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ASSESSMENT OF THE PROFITABILITY, CONSTRAINTS AND DRIVERS OF PRODUCTIVITY AMONG SMALLHOLDER MAIZE FARMERS IN KOGI STATE, NIGERIA.

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ABSTRACT

This study evaluated the profitability, constraints, and drivers of productivity among smallholder maize farmers in Kogi State, Nigeria, using a cross-sectional survey of 300 farmers selected through multi-stage sampling. The objectives were to assess socio-economic characteristics, evaluate profitability, analyze productivity determinants, and rank constraints. Descriptive statistics, Stochastic Frontier Analysis (SFA), Likert scale ranking, t-test statistics and z-test statistics were employed. Results revealed a youthful farming population (mean age: 41 years), with 75% male and 55% having secondary or tertiary education, but limited access to credit (46.33%) and extension services (62.67%). Maize farming was profitable, with a net farm income of ₦199,122, a benefit-cost ratio of 1.47, and a t-test ($t = 21.91$, $p < 0.01$) rejecting the null hypothesis of non-profitability. SFA showed that seeds ($\beta = 0.3829$, $p < 0.01$), farm size ($\beta = 0.1684$, $p < 0.01$), labour ($\beta = 0.1134$, $p < 0.01$), fertilizer ($\beta = 0.0069$, $p < 0.01$), and agrochemicals ($\beta = 0.0156$, $p < 0.05$) significantly influenced productivity, while education, extension contact, and experience reduced inefficiency, rejecting null hypotheses on socio-economic and production impacts. Key constraints included lack of government support (mean = 4.48) and limited credit access (mean = 4.29). The study recommends enhancing credit access, extension services, and input subsidies to improve profitability and productivity. These findings support Nigeria's agricultural transformation goals by highlighting strategies to address constraints and leverage productivity drivers for sustainable maize farming and food security.

Keywords: Maize Farming, Profitability, Productivity Drivers, Constraints, Stochastic Frontier Analysis, Kogi State.

INTRODUCTION

Maize (*Zea mays* L.) is a staple crop and a critical component of food security in Nigeria, particularly among smallholder farmers who dominate the agricultural landscape (Aduba, 2017). As one of the most widely cultivated crops in the country, maize contributes significantly to household food security, income generation, and rural livelihoods (Ogunniyi et al., 2021). In Nigeria, smallholder farmers account for over 80% of agricultural production, with maize being a major crop cultivated across diverse agro-ecological zones (Falola et al., 2022). Kogi State, located in Nigeria's Middle Belt, is a significant maize-producing region due to its favourable climatic conditions and fertile soils. However, smallholder maize farmers in the state face numerous challenges that constrain productivity, including limited access to inputs, inadequate extension services, and environmental factors such as climate variability (Opaluwa et al., 2014; Aduba, 2017).

The productivity of smallholder maize farming is influenced by a complex interplay of socio-economic and production-related factors. Socio-economic characteristics, such as age, education, household size, and access to credit, have been identified as critical determinants of agricultural productivity (Ogunniyi et al., 2021; Falola et al., 2022). For instance, education and access to extension services enhance farmers' ability to adopt improved technologies and practices, thereby increasing productivity (Abdulaleem et al., 2019). Similarly, production characteristics, including farm size, input use, and farming experience, play a pivotal role in determining output levels (Aduba, 2017). Understanding these drivers is essential for designing targeted interventions to improve maize productivity and enhance rural livelihoods in Kogi State.

Despite its importance, smallholder maize farming in Nigeria is characterized by low productivity, with average yields significantly below global standards (Etim & Okon, 2013; Abdulaleem et al., 2019). In Kogi State, maize yields are constrained by factors such as pest and disease infestations, inadequate access to credit, and poor infrastructure (Aduba, 2017). Additionally, climate change poses a significant threat to maize production, with erratic rainfall and rising temperatures affecting crop yields (Akinyemi et al., 2021). These constraints limit the profitability of maize farming, undermining its potential to contribute to poverty reduction and food security (Ogunniyi et al., 2021). Addressing these challenges requires a comprehensive evaluation of the factors influencing productivity and the constraints faced by farmers.

The profitability of maize farming is a critical measure of its viability as a livelihood strategy for smallholder farmers. Studies have shown that maize production can be profitable in Nigeria, with returns on investment varying based on input costs, market access, and farming practices (Abdulaleem et al., 2019; Aduba, 2017). However, high production costs, limited access to markets, and post-harvest losses often erode profit margins (Falola et al., 2022). In Kogi State, the economic viability of maize farming remains understudied, necessitating an in-depth analysis of costs, returns, and profitability to inform policy interventions.

