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Cost and Return Analysis of Maize (Zea Mays L.) Production in Otukpo Local Government Area, Benue State, Nigeria

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ABSTRACT

Maize (*Zea mays* L.) is a major staple and cash crop in Nigeria, serving as a key component of household diets, livestock feed, and agro-industrial raw material. This study analyzed the cost and return structure of maize production in Otukpo Local Government Area (LGA), Benue State, using primary data obtained from 120 randomly selected farmers during the 2024 farming season. Descriptive statistics, gross margin analysis, benefit–cost ratio (BCR), and multiple regression models were employed. Results revealed that the average farm size was 1.6 hectares, with mean yields of 3.2 tonnes/ha, generating average revenue of ₦576,000 per hectare. The gross margin was ₦296,000/ha, with a BCR of 1.86, indicating profitability. Regression results showed that farm size, labor input, fertilizer application, and farmer education significantly influenced maize output ($p < 0.05$). Farmers reported constraints including high labor costs (72%), limited access to credit (65%), high input prices (60%), and inadequate storage (55%). The findings highlight the profitability of maize farming in Otukpo but underscore the need for improved input access, farmer training, and market linkages. Policy implications include strengthening cooperative structures, expanding rural infrastructure, and introducing targeted credit facilities.

1. Introduction

Agriculture remains the backbone of Nigeria's economy, employing more than 60% of the labor force and contributing significantly to food security and rural livelihoods (FAO, 2022). Maize (*Zea mays* L.) is among Nigeria's most important cereal crops, cultivated across all ecological zones due to its adaptability and versatility. It is consumed in various forms and serves as a raw material for livestock feed, brewing, and starch-based industries.

In Benue State—popularly known as the *Food Basket of the Nation*—maize holds strategic importance for both subsistence and commercial farming. Otukpo Local Government Area (LGA), located in southern Benue, is characterized by favorable climatic conditions, fertile soils, and strong farming traditions, making maize cultivation a dominant livelihood activity. However, despite its potential, maize production in Otukpo faces constraints such as rising labor costs, inadequate storage infrastructure, fluctuating input prices, and limited credit access.

Previous studies on maize profitability in Nigeria (Omotayo & Abdulazeez, 2018; Nyiatagher & Ocholi, 2015) have shown that smallholder maize farming is generally profitable, but constrained by inefficiencies in input use and weak market linkages. However, most existing studies focus on other regions (e.g., Kaduna, Adamawa, Kwande), with limited empirical evidence from Otukpo and other southern Benue LGAs. This gap justifies a localized cost and return analysis to better inform policies and farmer support interventions.

This study therefore aims to:

1. Examine the socio-economic characteristics of maize farmers in Otukpo LGA.
2. Analyze the costs, returns, gross margin, and BCR of maize production.
3. Identify the major constraints faced by maize farmers.
4. Provide recommendations for improving profitability and sustainability of maize production in Benue State.

By addressing these objectives, the study contributes evidence-based insights to strengthen

2. Literature Review

2.1 Importance of Maize in Nigeria

Maize (*Zea mays* L.) is the most widely cultivated cereal in Nigeria after rice, with an estimated production of 12.7 million metric tonnes in 2022 (FAO, 2022). It is grown across all agro-ecological zones, serving multiple purposes: human food, livestock feed, and industrial raw material. According to International Institute of Tropical Agriculture (IITA, 2021), maize accounts for more than 20% of calorie intake in Nigerian households and forms a core input in poultry and brewing industries.

The crop's versatility has made it a driver of rural income. However, despite its importance, maize yields in Nigeria average 2.0–3.0 tonnes per hectare, far below the global average of 5–6 tonnes/ha (World Bank, 2021). Yield gaps are attributed to low input use, poor seed quality, labor bottlenecks, and limited mechanization. Addressing these constraints has been a key priority for Nigeria's agricultural policy frameworks, including the Agricultural Transformation Agenda (ATA) and the Anchor Borrowers Programme (CBN, 2020).

2.2 Maize Production in Benue State

Benue State is often referred to as Nigeria's "Food Basket" because of its favorable agro-climatic conditions for root and cereal crops. Maize is cultivated in virtually all 23 Local Government Areas (LGAs), either as a sole crop or intercropped with yam, cassava, or groundnuts (Benue State Ministry of Agriculture, 2023). Smallholder farmers dominate production, with average farm sizes ranging between 1–3 hectares.

