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ECONOMICS OF MAIZE PRODUCTION IN IKWUANO LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

***Osondu, K. R[1]., Ashiegbu, G. N [2]., Nze, E.O[3]., and Ike, J[4].**
[1&4]Department of Agricultural Economics, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria
[2]Department of Agricultural Extension and Rural Development, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
[3]Department of Agribusiness and Management, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
*Correspondent author's email : osondu.rosemary@mouau.edu.ng, Phone : 08063741940,
Orcid id : 0009000590017061

Abstract
Maize is a crucial staple crop in Nigeria, contributing significantly to food security, providing essential nutrients, and serving as a primary source of income for millions of smallholder farmers. Its production enhances rural livelihoods through job creation, boosts local economies, and plays a vital role in agricultural diversification and sustainable development strategies across the country. This study examines the economics of maize production in Ikwuano Local Government Area (LGA), Abia State, Nigeria. Maize is a crucial raw material in various industries, including the production of cooking oil, confectionery, and bakery products. In Nigeria maize has gained increasing prominence, particularly in food processing industries and livestock feed mills. The specific objectives were to estimate the costs and returns associated with maize production, assess the profitability, determine the production function for maize farmers, and analyse the elasticity of production and returns to scale in the region. A multi-stage sampling technique was utilized to select 80 maize based farmers. Primary data were gathered using a structured questionnaire. Data analysis was conducted using net farm income calculations and the Cobb-Douglas production function model. The findings reveal that, on average, maize farmers in the area achieve a net return of ₦294,716.73 per annum. The Cobb-Douglas model estimates indicate that 95.9% of the variation in maize output can be explained by the independent variables included in the model. Significant factors influencing maize output include capital ($p<0.1$), labour ($p<0.1$), planting materials ($p<0.01$), and inorganic fertilizer ($p<0.01$). The study recommends that, given the profitability of maize production in the study area, both private individuals and the government should implement supportive measures to encourage more farmers to engage in maize farming as a viable professional pursuit. Also, there should be adequate provision of capital by the Government to smallholder maize farmers to boost production
Keywords: Maize, Malnutrition, Production, Profit, Abia State, Nigeria

Introduction
Maize (*Zea mays* L.), a member of the grass family (Gramineae), originated in Central America and has been a staple crop for human civilizations for millennia. As a C4 plant, maize possesses significant genetic potential and is recognized for its efficient photosynthetic mechanism. The C4 pathway enables maize to capture carbon dioxide more effectively and convert it into energy, offering an advantage in environments characterized by high light intensity and elevated temperatures. This photosynthetic adaptation minimizes water loss and supports robust growth under conditions where carbon dioxide is relatively low (Oxford Academic, 2024). The nutritional composition of maize grain is notable, consisting of approximately 79% starch, 10% protein, 4% fibre, 4% fat, and 3% minerals (Ahmad *et al.*, 2017). While maize is primarily cultivated for its grain and fodder, it also serves as an essential raw material in various industries, including the production of cooking oil, confectionery, and bakery products (Ahmad *et al.*, 2017)

Recent studies further emphasize the importance of maize in addressing global food security and its adaptability to diverse environmental conditions (Smith *et al.*, 2020; Johnson *et al.*, 2021). Its role in sustainable agriculture and its potential in biofortification to combat malnutrition have also been highlighted (Kumar *et al.*, 2022). The global maize production stands at approximately 1,060.2 million tonnes, cultivated over an area of 188 million hectares, resulting in an average yield of 5.63 tonnes per hectare (USDA, 2017). The United States leads global production, with 370.96 million tonnes harvested from 33.4 million hectares, while other major maize-producing countries include China, Brazil, the European Union, and Argentina. Pakistan ranks 17th in global maize production.

In Nigeria, maize has gained increasing prominence, particularly in food processing industries and livestock feed mills. Studies have shown that maize production is significantly important, especially in the Southwest region, where at least 30% of farmland is dedicated to maize cultivation under various cropping systems. Cultivating maize on farms of 1-2 hectares has been identified as a strategy to combat household hunger, with the potential to double food production across Africa (Ebido *et al.,* 2020).

Achieving optimal maize production requires the availability and efficient utilization of resources (Omoigui e*t al.,* 2020). Effective farm planning and policy development necessitate an understanding of resource productivity to determine which resources should be increased or decreased in use(Fuglie *et al.*, 2024) Efficiency in maize production involves achieving the desired output with minimal input, which can be enhanced through technological advancements and improvements in technical, allocative, and economic efficiency (Omoigui *et al.,* 2020). From an economic perspective, the supply dynamics of maize significantly impact its market price. An excessive supply of maize typically leads to a reduction in price, whereas a decrease in supply results in price increases. Therefore, economic principles are intrinsically linked to the profitability of agricultural enterprises. Effective organization and coordination in utilizing production factors are essential for maximizing farm income (Okeke & Onwumere, 2017).