This study evaluated the constraints and drivers of productivity among smallholder maize farmers in Kogi State, Nigeria, in the context of the following objectives: (1) to assess the socio-economic characteristics of smallholder maize farmers, (2) to evaluate the profitability of smallholder maize farming, (3) to analyze the determinants of productivity, and (4) to identify and rank the constraints facing maize production. The study tested the null hypotheses that smallholder maize farming is not profitable, and that socio-economic and production characteristics have no significant effect on productivity. To achieve these objectives, the study employed descriptive statistics to summarize socio-economic characteristics, Stochastic Frontier Analysis (SFA) to identify determinants of productivity, and Likert scale ranking to evaluate constraints. These analytical methods provided a robust framework for understanding the factors influencing maize productivity and the barriers to achieving sustainable agricultural outcomes.

This research is timely and relevant given the Nigerian government's focus on agricultural transformation and food security through initiatives such as the Agricultural Transformation Agenda (ATA) (Aduba, 2017). By identifying the key drivers and constraints of maize productivity in Kogi State, the study contributes to the literature on smallholder agriculture and provides evidence-based insights for policymakers, extension agents, and development practitioners. The findings are expected to inform strategies for enhancing maize productivity, improving profitability, and addressing the constraints faced by smallholder farmers, thereby supporting sustainable agricultural development and food security in Nigeria.

Theoretical Framework

This study is anchored on the Stochastic Frontier Production Theory and the Theory of Constraints, which provide a robust framework for evaluating the drivers and constraints of productivity among smallholder maize farmers in Kogi State, Nigeria. These theories align with the study's objectives of assessing socio-economic characteristics, profitability, determinants of productivity, and constraints faced by farmers. The Stochastic Frontier Production Theory, developed by Aigner et al. (1977) and extended in agricultural economics (Ogunniyi et al., 2021), posits that a farmer's output is determined by a production frontier that represents the maximum achievable output given a set of inputs. Deviations from this frontier result from technical inefficiency and random errors. In this study, the theory underpins the use of Stochastic Frontier Analysis (SFA) to analyze productivity determinants, such as farm size, labour, and fertilizer use, while accounting for inefficiencies influenced by socio-economic factors like education and extension contact (Abdulaleem et al., 2019). The theory assumes that smallholder maize farmers operate under resource constraints, and their productivity is affected by both controllable (e.g., input use) and uncontrollable (e.g., weather) factors. The Cobb-Douglas production function is employed to model the relationship between inputs and maize output, while the inefficiency component captures socio-economic variables impacting productivity (Ogunniyi et al., 2021).

The Theory of Constraints (TOC), proposed by Goldratt (1984) and applied to agriculture by Aduba (2017), emphasizes identifying and addressing the most critical bottlenecks limiting system performance. In the context of smallholder maize farming, TOC guides the evaluation of constraints such as limited access to credit, inadequate extension services, and high input costs (Akinyemi et al., 2021). By ranking constraints using a Likert scale, the study identifies the most severe barriers to productivity, enabling targeted interventions to alleviate these bottlenecks. TOC assumes that improving the weakest link in the production process (e.g., access to credit) will enhance overall farm performance (Falola et al., 2022). Together, these theories provide a comprehensive framework for understanding productivity dynamics. The Stochastic Frontier Production Theory quantifies the technical efficiency and determinants of maize output, while TOC prioritizes constraints for policy intervention. This dual approach ensures a holistic analysis of both the drivers (e.g., input use, education) and barriers (e.g., credit access, infrastructure) affecting smallholder maize farming in Kogi State. The framework supports the study's hypotheses that socio-economic and production characteristics influence productivity and that addressing constraints can enhance profitability and food security, aligning with Nigeria's agricultural transformation goals (Aduba, 2017).