Studies in Benue have highlighted both the profitability and challenges of maize farming. Nyiatagher and Ocholi (2015), in their study in Kwande LGA, reported average net farm income of ₦225,000/ha, but noted major constraints including poor access to fertilizer and market fluctuations. Similarly, Adakole (2024) found that farmer participation in maize markets in Benue was significantly influenced by access to cooperatives and education level. Despite these findings, limited studies have examined profitability in Otukpo LGA specifically, making this research timely and locally relevant.

2.3 Cost and Return Analysis in Nigerian Agriculture

Cost and return analysis is a widely applied framework in agricultural economics to determine the profitability of farming enterprises. Gross margin analysis, benefit–cost ratios (BCR), and net farm income are standard tools for evaluating enterprise performance (Olukosi & Erhabor, 2008). For smallholder maize farming, this analysis is critical since farmers operate under resource constraints and face fluctuating input/output markets.

Omotayo and Abdulazeez (2018) conducted a cost and return analysis of maize production in Kaduna State, reporting gross margins of ₦185,000/ha and a BCR of 1.65, confirming profitability. Conversely, studies in Adamawa (Aliyu *et al*., 2021) highlighted that profitability was highly sensitive to fertilizer costs, which constitute over 40% of variable costs. These studies emphasize the need to contextualize profitability within regional realities such as input markets, labor availability, and climate conditions.

2.4 Socio-Economic Characteristics and Farm Productivity

Socio-economic factors such as age, education, household size, gender, and farming experience influence farm productivity. Osondu et al. (2014) found that farmer education significantly affected adoption of improved maize varieties in southeastern Nigeria. Similarly, Ogunniyi et al. (2012) reported that younger farmers with access to extension services were more likely to adopt fertilizer and mechanization, boosting yields.

In Benue, Adakole (2024) showed that farmer market participation is linked to cooperative membership, gender, and access to transport. Otukpo farmers, who often farm smaller plots and face high transport costs due to poor road infrastructure, may therefore have different socio-economic dynamics than farmers in northern Benue LGAs with larger landholdings.

2.5 Constraints in Maize Production

Constraints to maize production in Nigeria are multifaceted. Studies consistently highlight high labor costs, poor input access, inadequate credit facilities, post-harvest losses, and market volatility (Agada *et al.*, 2023; Ikpe & Omede, 2025). In Benue, farmers face additional challenges from insecurity in rural areas, climate variability, and price exploitation by middlemen (Ijirshar *et al.*, 2025). These factors not only reduce productivity but also discourage smallholders from scaling up maize production.

2.6 Research Gap and Rationale for the Study

While numerous studies have been conducted on maize profitability in Nigeria, relatively few focus on Benue State, and fewer still on Otukpo LGA. Given the strategic role of Benue in Nigeria's food security, and Otukpo's position as a major maize-producing area in southern Benue, localized evidence is necessary. This study addresses this gap by applying cost and return analysis to maize farming in Otukpo, while also incorporating regression analysis to identify determinants of productivity. The findings are expected to guide both policy interventions and farmer decision-making.

3. Methodology

3.1 Study Area

The study was conducted in Otukpo Local Government Area (LGA) of Benue State, Nigeria. Otukpo is located between latitudes 7°12′N and 7°30′N and longitudes 8°08′E and 8°25′E, covering approximately 750 square kilometers. The population is projected at 266,000 in 2024 (NPC, 2023), with the Idoma ethnic group constituting the majority.

The climate is tropical, characterized by a rainy season (April–October) and a dry season (November–March). Average annual rainfall is about 1,500 mm, while mean temperature is around 27°C, both suitable for maize production. The soils are predominantly sandy loam and fertile enough for cereals and root crops. Farming is largely rain-fed, with maize cultivated as a staple and cash crop, either as a sole crop or intercropped with cassava, yam, or groundnuts.

3.2 Sampling Procedure

A multistage sampling technique was adopted:

Stage 1 – Four wards were randomly selected from the 13 wards in Otukpo LGA.

Stage 2 – Three villages were randomly selected from each ward.

Stage 3 – Ten maize farmers were randomly selected from each village, giving a total of 120 respondents.

This sample size was considered sufficient to capture variability in socio-economic characteristics, farm size, and production practices within the study area.

3.3 Data Collection

Primary data were collected during the 2024 production season using a structured questionnaire and oral interviews. Information was obtained on:

- Socio-economic characteristics (age, gender, education, household size, farming experience).
- Farm characteristics (farm size, inputs used, labor type, access to credit, extension services).
- Cost structure (input costs, labor, land rent, seed, fertilizer, chemicals).
- Output and revenue (yield, selling price, total income).
- Production constraints.