Maize (*Zea mays L.*) is an essential staple crop with significant implications for both human consumption and industrial applications globally. Its high nutritional value, substantial yield potential, and adaptability to various environmental conditions render it a vital component of food security and economic growth. In Ikwuano, Abia State, Nigeria, maize production is economically significant, providing livelihoods for numerous smallholder farmers and contributing substantially to the region's agricultural productivity (Ahmad *et al.*, 2017; Smith *et al.,* 2020).

However, despite its critical role, maize production in Ikwuano encounters several economic obstacles that impede its optimal performance. Smallholder farmers in the area face challenges such as inadequate access to advanced agricultural technologies, limited availability of high-quality inputs, and insufficient extension services. These issues lead to low productivity and inefficiencies in maize cultivation. Furthermore, difficulties in market access and price volatility compound the economic hardships experienced by maize producers in Ikwuano. Therefore, this study focuses on estimating the costs and returns, and hence profitability of maize production, estimating the production function of maize farmers; and to derive the elasticity of production and returns to scale of maize farmers in the area in Ikwuano L.G.A of Abia State, Nigeria. Addressing these challenges is imperative for enhancing maize production, improving the livelihoods of smallholder farmers, and fostering sustainable agricultural development in Ikwuano L. G. Area.

Methodology

Study Area

The research was conducted in the Ikwuano Local Government Area (LGA) of Abia State, Nigeria. Established on August 27, 1991, Ikwuano’s administrative headquarters is located in Isiala-Oboro, approximately 14 kilometres from the state capital, Umuahia. Geographically, Ikwuano is situated between the latitude 5.5°N and longitude 7.5°E. The area is composed of four prominent historic clans: Ibere, Oloko, Ariam, and Oboro, encompassing fifty-seven villages and seventeen communities. The climate is characterized by annual rainfall ranging from 1600 mm to 1700 mm, with an average temperature between 26°C and 32°C. Agriculture is a principal occupation in the region, with smallholder farmers being predominant. Many of these farmers also engage in petty trading. According to the most recent data, the population of Ikwuano Local Government Area (LGA) is 137,993 (Media Nigeria, 2022), with approximately 65% of the population engaged in agricultural activities (National Bureau of Statistics (NB, 2020).

The region is endowed with fertile land suitable for the cultivation of a variety of arable crops such as yam, cassava, cocoyam, rice, maize, melon, and a range of vegetables. Common perennial crops include oil palm, cashew, mango, orange, kola nut, and avocado. Livestock farming, including goats, poultry, and pigs, is prevalent, while fish farming is emerging as a new sector. Cocoa remains the primary cash crop grown in Ikwuano (Johnson *et al*,. 2021).

Sampling Procedure

The study employed a multi-stage random sampling technique to select the respondents. Ikwuano Local Government Area (LGA) is comprised of four major historic clans: Ibere, Oloko, Ariam, and Oboro. In the first stage, all four clans were selected from the LGA. In the second stage, two (2) autonomous communities were randomly chosen from each of the four clans, resulting in a total of eight autonomous communities. The third stage involved the random selection of one village from each of the selected autonomous communities, yielding a total of eight villages for the study. The maize farmers within these villages formed the sampling frame. Finally, in the last stage, ten (10) maize farmers were randomly selected from each of the eight villages, leading to a total sample size of 80 maize-based farmers in Ikwuano.

Analytical Techniques

Data for this study were collected from primary source. The primary data was obtained using a well-structured questionnaire designed to capture the costs and returns and profitability of small-scale maize farmers in the area and input and output relationship in maize production in Ikwuano L.G.A of Abia State, Nigeria

Objective (i) was analyzed using net return analysis

$$NR = TR - TC \quad - \quad - \quad - \quad 1$$

Total cost is the addition of the entire variable cost (VC) and fixed cost (FC) items;

$$TC = TVC + TFC \quad -- \quad - \quad 2$$

Total revenue is the total amount of money that a farmer received from the sale of maize;

$$TR = \Sigma P_x Q_x \quad - \quad - \quad 3$$

$$GP = TR - TVC \quad - \quad - \quad 4$$

$$R/N = \frac{GP}{TC} \quad -- \quad - \quad - \quad 5$$

$$\text{Gross Ratio (GR)} = TC/TR \quad - \quad 6$$

Where;

P = price per bag of maize

Q = quantity of maize sold

GP = Gross profit

Objective (ii) production function was estimated using Cobb-Douglas production function

The model is specified implicitly as follows;

$$LnY_{ij} = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + e_i \quad - \quad 7$$

Where ij refers to the ith observation of the jth farmer.

