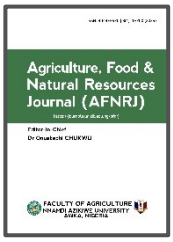
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Original Article

Assessment of allocative efficiency of resources for yam production in Afikpo North, Nigeria

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ABSTRACT

This study assessed the allocative efficiency of resources used in yam production in the Afikpo North Local Government Area of Ebonyi State for sustainable management. A multistage random sampling technique was used to select 90 yam farmers. Descriptive statistics, regression, and gross margin were used for the analysis. The result showed that 88.8% were within the age range of 30-49 years, as 56.7% were males, while 51.1% were married, 55.5% of the yam farmers had above 16 years of experience, and 55.6% perceived that hiring of labour is their major source with a farm size of 1.5-1.8 ha, as perceived by 53.3% of the yam farmers. The result further showed that the Cob-Douglas functional form gave the best fit, and the value of the coefficient of multiple determination (R^2) was 0.5768, which implied that 57.68% of the variations in the profitability of yam production were accounted for by the explanatory variables, such as fertilizer, insecticide, herbicide, mini-sett, hired labour, family labour and farm size, which were estimated. The result of estimated allocative efficiency levels of the inputs used showed that fertilizer, insecticide, mini-sett, hired labour, family labour and farm size were all overutilized, indicating inefficiency in resource use. Also, 88.9% of the respondents indicated that lack of capital was the major challenge they face, while 83.3% of the respondents perceived lack of improved varieties as a constraint. The findings recommended that affordable labour-saving farm tools to reduce production costs should be developed and distributed and provide farmers with affordable credit at low interest rates and flexible collateral requirements.

KEYWORDS: *Ebonyi State, Input Levels, Homestead, Sustainable, Yam farmers*

INTRODUCTION

Global demand for yam (*Dioscorea spp.*) has been growing significantly between 2004 and 2023 because of its appeal as a food security crop for growing populations in emerging markets, and the growing demand for industrially processed products (Anyaegbunam, *et al*., 2024). Africa produces over 95% of the world's yams with Nigeria alone accounting for about 67-70% of global production, despite high production Africa's share of global yam exports is very small, less than 1% of total production is exported outside the continent, most yam is consumed locally or traded regionally in West Africa (FAOSTAT,2022). Yam is a source of livelihood for at least 300 million people. Virtually all the yams (90%) produced in Africa are used as a staple food for human consumption, providing calories for – 500 million people and constituting 37% of the population's dietary energy requirements. However, in several African countries, yam is perceived, not only as a food security crop, but also as raw material for various types of industries. In some countries, there are concerted efforts being initiated, sometimes with strong political support at the highest level to make yam an engine of economic growth. (Anyaegbunam, *et al*., 2024). The huge and untapped market opportunities of yam in Africa can be effectively exploited for transforming Africa's agriculture. The challenge today is to increase productivity, marketing opportunities and profitability through effective and efficient yam value chain development. yam can be converted into a large number of products ranging

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from traditional and novel food products, livestock feeds, flour, starch and numerous other derivatives. Yam can also provide locally produced products to substitute for imported commodities to reduce food imports, to improve foreign exchange balances and to provide local earning potential within Africa. Farmers engage in yam cultivation for household food supply, income generation through marketing ware yams; and production of planting material to meet their own needs and generate some income from the sale of surplus seed yams. Yam is one of the major staple food crops grown generally in Nigeria and specifically in Afikpo North Local Government Area of Ebonyi State. The common species grown in Afikpo North Local Government Area in Ebonyi State, Nigeria; are *Dioscorea rotundata* (white yam) and *Dioscorea alata* (water yam) and popularly stored in barns and storage losses recorded ranges between 40-50 percent; (Coursey 2009).