Secondary data were sourced from publications of the Benue State Ministry of Agriculture, National Bureau of Statistics, FAO, and previous research works.

3.4 Analytical Framework

(a) Descriptive Statistics

Used to summarize socio-economic characteristics and constraints. Frequencies, percentages, and means were applied.

(b) Gross Margin and Benefit–Cost Ratio Analysis

Gross Margin (GM) and BCR were computed as:

$$GM = TR - TVC$$

$$BCR = \frac{TR}{TC}$$

Where:

TR = Total Revenue

TVC = Total Variable Cost

TC = Total Cost

A BCR greater than 1 implies profitability.

(c) Net Farm Income (NFI)

NFI=TR−(TVC+TFC)

Where TFC = Total Fixed Costs.

(d) Multiple Regression Analysis

To identify factors influencing maize output, the following production function was specified:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon$$

Where:

Y = Maize output (kg/ha)

X_1 = Farm size (ha)

X_2 = Labor input (man-days)

X_3 = Quantity of fertilizer used (kg)

X_4 = Seed cost (₦)

X_5 = Education level of farmer (years of schooling)

ϵ = Error term

The Cobb–Douglas production function was estimated due to its suitability for agricultural production studies. The coefficients represent elasticities of production with respect to each input.

3.5 Justification of Analytical Tools

- Descriptive statistics provided insights into farmer profiles and constraints.
- Gross margin and BCR enabled evaluation of enterprise profitability.
- Regression analysis captured the influence of socio-economic and farm-level factors

4. Results and Discussion

4.1 Socio-Economic Characteristics of Respondents

The socio-economic profile of maize farmers in Otukpo provides context for understanding production practices and profitability. Table 1 summarizes key characteristics.

Table 1: Socio-Economic Characteristics of Maize Farmers in Otukpo (n = 120)

Variable	Mean/Distribution	% of Respondents
Age (years)	43 years (range: 22–65)	–
Gender	Male: 68%, Female: 32%	–
Household size	6 persons (range: 3–12)	–
Education level	None: 15%, Primary: 25%, Secondary: 40%, Tertiary: 20%	–
Farming experience	12 years (average)	–
Average farm size	1.6 hectares	–
Access to credit	Yes: 34%, No: 66%	–
Access to extension	Yes: 45%, No: 55%	–

Discussion:

The majority (68%) of farmers were male, reflecting cultural land ownership norms.

The average age of 43 suggests that both young and middle-aged farmers engage in maize farming, but youth participation remains limited.

A significant proportion (60%) had at least secondary education, which may positively influence adoption of improved technologies.

Limited credit (34%) and extension access (45%) constrain the adoption of yield-enhancing practices.

4.2 Costs and Returns of Maize Production

Table 2 presents the cost and return structure per hectare.

Table 2: Cost and Return Analysis of Maize Production in Otukpo (₦/ha)

Item	Cost/Revenue (₦)
Revenue (3.2 t × ₦180,000/t)	576,000
Variable Costs	
– Labor	120,000
– Fertilizer & chemicals	80,000
– Seed	40,000
– Miscellaneous	40,000
Total Variable Cost (TVC)	280,000
Fixed Costs (land rent, tools)	30,000
Total Cost (TC)	310,000
Gross Margin (GM)	296,000
Net Farm Income (NFI)	266,000
Benefit–Cost Ratio (BCR)	1.86

The gross margin of ₦296,000/ha and BCR of 1.86 indicate that maize production in Otukpo is profitable. Every ₦1 invested returns ₦1.86. Profitability is slightly higher than findings from Kaduna (Omotayo & Abdulazeez, 2018; BCR = 1.65), but comparable to Kwande, Benue (Nyiatagher & Ocholi, 2015; ₦225,000/ha net return). This suggests that Otukpo has competitive advantages, possibly due to fertile soils and proximity to markets.

4.3 Regression Results on Determinants of Output

The Cobb–Douglas model was estimated, and results are presented in Table 3.