METHODOLOGY

The study was conducted in Kogi State, Nigeria, located in the Middle Belt region of the country, with coordinates approximately between latitudes 6°30'N and 8°45'N and longitudes 6°30'E and 8°00'E (Aduba, 2017). Kogi State spans an area of about 29,833 km² and is characterized by a tropical climate with distinct wet and dry seasons, making it suitable for maize production. The wet season span the period of March till October while the dry season last from November till February. The state comprises 21 Local Government Areas (LGAs) and has a population of approximately 4.7 million (National Population Commission [NPC], 2020). Agriculture is the mainstay of the economy, with smallholder farmers predominantly cultivating crops such as maize, yam, and cassava. The state's fertile soils and favourable rainfall patterns (800–1500 mm annually) support maize farming, though challenges like erratic rainfall and poor infrastructure persist (Akinyemi et al., 2021).

A cross-sectional research design was adopted to collect primary data from smallholder maize farmers. A multi-stage sampling technique was employed to ensure representativeness. In the first stage, five LGAs (Ankpa, Dekina, Ofu, Bassa and Olamaboro) were purposively selected based on their prominence in maize production (Aduba, 2017). In the second stage, five communities were randomly selected from each LGA, resulting in 25 communities. In the third stage, 12 smallholder maize farmers were randomly sampled from each community, yielding a total sample size of 300 farmers. This sample size aligns with recommendations for robust statistical analysis in agricultural studies (Ogunniyi et al., 2021).

Primary data were collected using structured questionnaires administered through face-to-face interviews. The questionnaire captured data on socio-economic characteristics (e.g., age, education, household size, and access to credit), production characteristics (e.g., farm size, input use, and farming experience), costs and returns for profitability analysis, and constraints faced by farmers. Data collection occurred during the 2024 cropping season to ensure accuracy and relevance. Enumerators were trained to ensure consistency, and questionnaires were pre-tested to enhance reliability.

Analytical Methods
Descriptive Statistics: Frequencies, percentages, and means were used to summarize the socio-economic characteristics of the farmers, providing insights into their demographic and economic profiles (Ogunniyi et al., 2021). The analytical methods for the evaluation of profitability included: gross margin, net farm income, return on investment and benefit-cost ratio analyses.

Gross Margin (GM)
Calculated as:
GM = TR - TVC
Where;
GM = Gross Margin
TR = Total Revenue (₦)
TVC = Total Variable Cost (₦)
A positive gross margin indicates profitability.

Net Farm Income (NFI)
Calculated as:
NFI = TR - TVC - TFC
NFI = TR - TC
Where,
NFI = Net Farm Income (₦)
TR = Total Revenue (₦)
TVC = Total Variable Cost (₦)
TFC = Total Fixed Cost (₦)
TC = Total Cost (₦)

Rate of Return (ROR)
Calculated as:
$$ROR = \frac{NR}{TC}$$
Where,
ROR = Rate of Return (Number)
NR = Net Revenue (₦)
TC = Total Cost (₦)
A positive ROR indicates profitability.

Benefit-Cost Ratio (BCR)
Calculated as:
$$BCR = \frac{TR}{TC}$$
Where;
TR = Total Revenue
TC = Total Cost (Variable + Fixed Costs).
A BCR > 1 indicates profitability.

Stochastic Frontier Analysis (SFA) was employed to analyze the determinants of productivity and efficiency. The stochastic frontier production function model developed by Aigner *et al.* (1977) is specified as follows:
$$\text{TFP}_i = f(X_i, \gamma)\epsilon, i = 1, \dots, N$$
$$\epsilon = v_i - u_i$$
The Stochastic Frontier Model is stated thus:
$$\text{TFP}_i = F(X_i, \gamma) + \epsilon_i$$
$$\text{TFP}_i = f(X_1, X_2, X_3, X_4, X_5, X_6, V - U_i)$$
$$Ln\text{TFP}_i = \gamma_0 + \sum_{i=1}^{5} \gamma_i\, LnX_i + \cdots \gamma_n LnX_n + V - U_i$$
Explicitly expressed as:
$$Ln\text{TFP}_i = \gamma_0 + \gamma_1 LnX_1 + \gamma_2 LnX_2 + \gamma_3 LnX_3 + \gamma_4 lnX_4 + \gamma_5 LnX_5 + V_i - U_i$$
Where,
TFP_i = Total Factor Productivity of each Maize Farmer (Kg/₦)
X_1= Maize Seeds Input (Kg)
X_2 = Farm Size (Hectares)
X_3 = Labour Input (Mandays)
X_4 = Quantity of Fertilizer (Kg)
X_5 = Agrochemical Input (Litres)
γ_0 = Constant Term
$\gamma_1 - \gamma_5$ = Regression Coefficients
The Inefficiency Component of the Stochastic Frontier Model is stated thus:
$$U_i = \beta_0 - \beta_1 Z_1 - \beta_2 Z_2 - \beta_3 Z_3 - \beta_4 Z_4 - \beta_5 Z_5$$
Where,
U_i = Inefficiency Component
Z_1= Household Size (Number)
Z_2= Education Level of the maize Farmers (Years Spent Schooling)
Z_3= Age of maize Farmers (Years)
Z_4= Extension Contact (Number of Contact per Month)
Z_5= Farming Experience (Years)
α_0 = Constant Term
$\beta_1 - \beta_5$ = Regression Coefficients
V_i = Error Term
U_i = Measure of Inefficiency
Total Factor Productivity (TFP) level for each of the respondents, in this study, was computed as:
$$\text{TFPi} = \frac{Y_i}{\sum P_i X_i}$$
Where,
TFPi = Total Factor Productivity for ith Farmer (Kg/₦).
Yi = Quantity of Maize Produced (Kg) by ith Farmer.
Pi = Unit Price of ith Variable Input (N)
Xi = Quantity of ith Variable Input Used.
$\sum$ = Summation