Ln = logarithm to base e

Y = Value of maize (Naira)

X_1 = Capital (Depreciation, insurance, tax, interest and rent on land)

X_2 = Farm size (hectare)

X_3 = Cost of labour (Naira)

X_4 = Cost of planting materials (Naira)

X_5= Quantity of Fertilizer (kg)

The elasticity of production and returns to scale of maize farmers in the area was estimated using the identity used by Onyenweaku & Nwaru, (2005)

$$\sum_{i=n}^{k} EPxi = RST \quad - \quad - \quad 8$$

Where;

EP_{xi} = Elasticity of production of the ith input

RST = Return to scale (i.e sum of coefficient of elasticity of production)

K = number of resources

Results and Discussion

The profitability analysis of maize cultivation per hectare, as illustrated in Table 1, reveals several insights into the economic dynamics of maize farming. The result is presented in Table 1.

Table 1 Profitability analysis of maize farmers per hectare

Variables/Items	Quantity ($\ddot{X}$)	Unit selling price ($\ddot{X}$)	Average value	% of revenue
A. Revenue				
Maize (bag)	67 bags	9,625.00	644,875.00	
Total return/revenue				
B. COST				
Variable cost				**% of total cost**
Seedling (kg)	10	5,580	55,800.00	15.94%
Agrochemical (25kg)	50	646	32,300.00	9.22%
Labour (man-days)	10	7,551.15	75,511.50	21.56%
Fertilizer			48,180.00	13.76%
Total variable cost			**211,791.50**	60.48%
Gross profit			**433,083.5**	
Fixed cost				**% of total cost**
Rent of land	3	25,000	75,000.00	21.42%
Insurance premium	5	75.526	377.63	0.11%
Depreciated values of farm asset	3	20,996.38	62,989.14	17.99%
Total fixed cost			138,366.77	39.52%
Total cost			**350,158.27**	**100.00%**
C. Profit				
Net Return			**294,716.73**	

Source: Field Survey Data, 2023

The analysis of maize farming profitability per hectare, as illustrated in Table 1, reveals significant economic considerations surrounding maize production among smallholder farmers. The total revenue generated from maize cultivation amounts to ₦644,875.00, derived from the sale of 67 bags priced at ₦9,625.00 each. This revenue emphasizes the capacity of maize farming to substantially improve the income levels of rural households, thereby enhancing their economic stability (Johnson *et al.*, 2021).

The analysis further reveals that the total variable costs for maize farming per hectare amount to ₦211,791.50, comprising 60.48% of total production expenses. This significant proportion underscores the critical need for efficient cost management to sustain crop quality and yield. Major components of these variable costs include seedling expenses (₦55,800.00), agrochemical costs (₦32,300.00), labor (₦75,511.50), and fertilizer (₦48,180.00), which correlate with the respective input quantities of 10, 50, 10, and 6 units. Effectively managing these costs is essential to optimizing production and maintaining profitability (Ogunleye & Thomas, 2020).

Recent studies highlight the central role of inputs like labor and agrochemicals in profitability, particularly in smallholder farming systems prevalent in developing countries. High input costs can significantly erode profit margins, even with favorable productivity, underscoring the urgent need for more accessible, affordable agricultural inputs (Adedayo & Omolara, 2023). Policy initiatives aimed at reducing input costs or offering subsidies could significantly enhance the profitability and sustainability of maize farming, making it a more viable income source for smallholder farmers and contributing to broader food security goals.

Total fixed costs was ₦138,366.77 and constituting 39.52% of the total costs, include land rent (₦75,000.00), association/levies (₦377.63), and the depreciated values of farm assets (₦62,989.14). The fixed costs, while substantial, are relatively stable compared to variable costs and include essential expenditures that support the infrastructure and operational capacity of the farm. The proportion of fixed costs aligns with findings from recent agricultural economics research, which suggests that fixed costs contribute significantly to overall production expenses (Egbinola & Ibitoye, 2023). The net return from maize farming per hectare stands at ₦294,716.73. This figure represents the gross profit after deducting both variable and fixed costs from the total revenue. The substantial net return indicates a favourable profitability scenario for maize farmers in the region, suggesting that maize cultivation can be a viable agricultural enterprise with proper cost management and efficient farming practices.

