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Allocative Efficiency in Okra (*Abelmoschus spp*) Production in Ayamelum Local Government Area of Anambra State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author SIU designed the study, wrote the protocol and wrote the first draft of the manuscript. Author JCN managed the literature searches, analyses of the study performed the spectroscopy analysis and author SOU managed the experimental process and author EOI identified the species of plant. All authors read and approved the final manuscript.

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ABSTRACT

Okro is a very important vegetable fruit and is cultivated by small scale farmers in the South East and South West of Nigeria. Poor yield has characterized its production in recent times and this is evidenced by poverty that typifies the okra farmers. Studies attributed this scenario to poor resource use by the okra farmers. It is this problem that this study tends to address. 120 farmers were selected from the study area using multi stage random sampling technique. Data used were generated through structured questionnaire and interview schedule from the respondents. Net farm income analysis and ordinary least squares regression method were used to analyse the objectives of the study. Result shows that okra production in the study area was profitable with positive net farm income of ₦482,100. Result of the resource efficiency showed that farmers did not achieve optimum allocative efficiency in the use of the any of the resources such as fertilizer, seeds, and pesticides. The result of the elasticity of production revealed that the farmers were operating at increasing returns to scale. The study recommended on the need for policy options that would enable farmers to employ more of the resources that were underutilized, while for over utilized resources, farmers should use less of the resource in their productions in order to achieve higher productivity.

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1. INTRODUCTION

Food insecurity, hunger and unemployment are cardinal issues of the millennium development goal of many developing and as well occupied centre stage for debate in several world conferences and summits [1]. Among the staple food that is deficit but the most affordable and accessible source of micronutrient especially in Nigeria and other developing countries of Africa where the daily diet is dominated by starchy food is vegetable [2]. Among the important indigenous vegetables that are grown in Nigeria, okra is widely cultivated and consumed in northern and western Nigeria [3]. Okra is of the genus; *Abelmoschus*, family; *Maluaceae* and is widely distributed in the tropics, subtropics, and warmer portions of the temperate region [4].

Okra is used for human consumption (in different forms, boiled, fried or cooked), preparation of vegetable curds, coffee additives, and confectionary. Okro production offers income and employment opportunities to the poor, especially women who form a substantial producer [5,3].

Several studies have shown that the production and productivity of okra in Nigeria is dwindling in recent year as yield less than 1.8 tons per hectare, thus limiting the ability of the crop to perform its' traditional role in economic development [6,7,8]. The productivity of okra can be increased through application or adoption of new technologies or efficient utilization of existing resource. Nevertheless, reports on adoption of technology by farmers in developing countries are not impressive, hence improving their productivities entail efficiency in resource use [7]. Allocative efficiency is the manipulation of available scarce resources and technical know how to achieve the highest possible economic benefits within given resources where its marginal value product is equated to its unit price [6]. This study examined the profitability of Okro production, estimated and analysed the production function for efficiency, elasticity of production and return to scale and constraints to Okro production in the study area.

2. MATERIALS AND METHODS

The study was conducted in Ayamelum Local Government Area of Anambra State. Ayamelum L.G.A is made up of 6 towns (namely; Anaku, Omo, Ifite Ogwari, Igbankwu, Umumbo, and Omasi) and many villages. The choice of the Local Government Area is borne out of high production of okro especially dry season okro in the study area [9]. It has a land mass of 428 square kilometers and population of 22,860 people [10]. Ayamelum L.G.A lies approximately between latitude 5°36′ and 6°18′ North of equator and longitude 7°24′ and 8°27′ East of Greenwich meridian. It shared common boundaries to the North with Uzo-Uwani Local Government Area in Enugu State and in the South by Anambra East, in the West and South by Ezeagu Local Government Area in Enugu State and Igbola Local Government Area of Benue State respectively. The Local Government Area has favourable warm climate for the growth of both cash (Palm tree, Kola nut and Cocoa), food crops (Okra, yam, cassava and Melon) and rearing of animals (Goat, Sheep, Rabbit and Pigs).

Multi – Stage random sampling technique was used to select towns, villages and respondents. Firstly, four towns were randomly selected out of five (5). In the second stage, five villages out of eight villages were randomly selected from each of the towns. This brings to a total of 20 villages. Thirdly, six farmers were randomly selected from each village. This gave a total of one hundred and twenty (120) farmers for detailed study.

Structured questionnaire was used to obtain primary data, while Secondary data was through internets, Journals and other periodicals in writing the literatures of the work. The profitability of okro production was captured using net farm analysis.

$$\text{Gross margin=} \quad (\text{G.M.}) = \text{TR} - \text{TVC} \qquad (1)$$

$$\text{i.e. G.M} = \sum_{1-1}^{n} P_1 Q_1 - \sum_{j-i}^{m} r_i x_i \qquad (2)$$

The Net farm income can be calculated by gross margin less fixed input. The net farm income can be expressed as thus:

$$\text{NFI} = \sum_{1-1}^{n} P_1 Q_1 - \left[\left(\sum_{j-i}^{m} r_i x_i \right) + k \right] \qquad (3)$$

