constraints Encountered by Okra Producers

Constraints	Eigen-Value	Difference	Proportion	Cumulative
Lack of Farm Input	4.02962	2.09571	0.3100	0.3100
Lack of Credit Facilities	1.93391	.480707	0.1488	0.4587
High Cost of Labour	1.4532	.297931	0.1118	0.5705
Lack of Extension Agents	1.15527	.143099	0.0889	0.6594
Bad Road Infrastructures	1.01217	.270745	0.0779	0.7372
Pest and Disease Infestations	1.00142	.0565095	0.0570	0.7943
Lack of Chemicals	1.00119	.0982798	0.0527	0.8470
Lack of Fertilizers	1.00063	.153186	0.0451	0.8921
Bartlett Test of Sphericity				
Chi Square	234.56			
KMO	0.87			
Rho	1.0000			

Source: Field Survey (2022)

Principal Component Analysis of Constraints Facing Smallholder Okra Farmers

Table 5 shows the results of the constraints faced by smallholder okra farmers, PCA is a statistical package that transform interrelated data with many variables into few numbers of uncorrelated variables. From the result the number of principal components retained using the Kaiser Meyer criterion are eight (8) based on the Eigen value greater than 1. The retained components explained 89.21% of the variations of the component included in the model. The Kaiser-Meyer- Olkin measures of sampling adequacy (KMO) of 0.87 and Bartlett test of sphericity of 234.56 was significant at 1 % level of probability and demonstrated the feasibility of using the data set for principal component analysis. Lack of farm inputs had an Eigen value of 4.02962 and it was ranked 1st in the order of importance based on perceptions of the smallholder okra farmers. Lack of credit facilities and high cost of labour with Eigen values of 1.93391 and 1.4532 respectively were ranked 2nd and 3rd respectively in the order of occurrence based on the perceptions of the smallholder okra farmers as the major constraints facing okra production. Lack of extension agent, bad road infrastructures and pest and disease infestations with Eigen values of 1.15527, 1.01217 and 1.00142 were ranked 4th, 5th and 6th respectively in order of their occurrence and importance respectively based on the perceptions of smallholder okra farmers.

Conclusion and Recommendations

Based on these findings, it is concluded that okra production was profitable going the both profitability and financial indices. Similarly, the wide variations in the minimum and maximum values of technical, allocative and economic efficiencies were indicative of the inefficiencies of okra farmers, while lack of farm inputs, credit facilities, high cost of labour, lack of extension agents, bad road infrastructure, pests and disease infestations, lack of chemicals and lack of fertilizers were the identified constraints to okra production. It is therefore recommended that: - [1] Farmers should increase their farm size in order to increase their profitability, [2] Farmers should be educated through extension agencies in order to improve their technical, allocative and economic efficiencies for optimum profitability, and [3] Farm inputs like improved seeds, fertilizer input, tractors, chemicals, credit facilities should be made available to okra farmers to increase productivity and efficiency.

COMPLIANCE WITH ETHICAL STANDARDS

Peer Reviewed

Externally Reviewed

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Ethics committee approval is not required.

Funding

No financial support was received for this study.

Data availability

Not applicable.

Consent for publication

Not applicable.

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