Constraints to maize farming were evaluated using a 5-point Likert scale (1 = not a challenge, 2 = mild, 3 = moderate, 4 = severe 5 = very severe). Mean scores were calculated and ranked to identify the most critical constraints, following the approach of Akinyemi et al. (2021).

The mean score was calculated using the formula:

$$MS = \frac{\Sigma(f_i \times w_i)}{\Sigma f}$$

Where:

f_i = Frequency of each Response

w_i = Likert Weight

Σf = Total Number of Respondents

The hypotheses of the study were tested using t-test and z-test statistics.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Smallholder Maize Farmers

The socio-economic characteristics of the 300 sampled farmers as shown in Table 1 provide critical insights into the demographic and economic context shaping maize productivity in Kogi State. The mean age of 41 years, with 54.67% of farmers aged 25–45 years, indicates a youthful farming population, which is advantageous for adopting innovative agricultural practices such as improved seed varieties and modern farming techniques as noted by Ogundari, (2018). This youthful demographic aligns with findings by Adebayo and Olagunju (2020), who noted that younger farmers are more likely to embrace risk and innovation, potentially increasing productivity. However, the predominance of male farmers, 75%, reflects gender disparities in Nigerian agriculture, where cultural norms often limit women's access to resources and decision-making (Ojo et al., 2020). This gender imbalance may constrain overall productivity, as female farmers, when empowered, contribute significantly to agricultural output (Awotide et al., 2016).

The mean household size of 5 persons suggests adequate labour availability for labour-intensive maize farming, but it also implies higher dependency ratios, which could strain household resources and limit reinvestment in farming activities (Adebayo & Olagunju, 2020). The educational profile, with 33% having secondary education and 22% tertiary, indicates a moderate level of literacy, which is crucial for understanding and adopting extension advice and modern technologies (Abdulaleem et al., 2019). However, the limited access to credit (46.33%) and extension services (62.67% with no contact) highlights systemic barriers to resource acquisition, corroborating the findings of Ogunniyi et al. (2021), who emphasized that financial and informational constraints significantly hinder smallholder productivity. The mean farming experience of 10 years reflects substantial expertise, which can enhance technical efficiency through accumulated knowledge of local conditions as noted by Ogundari, (2018). However, the small average farm size of 1.2 hectares, with 95.67% of farms under 2 hectares, limits economies of scale and mechanization potential, aligning with the findings of Awotide et al. (2016), who noted that small farm sizes constrain productivity in Nigerian agriculture. These socio-economic characteristics provide a foundational understanding of the factors influencing productivity and the context for addressing constraints, setting the stage for subsequent analyses.

Table 1: Socioeconomic Characteristics of Maize Farmers in Kogi State, Nigeria

Characteristic	Frequency	Percentage (%)	Mean
Age (Years)			
< 25	76	25.33	
25 – 45	164	54.67	
> 45	60	20	
Total	**300**	**100**	**41**
Gender			
Male	226	75	
Female	74	25	
Total	**300**	**100**	
Household Size			
<2	89	29.67	
2 – 6	134	44.67	
>6	77	25.67	
Total	**300**	**100**	**5**
Level of Education			
None	63	21	
Primary	72	24	
Secondary	99	33	
Tertiary	66	22	