Where: GM = Gross margin (₦), NFI = Net farm income (₦), P1 = Market (unit) price of output (₦), Q = Quantity of output (kg), ri = Unit price of

the variable input (kg), xi = quantity of the variable input (kg), K = Annual fixed cost (depreciation) (₦), i = 1 2 3 …….. n, j = 1 2 3

The b' co efficient of the allocative efficiency is determined using multiple regressions analysis. The multiple regression function is explicitly stated as

$$Y = b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+\ldots. +bnxn+e \quad (4)$$

Where Y = Yield of the 1st farm in kg, X_1 = Farm size (ha), X_2 = Quantity of fertilizer (kg), X_3 = Quantity of seed (kg), X_4 = Labour and X_5 = Capital input (₦).The four functional forms of equation (1) were tried and the best fit chosen as lead equation. The estimated coefficient of the inputs of the lead equation form the basis for the analysis of farmers allocative efficiency.

Allocative efficiency is determined by equating the marginal value product of a resource to its unit price. That is;

$$MVpi = p_y f_i = Px_i \quad (5)$$

MVP = Marginal value product of $_i^{th}$ resource, P_y= price of unit of output

$F_i = \frac{d_y}{dx_i}$ is the marginal physical production of $_i^{th}$ resource, Px_i=is the unit of the $_i^{th}$ resource

Px_i =is the unit price of $_i^{th}$ resource. The allocative index for each resource is derived as follows;

$$k_i = MVP/P_i = P_y f_i/P_i \quad (6)$$

where k_i =allocative efficiency index and other terms were previously defined.

If r = 1, it implies that resources are efficiently utilized i.e. MVP = MFC = 1
r > 1, implied that resources are underutilized, r < 1, implied that resources are over utilized (10).

3. RESULTS AND DISCUSSION

Results in Table 1 shows that the cost and return of rice production based on 2013 market prices of inputs and outputs. The analysis revealed that cost of labour (37.6%) constituted the highest share of the total cost of production. Mwanth [4] reported that with urban drift of youths, aging of farming population, increase in population and feminization of agriculture have made labour inelastic and thus remain expensive. This followed by cost of fertilizer, which constituted about 16.7% of the total cost. Fertilizer according to Daramola [11], Ashraf [12] was among major factors limiting productivity growth of agriculture in Sub-Saharan Africa. Its effect on crop yield is positive and immediate; hence, the most readily adopted technology.

The least (3.4%) was cost of planting material. The average cost of production was ₦ 117900 with net farm income of ₦ 482100. This implies that rice production is profitable in the study area. The return per investment was 1: 4.09, which means that in every ₦1 invested in paddy production, ₦ 4.09 would be realised. Cobb Douglas (Double log) formed the lead equation based on econometric and statistical criteria and used to compute the allocative efficiency indices bi-coefficient as presented in Table 2 The coefficient of the multiple determination of the cobb Douglas was 0.784, which implies that 78.4% by the variation of okra output was accounted for by the included independent variable and the remaining 21.6% were due to error term. The coefficients of intercepts, capital and labour were statically significant and positively related to okro output. These implied that increase in labour and capital would lead to increase in okra production *ceteris paribus.* This assertion is in line with the finding of Daramola [11].

The allocative index was presented in Table 3. The allocative index of all the resources considered with exception of fertilizer were greater than I (K,>I), indicating under- utilization of these resource. These implied that less than profit maximization levels of these inputs were used. Therefore, for profit to be optimized in okra production in the study area, these resource, farm size, planting material (seed), and capital which were under- utilized should be increased by 18.26%, 76.4%, 98.46% and 95.74% respectively from their current level of use. Furthermore, fertilizer, (-9.78), which was over utilized should be reduced by 99.1% from its current level of use for profit to be optimized in okra production in the study area.

Elasticity of Production and Return to Scale is presented in Table 4. The elasticity of production indicates the change in output relative to unit change in input [13]. The elasticity of production is derived directly from Cobb Douglass production function coefficients. The return to

scale was derived by summing up the elasticity of production (EP) for each resource. The return to scale for okra production (5.001) was greater than 1 (EP>1). This indicates that the farmers were operating at increasing returns to scale. The farmers are operating at region I of the production process, which is irrational stage. The implication was that when all the factor input are varied by 1%, the responsiveness of okra output to such input variation will be 5.001. Therefore, this implied that okra farmers in the study area can improve on their production by engaging all the inputs considered with exception of fertilizer.

The Table 5 showed that land problem (18%) was the major constraint to okra farmers in the study area. This could be due to land fragmentation caused by land tenure system and government taking over of land particularly farming land for other developmental projects which are prevalent in the study area [14]. The problem of Unavailability of labour was encountered by 17% of okra farmers interviewed in the study area. This is as a result of urban drift of energetic and able bodied youths in search of white collar Job, thereby leaving farming to aged men, women and their children. This in turn results in low output as few land areas are cultivated. The finding of Ibeawuchi et al. [15] is in line with this thought. Poor soil fertility, (10%) was reported as a problem to okra production. This is caused by the action of soil erosion and poor farming practices that are prevalent in the study area resulting in poor crop yield [11].