Table 3: Regression Estimates of Factors Influencing Maize Output in Otukpo

Variable	Coefficient (β)	Std. Error	t-value	Significance
Constant	2.135	0.214	9.98	***
Farm size (ha)	0.462	0.083	5.56	***
Labor (man-days)	0.275	0.071	3.87	***
Fertilizer (kg)	0.198	0.065	3.05	**
Seed cost (₦)	0.082	0.048	1.71	*
Education (years)	0.124	0.052	2.38	**
R^2	0.73	–	–	–

Note: *** = 1% significance; ** = 5%; * = 10%.

- Farm size had the largest elasticity (0.462), meaning a 1% increase in land cultivated increased output by 0.46%.
- Labor and fertilizer use also significantly boosted productivity.
- Education was significant at 5%, indicating that literate farmers adopted better management practices.
- The R^2 of 0.73 shows that 73% of output variation was explained by the model.

4.4 Production Constraints

Farmers reported multiple constraints to maize production. Figure 1 summarizes the most frequently cited challenges.

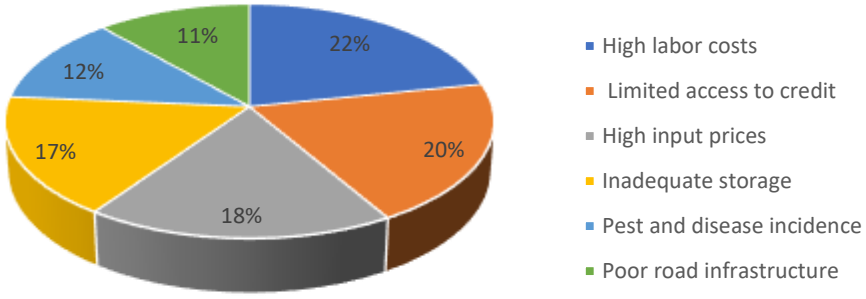

Figure 1: Major Constraints in Maize Production in Otukpo (% of Farmers Reporting)

- High labor costs – 72%
- Limited access to credit – 65%
- High input prices – 60%
- Inadequate storage – 55%
- Pest and disease incidence – 40%
- Poor road infrastructure – 38%

Labor cost was the most critical constraint, consistent with findings in Adamawa (Aliyu et al., 2021). Limited credit access also hinders expansion and adoption of inputs. Post-harvest storage issues contribute to price fluctuations, reinforcing the need for modern storage facilities in Otukpo.

5. Conclusion and Policy Implications

This study examined the cost and return structure of maize production in Otukpo Local Government Area, Benue State, Nigeria, using data from 120 farmers. Results revealed that maize farming is a profitable enterprise, with a gross margin of ₦296,000/ha and a benefit–cost ratio (BCR) of 1.86. These findings align with earlier studies in other regions of Nigeria but provide new, localized evidence for southern Benue.

The regression analysis showed that farm size, labor, fertilizer use, seed cost, and farmer education significantly influence maize output, with farm size and labor being the most critical determinants. This highlights the importance of expanding land under cultivation and improving labor efficiency. The role of education also suggests that investments in farmer training and extension can enhance productivity.

Despite profitability, maize production in Otukpo is constrained by high labor costs, limited access to credit, rising input prices, and poor storage facilities. These challenges reduce net returns and discourage expansion. Addressing them requires targeted interventions at both farmer and policy levels.

Policy Implications

1. Strengthening farmer cooperatives – Collective action can improve access to inputs, credit, and output markets, while reducing dependence on exploitative middlemen.
2. Affordable credit facilities – Government and NGOs should design credit schemes tailored to smallholder maize farmers, with flexible repayment schedules linked to seasonal harvest cycles.
3. Subsidized inputs – Fertilizers and improved maize varieties should be made more accessible to farmers in Otukpo, possibly through voucher-based distribution systems.
4. Labor-saving technologies – Promotion of mechanized planting and weeding tools could significantly reduce the burden of high labor costs.

5. Post-harvest infrastructure – Investment in community-level silos and improved storage will minimize losses and stabilize farm-gate prices.
6. Extension services and education – Training programs focusing on soil fertility management, pest control, and climate-smart practices can further boost productivity.
7. Infrastructure development – Improving rural roads will reduce transportation costs and enhance market access.

6. Recommendations for Future Research

While this study provides valuable insights into the profitability and constraints of maize farming in Otukpo, future research could:

- Conduct longitudinal studies covering multiple seasons to capture variability in prices and yields.
- Apply value chain analysis to examine how middlemen and processors influence farmer income.
- Explore the impact of climate change on maize yields in southern Benue.
- Test the effectiveness of specific policy interventions, such as subsidized inputs or cooperative-led marketing.

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