MATERIALS AND METHOD

Study Area

The study was conducted in Afikpo North Local Government Area of Ebonyi State because of its dominance in Yam production. The Local Government Area is located in the Northern part of the State. It is bounded by Onicha LGA located in the Northern east part, it is bounded in the South by Ezzah North, it is also bounded in the South West by Afikpo South LGA and Cross River State. The population of the Local Government Area is 156,611 people (NPC, 2006). The people of the area are predominantly farmers while yam, cassava and rice are the major farm produce of the area. The Afikpo North Local Government Area occupies a land mass of 240 square kilometers and lies within Latitudes 5°53' and 6°12' North of the Equator and Longitudes 7°56' and 8°2' East of the Greenwich Meridian. Afikpo North is a hilly area despite occupying a region low in altitude, which rises 350 feet above sea level. It is a transitional area between open grass land and tropical forest and has an average annual rainfall of seventy-seven inches (198cm).

Sample Size and Data Analysis

A multi-stage random sampling technique was adopted for this study. Three stages were involved; First stage: From the seven autonomous communities in Afikpo North LGA which include: Itim Ukwu, Nkpogoro, Ohaisu, Ugwuegu/Amaizu, Ozizza, Amasiri and Uwannah, three (3) autonomous communities were selected by random process which included: Oziza, Amasiri and Uwannah. Second stage: Six (6) villages were selected by random process from each of the selected autonomous communities to make it a total of eighteen (18) villages. Third stage: From the selected villages, five (5) yam farmers each were randomly selected to give a total of ninety (90) yam farmers. A semi-structured questionnaire was used in soliciting information from the respondents and data was analyzed using descriptive statistics, multiple regression techniques to determine the allocative efficiency of resources used in yam production and Gross margin model to estimate the cost and returns of yam production. The explicit form of the model is represented thus;

$$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9 + ei) \quad (1)$$

Where; Y = Output of yam (kg), X_1 = Quantity of fertilizer used in (kg), X_2 = Quantity of insecticides used in litres, X_3 = Herbicide use in litres, X_4 = Quantity of yam setts (seed) in (kg), X_5 = Hired labour in man-days, X_6 = Family labour in man-days, X_7 = Farming experience (years), X_8 = Farm size in hectares, and, ei = Error term

The Four Functional forms are specified as follows:

Linear form

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + ei \quad (2)$$

Cobb-Douglas (Double Log):

$$\log Y = b_0 + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + b_7\log x_7 + b_8\log x_8 + ei \quad (3)$$

Semi – Log:

$$Y = b_0 + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + b_4\log x_4 + b_5\log x_5 + b_6\log x_6 + b_7\log x_7 + b_8\log x_8 + ei \quad (4)$$

Exponential:

$$\log Y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + b_8 x_8 ei \quad (5)$$

Gross Margin Analysis

Gross Margin model can be expressed as:

$$N = GR - TC \quad (6)$$

$$\text{Net Return } (TR - TC) \quad (7)$$

Where: N = net income, TR= total revenue GR = gross revenue, and TC = total cost

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Yam Farmers in the Study Area

Table 1 showed the socio-economic characteristics of yam farmers. The result showed that 88.8% of the yam farmers were at the age bracket of 30-49. This implies that the farmers were young and very active to go into yam production. This is in line with the findings of Nwaneri *et al*., (2024) which states that most respondents are early youths who are active and possess the strength to go about their daily economic activities. The result also indicated that 56.7% were males, this means that males were more in number than their male counterparts. This could be attributed to the fact that the production and processing of food is believed to be the responsibility of men in the society. The result further showed that 51.1% of the yam

farmers were married. This implies that most of the yam farmers in the area were married. The involvement of married category in agriculture is in line with Ogonu (2024) whose report shows that the predominance of married farmers in the area may be attributed to the fact that marriage often provides access to family labour, which is particularly important in labour-intensive agricultural activities such as yam production.

married class are more involved in agriculture because of the need to supplement the families' means of livelihood while 55.5% had a farming experience of above 16 years. This implies that the respondents are agrarians and have been into farming for a long time. The result further revealed that a good proportion (55.6%) of the farmers had the perception that their major source of labour was through hiring. Also, 53.3% of the farmers had farm size of 1.5-1.8ha. This implies that the study area is dominated by farmers with small-farm sizes. Ogonu, *et al*. (2024) reported that the nature of land tenure system in an area allows for fragmentation of lands making more land non-accessible to farmers for production.