Pest and diseases constraints were complained by 10% of the total respondents. This resulted to substantial losses in the yield of okra, especially dry season ones [3]. Furthermore, 8% of the respondents reported high cost of pesticides as constraint to okra, production. This problem is complicated by unavailability of the resource at the right time and coupled with problem of adulteration [16,17].

Table 1. Costs and return analysis in Okro production

	Unit	Quantity	Cost\unit	Total revenue	Percentage
Revenue	Naira	6000	100	600,000	
Planting Material	kg	50	100	5000	3.4
Fertilizer	kg	200	6000	24,000	16.7
Labour	md			**116,900**	**37.6**
Miscellaneous	**Naira**			**32000**	**21.5**
Total variable cost (TVC)				116900	
Gross margin				483,200	
Total fixed cost				117,900	
Net farm income				482100	
Benefit cost ratio				4.09	

Source: Field Survey, 2015; Md = manday, kg = kilogram

Table 2. Determination of the resource use efficiency of Okra farmers in Ayamelum local Government area

Variable	Linear	Exponential	Double log^{+}	Semi-log
Intercept	8.538	10.171	2398.975	-516.377
	(9.413)**	(9.074)***	(7.389)***	(-8.063)***
Farm size	-2.062	-1.222	-0.324	931.726
	(-2.507)**	(-3.117)***	(-2.455)**	(0.801)**
Planting	0.300	0.298	0.281	273.979
Material	(0.830)	(1.919)	(-2.464)	(2.720)
Fertilizer	-0.342	-0.012	-1.270	-1416.897
	(-0.867)	(-0.513)	(-1.882)	(-1.061)
Labour	0.620	0.039	0.498	1033.797
	(1.010)	(1.165)	(3.712)***	(6.646)**
Capital	0.168	0.048	2.877	4454.700
	(0.135)	(1.390)	(3.579)***	(3.061)
R^2	0.5021	0.409	0.784	0.468
F-value	2.653**	2.364**	4.172***	7.096**

Source: Field Survey, 2015

, and*** significant at 10%, 5% and 1% respectively, figures in parentheses are the t-ratios*

Table 3. Distribution of resource use efficiency indices of Okra farmer

Variable	Y	X	β_i	Mpp	MVP	MFC	R	Di
Farm Size	4000	780	-0.324	8.52	8.520	1000	8.52	88.26
Planting material	4000	320	0.281	3.51	421.2	100	4.21	76.24
Fertilizer	4000	420	1.027	-9.7809	-1173.10	120	-9.78	99.10
Labour	4000	380	0.498	55.17	66204	1000	66.20	98.48
Capital	4000	460	2.871	24.96	7987.2	340	23.49	95.74

Source: Field Survey, 2015

Table 4. Elasticity of production and return to scale

Variables	Elasticity of production(EP)
Farm size	0.324
Planting materials	0.281
Fertilizer	-1.027
Labour	0.498
Capital	2.871
Return to scale	2.001

Source: Field Survey, 2015

Table 5. Distribution of farmer according to constraints to Okro production

Constraints	Frequency	Percentage
Land problem	22	18
Unavailable of labour	20	17
Poor soil fertility	12	10
Pest and disease attack	10	8
High cost of pesticides	8	7
Distance from market	14	12
Poor access to credit	10	8
Poor storage facilities	4	3
Theft	12	10
Lack of extension contact	8	7
Total	120	100

Source: Field survey; 2015

The table also showed that poor access to credit (8%) was one of the constraints to okra production in the study area. This finding agrees with Ume et al. [14], who posited that farmers had poor access to credit as a result of high bank lending interest rates and also location of most banks in urban areas which is far away from farmers' reach.

Furthermore, poor storage facilities was complained by 3% of the farmers studied. This results in farmers' selling their produce immediately after harvest at giveaway price, (low selling price) in order to avoid possible spoilage [18].

4. CONCLUSION AND RECOMMENDATIONS

The major conclusions drawn from this study were that; okro farming was profitable in the study area with an average revenue of ₦600,000 and total cost of production of N117,900 per hectare. Furthermore, okro farmers were not allocatively efficient in the use of their farm resources. Most of the farmers' resources considered were underutilized with exception of fertilizer that was over utilized, which implies that they operated in region 1 of production process. The major constraints to okra production in the study area were; land problem, unavailability of labour, poor soil fertility and pest and diseases attack.

Based on the results, the following recommendations were made;

i. There is need for policy options to increase farmers' access to improved production inputs such as fertilizer, seed, credit and pesticides at lower cost and at right time for the farmers to achieve high production.

ii. Farmers' access to land should be enhanced through enforcing land use decrees act of 1978.
iii. To achieve optimum allocative efficiency and hence maximum profit in okro production in the study area, farmers should be encouraged to maximise the use of underutilized resource and minimize the use of over utilized resource in order to improve the farmers' productivity and income in the study area. This can be achieved through appropriate policy options that would encourage the reallocation and redistribution of these inputs.
iv. Efficient marketing mechanism for okro should be encouraged through having organized markets.
v. Labour saving device such as hand driving plough should be made available and distributed to the farmers at subsidized cost.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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