Total	**300**	**100**	
Maize Farming Experience (Years)			
<5	63	21	
5 – 15	148	49.33	
>15	89	29.67	
Total	**300**	**100**	**10**
Membership of Cooperative Group			
Yes	154	51.33	
No	146	48.67	
Total	**300**	**100**	
Access to Credit			
Yes	139	46.33	
No	161	53.67	
Total	**300**	**100**	
Farm Size (ha)			
<1	131	43.67	
1 – 2	156	52	
>2	13	4.33	
Total	**300**	**100**	1.2
Extension Contact per Month			
None	188	62.67	0.3
1 – 2	103	34.33	
>2	9	3	
Total	300	100	

Source: Computed from Field Survey Data (2025)

Profitability of Smallholder Maize Farming

The profitability analysis presented in Table 2 demonstrates that smallholder maize farming in Kogi State is economically viable. The gross margin of ₦271,309, net farm income of ₦199,122, rate of return (ROR) of 0.47, and benefit-cost ratio (BCR) of 1.47 per season indicate positive returns, consistent with the findings of Aduba (2017), who reported profitability in Kogi State maize production. The BCR of 1.47 suggests that for every ₦1 invested, farmers earn ₦1.47, which is comparable to findings by Adeyemo et al. (2019) in Oyo State, where maize farming yielded a BCR of 1.5. However, the high labour cost (48.95% of total variable cost) underscores the labour-intensive nature of smallholder maize farming, aligning with the report of Adebayo and Olagunju (2020), who identified labour as the dominant cost component in Nigerian maize production. This reliance on manual labour, coupled with limited mechanization (as evidenced in Table 4), increases production costs and reduces efficiency (Ogundari, 2018).

The variable costs, including seeds (10.82%), fertilizers (6.69%), and agrochemicals (6.14%), reflect low input intensity, which may contribute to the lower yields compared to global standards (Awotide et al., 2016). Fixed costs, such as land rent (7.34%) and asset depreciation (5.09%), indicate underinvestment in durable assets like machinery, which limits long-term productivity gains (Ojo et al., 2020). Transportation costs (7.28%) highlight infrastructural challenges, as poor road networks increase market access costs, consistent with the findings of Falola et al. (2022). The positive profitability, despite these challenges, suggests that maize farming remains a viable livelihood strategy, but margins could be improved through cost-reducing interventions, such as input subsidies and improved market linkages (Adeyemo et al., 2019). These findings emphasize the need for policies that address cost structures and enhance access to affordable inputs to sustain and improve profitability among smallholder maize farmers.

Table 2: Average Cost and Return of Maize Farming per Season in the Study Area

Item	Amount (₦)	Percentage of Total Cost (%)
Variable Inputs Cost		
Maize Seeds	46,213	10.82
Agrochemicals	26,214	6.14
Fertilizer	28,581	6.69
Labour	209,132	48.95
Transportation	31,094	7.28
Miscellaneous	13,778	3.23
Total Variable Cost (TVC)	**355,012**	83.10
Fixed Inputs		
Interest on Loans	19,080	4.47
Rent on Land	31,361	7.34
Depreciation on Assets	21,746	5.09
Total Fixed Cost (TFC)	**72,187**	16.90
Total Cost	**427,199**	
Total Revenue	**626,321**	
GM (TR - TVC)	**271,309**	
NFI (GM - TFC)	**199,122**	
ROR	**0.46611064**	
BCR	**1.46611064**	

Source: Computed from Field Survey Data (2025)

Determinants of Productivity among Smallholder Maize Farmers in Kogi State, Nigeria

The Stochastic Frontier Analysis (SFA) results presented in Table 3 provide a robust evidence of the drivers of maize productivity, rejecting the null hypotheses (H_{02} and H_{03}) that socio-economic and production characteristics have no significant effect on productivity. The Cobb-Douglas production function shows that seeds (β = 0.3829, $p < 0.01$), farm size (β = 0.1684, $p < 0.01$), labour (β = 0.1134, $p < 0.01$), fertilizer (β = 0.0069, $p < 0.01$), and agrochemicals (β = 0.0156, $p < 0.05$) are significant positive determinants of maize output. These findings align with the findings of Adebayo and Olagunju (2020), who found that increased input use, particularly seeds and fertilizers, significantly boosts maize yields in Nigeria. The strong influence of farm size suggests that larger farms benefit from economies of scale, though the small average farm size (1.2 ha) limits this advantage for most farmers (Awotide et al., 2016). Labour's significance reflects its critical role in smallholder systems, but over-reliance on manual labour may reduce efficiency, as noted by Ogundari (2018).