Table 2 showed the allocative efficiency of resources used in yam production in Afikpo North LGA of Ebonyi State. The table showed that the Cob-Douglas functional form gave the best fit having the highest value of co-efficient of multiple determination (R^2), highest number of significant variables, relative mode of F-value and in conformity with *a priori* expectation and was therefore selected as the lead equation. The value of co-efficient of multiple determination (R^2) was 0.5768, which implied that 57.68% of the variations in the profitability of yam production was accounted for by the explanatory variables. Variables such: as fertilizer, insecticide, herbicide, mini-sett, hired labour, family labour and farm size were estimated in the study area. The F value (14.58^{***}) was highly significant at 1% level indicating its goodness on the regression line. The coefficient of use of fertilizers and insecticides were positively signed and highly significant at 5.0% level and the coefficient implied that increase in fertilizer use by 1.0% resulted in 0.245 and 2.44 units increase in yam output of the farmers respectively. This is in accordance with Nwaneri *et al*., (2024) who opined that adoption of innovations such as fertilizers and insecticides increase farmers output and income hence food security. The coefficient of use of Herbicides was positively signed and highly significant at 1.0% level and the coefficient implied that increase in herbicides use by 1.0% resulted in 0.415 units increase in yam output of the farmers. This finding is in line with Adebayo *et al*., (2022), who obtained a similar result. Similarly, the coefficient of family labour was positively signed and highly significant at 5.0% level and the coefficient implied that increase in family use by 1.0% resulted in 0.159 units increase in yam output of the farmers. Nwaneri *et al* (2022) in his findings on selected socio-economic factors affecting homestead garden egg production in Ezza North Local Government Area of Ebonyi State, obtained a similar result.

Table 3 showed the estimated allocative efficiency levels of the inputs used by the yam farmers. The results showed that fertilizer, insecticide, mini-sett, hired labour, family labour and farm size were all over utilized by the farmers indicating in-efficiency in resource use. The reason behind the over-utilization of labour (family and hired) inputs could be attributed to the high cost of labour necessitated by its security in the study area following Adeyeye, *et al*., (2024) in their study on Optimizing resource-use efficiency of yam producers in Ondo State. The underutilization of herbicides might be due to its insufficient utilization due to untimely suppliers and application, following Adeyeye, *et al.,* (2024). Increasing yam output in the area is possible by reducing over-utilized inputs (labour, fertilizer, mini-sett, insecticide and reducing the cost of land acquisition) and increasing the use of herbicide. With efficient use of herbicide, the cost of production will be reduced with the minimal cost of weeding if herbicide is applied.

Table 1: Characteristics of Respondents in Afikpo North L.G.A, Ebonyi State (N= 90)

Characteristics	Frequency	Percentage
Age (Years)		
10 – 19	-	-
20 - 29	5	5.6
30 – 39	40	44.4
40 – 49	40	44.4
50 – 59	5	5.6
Sex		
Male	51	56.7
Female	39	43.3
Marital Status		
Single	27	30
Married	46	51.1
Divorced	8	8.9
Widow	9	10
Farming Experience		
0 – 5	10	11.1
6 – 10	10	11.1
11 – 15	20	22.2
16 and above	50	55.5
Sources of Labour		
Hired Labour	50	55.6
Family Labour	30	33.3
Age grade	5	5.6
Communal Labour	5	5.6
Farm size(ha)		
0.5- 0.9	37	41.1
1.0 – 1.9	48	53.3
2.0 and above	5	5.6

Source: Field Survey 2024

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Table 2: Production Functions Estimates for Yam