Production Function for Maize Farmers in The Area

The results of Cobb- Douglas production function of maize farmers in Ikwuano L.G.A of Abia State were summarized and presented in Table 2.

Table 2: Estimated Cob-Douglas Production Functions for maize farmers

Variables	Coefficient	Std. Error	Z-ratio
Intercept	3.902	0.620	6.289***
Capital	0.059	0.036	1.616*
Farm Size	-0.053	0.076	-0.699
Labour used	0.107	0.062	1.707*
Planting materials	0.301	0.098	3.069***
Quantity of organic fertilizer	0.099	0.029	3.381***
R^2			0.959
Adjusted R^2			0.949
F-ratio			73.507***

Source: Field survey,2023 * Significant at 1% and** *significant at 10%

Table 2 indicates that the coefficient of multiple determination (R^2) is 0.959, suggesting that 95.9% of the variation in total maize production is explained by the independent variables in the model. The F-ratio value of 73.507 was statistically significant at the 1% level. The coefficients for capital, labour, planting materials, and inorganic fertilizer were identified as significant factors influencing maize output.

Capital was found to be significant at the 10% level and positively associated with maize output. This implies that an increase in capital, such as farm tools, is likely to enhance maize production levels. This finding aligns with the results of Deepashree (2018), who observed a positive and significant relationship between capital and output levels.

Planting materials were significant at the 1% level and positively correlated with maize output. This suggests that the quality and quantity of planting materials significantly impact the production levels of maize farmers. An increase in planting materials corresponds with an increase in output, as supported by Aigbokie *et al.,* (2021), who emphasized that the use of high-yield seeds is crucial for improving farmer output. Simonyan *et al.,* (2018) also highlighted the importance of optimal planting materials for achieving maximum maize yields.

Labour was significant at the 10% level and positively related to maize output. This indicates that a unit increase in labour leads to a proportional increase in output. Generally, the results suggest that increased labour inputs lead to a significant boost in production levels. This finding is consistent with Nwaru *et al.,* (2011), who reported that doubling labour and capital results in more than a double increase in output.

The quantity of fertilizer used was significant at the 1% level and positively related to maize output. This indicates that an increase in the application of manure such animal waste from cows, horses and chicken droppings leads to a notable improvement in production levels. This finding corroborates the results of (Frontiers, 2024) who highlighted that combining organic fertilizers, such as manure, with biochar resulted in improved maize yields and better nutrient retention, particularly in environments where chemical fertilizers were limited.

Elasticity of Production and Returns to Scale of Maize Production

The elasticity of production and returns to Scale for maize farmers is presented in Table 3.

Table 3. Elasticity of Production for maize production

Resources	β_i	Implications
Capital	0.059	
Farm Size	-0.053	
Labour used	0.107	
Planting materials	0.301	
Quantity of fertilizer	0.099	
Summation of β_i	**0.513**	**Ep<1 (Decreasing returns to scale)**

Source: Field Survey, 2023

Based on the results, the average farmers in the study area experiences a returns-to-scale coefficient of 0.513, indicating increasing returns to scale. This suggests that maize production is occurring within Stage II of the production function. In this stage, total output continues to rise at an accelerating rate, while both the marginal physical product (MPP) and the average physical product (APP) decline, with the MPP decreasing at a faster rate.

The presence of increasing returns to scale implies that production costs are not escalating proportionately with output; however, if the production were to exceed the optimal scale, decreasing returns to scale could manifest, leading to rising costs due to dis-economies of scale. These rising costs are often associated with managerial inefficiencies arising from the limited availability of production factors and challenges in achieving perfect substitution (Nwaru *et al.*, 2011).

Conclusion

Maize farming in Ikwuano Local Government Area is a profitable venture, although the farmers still have the potential to increase their overall efficiency to maximize yield and profit in the study area, but the coefficient of capital, labour, planting materials and inorganic fertilizer were the significant variables influencing the output of the maize farmers.

Recommendations

i. The results suggest that maize farming is a profitable venture. To enhance its sustainability and profitability, both private individuals and government should implement measures that support this sector, encouraging more farmers to engage in maize production as a professional pursuit.

ii. To enhance maize output, there is a need to improve farmers' access to capital. Although capital currently has a positive but relatively low impact on maize productivity, increased capital availability would allow farmers to invest in advanced farm tools and technology, which can significantly improve production efficiency. Efforts should focus on facilitating affordable credit access, subsidies for equipment acquisition, or microloan programs targeted at smallholder farmers. Such initiatives would enable farmers to adopt efficient farming practices and increase their overall productivity, aligning with sustainable agricultural development goals.

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