In the inefficiency model, education (γ = -0.0003, $p < 0.01$), extension contact (γ = -0.0639, $p < 0.10$), and farming experience (γ = -0.1950, $p < 0.05$) significantly reduce technical inefficiency, enhancing productivity. Education improves farmers' ability to adopt improved practices, such as integrated pest management, as supported by Abdulaleem et al. (2019). Extension contact facilitates knowledge transfer, aligning with the findings of Ogunniyi et al. (2021), who found that regular extension visits reduce inefficiency by 10–15%. Farming experience enhances efficiency through practical knowledge of local conditions, consistent with the report of Adeyemo et al. (2019). The non-significance of household size and age suggests that these factors have limited impact on inefficiency, possibly due to labour saturation or age-related productivity plateaus as noted by Ojo et al., (2020). The findings highlight the interplay of production and socio-economic factors in driving productivity, supporting targeted policy measures to enhance input access and knowledge dissemination.

Table 3: Result of the Stochastic Frontier Analysis on the Drivers of Productivity among Smallholder Maize Farmers in Kogi State, Nigeria

Variable	Coef.	Std. Err.	Z	P>|z|
TFP				
Seeds	0.3829***	0.097	3.95	0.000
Farm Size	0.168434***	2.59	0.064	0.000
Labour	0.113399***	0.02707	4.1951	0.000
Fertilizer	0.006882***	0.00237	3.0501	0.002
Agro Chemical	0.015646**	0.00626	2.5212	0.025
Constant	6.047944***	1.5501	3.9005	0.000
lnsig2v				
Constant	-8.82425	60.457186	-0.1481	0.89
lnsig2u				
Household Size	0.3128373	0.2590789	1.2201	0.231
Education	-0.000289***	0.0001127	-2.6901	0.003
Age	-0.158253	0.206859	-0.7899	0.391
Extension	-0.0638939*	0.1191027	0.5124	0.059
Experience	-.1950378**	0.0951327	-2.2113	0.025
Constant	-1.721878**	0.9368812	-1.9284	0.047
sigma_v	0.2609	0.5607		
Wald chi2(5)	78.921			
Prob. > chi2	0			
No. of obs	300			
Log likelihood	-9.180681			

Source: Computed from Field Survey Data (2025)

Constraints Facing Smallholder Maize Farmers in Kogi State, Nigeria

The Likert-scale ranking of 18 constraints in Table 4 provides a comprehensive overview of the barriers faced by smallholder maize farmers, with implications for policy and practice. Lack of government support (mean = 4.48) and limited access to credit (mean = 4.29) emerged as the most severe constraints, reflecting systemic policy and financial barriers. These findings align with the findings of Ogunniyi et al. (2021), who noted that inadequate government support, such as limited input subsidies, restricts smallholder productivity. Limited credit access, a critical bottleneck, hinders investment in inputs like fertilizers and seeds, corroborating the report by Adeyemo et al. (2019). High mechanization costs (mean = 4.20) and post-harvest losses (mean = 3.94) further exacerbate productivity challenges, as mechanization is prohibitively expensive for smallholders, and poor storage facilities lead to significant losses (Awotide et al., 2016).

High input costs (mean = 3.81) and interest rates (mean = 3.77) reflect financial constraints, limiting farmers' ability to invest in productivity-enhancing inputs (Falola et al., 2022). Inadequate extension services (mean = 3.41) and poor road infrastructure (mean = 3.36) highlight informational and logistical barriers, consistent with the findings of Akinyemi et al. (2021), who reported that limited extension services reduce adoption of climate-smart practices. Environmental constraints, such as erratic rainfall (mean = 2.20) and flooding (mean = 2.33), underscore the impact of climate change, aligning with the findings of Ojo et al. (2020), who found that climate variability reduces maize yields by up to 20%. Pest and disease infestations (mean = 2.56) rank lower, suggesting effective local coping strategies, though they remain significant (Adebayo & Olagunju, 2020). Constraints like poor market access (mean = 3.11) and unstable produce prices (mean = 3.31) reflect market inefficiencies, which erode profitability (Ogundari, 2018). These findings emphasize the need for multifaceted interventions, including improved credit access, extension services, and infrastructure development, to address the complex constraints facing smallholder maize farmers.