Variable	Linear	Exponential	Cob-Douglas+	Semi-log
Constant	-832.203	6.518	4.8706	-3977.25
	(-0.82)	(44,12***)	(9.19***)	(-1.04)
Fertilizer	-0.045	0.000046	0.2450	454.289
	(-0.06)	(0.43)	(2.96**)	(0.76)
Insecticide	17.696	0.0069	0.2446	776.194
	(0.26)	(0.70)	(2.81**)	(1.23)
Herbicide	744.384	0.2056	0.4158	1420.85
	(2.60**)	(4.96***)	(3.46***)	(1.64)
Mini-Sett	-0.228	-0.000025	0.0682	97.561
	(-0.31)	(0.24)	(0.97)	(0.19)
Hired labour	-3.974	0.0013	-0.0151	-582.34
	(-0.48)	(1.10)	(-0.30)	(-1.62)
Family labour	52.406	0.0161	0.1591	991.971
	(2.38**)	(5.02***)	(2.47**)	(2.12*)
Farm size	75.902	0.1337	0.0671	-19.483
	(0.18)	(2.16*)	(0.94)	(-0.04)
R^2	0.1154	0.4055	0.5768	0.1396
Adj. R^2	0.0601	0.3683	0.5441	0.0858
F	2.09*	10.91***	14.58***	2.60*

*Source: Field Survey data,2024. Figures in parentheses are t – values. + = lead equation. *, ** and ***in significant at 10%, 5% and 1% level of production.*

Table 3: Estimated Allocative Efficiency Levels of the Inputs

Variable	Coefficient	Mean	MFC	MVP	MVP/MFC	Efficiency
Fertilizer	0.2450	256	5.12	2.31	0.45	Over utilized
Insecticide	0.2446	3.167	378.91	186.33	0.49	Over utilized
Herbicide	0.4158	3.05	295.06	328.89	1.11	Under utilized
Mini-Sett	0.0682	242.33	200.00	0.68	0.0034	Over utilized
Hired labour	-0.0151	24.75	750.00	1.47	0.002	Over utilized
Family labour	0.1591	18.83	750.00	20.38	0.027	Over utilized
Farm size	0.0671	1.27	2000.00	127.46	0.063	Over utilized
Output	**2,412.50**					

Source: *field survey data, 2024*

Table 4 showed the perceived constraints to yam production by yam farmers in the area. The result revealed that a good proportion (88.9%) of the respondents indicated that lack of capital was the major challenge they face in the area while 83.3% of the respondents perceived lack of improved varieties as a constraint hence the rural dwellers. The study also revealed that 46.7% of the respondents opined that land ownership was a problem while 16.7% of them perceived incidence of pest and diseases as their own challenge. This implies that yam farmers face significant production challenges that may reduce farm productivity, increase production costs and ultimately lower the farmers' income and profitability. This finding is in tandem with the findings of Fasusi et al., (2022) on the determinants and constraints influencing yam production in Nigeria.

Table 4: Selected constraints to yam production in the study area.

Problems encountered	*Frequency	Percentage
Lack of capital	80	88.9
Lack of improved varieties	75	83.3
Land ownership	42	46.7
Incidence of pest and diseases	15	16.7
Other	-	-

Source; Field Survey 2024. *Multiple Responses Recorded.

CONCLUSION AND RECOMMENDATIONS

Allocative efficiency of resources used in yam production in Afikpo North Local Government Area of Ebonyi State, Nigeria was studied. The study found that fertilizer, insecticide, herbicide, mini-setts, hired/family labour, and farm size were over-utilized, indicating inefficient resource use. The major constraints reported by farmers were lack of capital and improved yam varieties. Based on the findings of the study, the following recommendations were made; affordable labour-

saving farm tools to reduce production costs should be developed and distributed to farmers, provide farmers with affordable credit at low interest rates and flexible collateral requirements.

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Authors' Contributions

TCN managed the data collections, interpretation of data, writing of manuscript, material support, Literature searches and review of manuscripts and wrote the first draft of the manuscript. CK managed the development of methodology, data analysis and development of the model. The Authors read and approved the final manuscript for publication.

Ethical Statement

Not applicable.

AI Declaration Statement

No form of artificial intelligence (AI) was used in any part of this research work.

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