Table 4: Likert-Scale Ranking of Constraints Faced by Maize Farmers in the Study Area

S/N	Constraints	Mean Score	Rank
1	Lack of government support	4.48	1
2	Limited access to credit	4.29	2
3	Limited and high cost of mechanization	4.20	3
4	High post-harvest losses	3.94	4
5	High cost of fertilizers and agrochemicals	3.81	5
6	High Interest Rates	3.77	6
7	Lack of processing and storage facilities	3.68	7
8	Inadequate extension services	3.41	8
9	Poor road infrastructure and high transportation cost	3.36	9
10	Unstable produce prices	3.31	10
11	Poor market access	3.11	11
12	Limited access to quality seeds	3.08	12
13	Poor access to land	2.99	13
14	Insecurity and herders attack	2.78	14
15	Pest and disease infestations	2.56	15
16	Lack of irrigation infrastructure	2.40	16
17	Flooding	2.33	17
18	Drought and unpredictable rainfall	2.20	18

Source: Computed from Field Survey Data (2025)

Hypothesis on the Profitability of Smallholder Maize Farming

The t-test results presented in Table 5 demonstrate that smallholder maize farming in Kogi State, Nigeria is profitable, leading to the rejection of the null hypothesis (H_{01}) that smallholder maize farming is not profitable. The mean net farm income (NFI) was ₦199,122, with a standard deviation of ₦157,428.1 and a 95% confidence interval ranging from ₦175,708.74 to ₦222,535.26. The t-calculated value of 21.91, compared to the t-tabulated value of 2.576 at a 1% significance level (α = 0.01) with 299 degrees of freedom, yields a p-value of 0.0000 for the alternative hypothesis (Ha: mean > 0). This highly significant result indicates that the mean NFI is statistically greater than zero, confirming the profitability of maize farming among smallholder farmers in Kogi State, Nigeria.

Table 5: Result of the t-test on Profitability of Maize Farmers in the Study Area

Variable	Obs.	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
NFI	300	199,122	9,089.1	157,428.1	222,535.26	175,708.74
mean = mean(NFI) Ho: mean = 0	Ha: mean < 0 Pr(T < t) = 1.0000		Ha: mean != 0 Pr(|T| > |t|) = 0.0000		Ha: mean > 0 Pr(T > t) = 0.0000	
t-calc. =21.91						
t-tab (α=0.01) = 2.576						
df = 299						

Source: Computed from Field Survey Data (2025)

SUMMARY

This research investigated the profitability, constraints, and productivity drivers of smallholder maize farming in

Kogi State, Nigeria, surveying 300 farmers across five Local Government Areas using a multi-stage sampling approach. Data were analyzed with descriptive statistics, Stochastic Frontier Analysis (SFA), Likert scale ranking, z-test statistics and t-test statistics to address four objectives: assessing socio-economic characteristics, evaluating profitability, analyzing productivity determinants, and identifying constraints. Findings showed farmers had a mean age of 41 years, 75% were male, and 55% had secondary or tertiary education, but only 46.33% accessed credit and 37.33% had extension contact. Maize farming was profitable, yielding a net farm income of ₦199,122, a benefit-cost ratio of 1.47, and a gross margin of ₦271,309, with a t-test ($t = 21.91$, $p < 0.01$) confirming profitability. SFA results indicated that seeds, farm size, labour, fertilizer, and agrochemicals significantly boosted output, while education, extension contact, and farming experience reduced technical inefficiency, rejecting null hypotheses on socio-economic and production effects. The most severe constraints were lack of government support (mean = 4.48), limited credit access (mean = 4.29), and high mechanization costs (mean = 4.20), highlighting systemic and financial barriers. The study underscores the viability of maize farming but emphasizes the need to address constraints through policy interventions. Recommendations include improving credit access, enhancing extension services, and providing input subsidies to boost productivity and profitability, aligning with Nigeria's food security objectives.

CONCLUSION

This study confirmed that smallholder maize farming in Kogi State, Nigeria, is profitable and has significant potential to enhance rural livelihoods and food security, despite numerous constraints. The analysis of 300 farmers revealed a youthful, moderately educated farming population, but limited access to credit and extension services hinders productivity. The profitability analysis, supported by a net farm income of ₦199,122 and a benefit-cost ratio of 1.47, rejected the null hypothesis of non-profitability, underscoring maize farming's economic viability. Stochastic Frontier Analysis identified seeds, farm size, labour, fertilizer, and agrochemicals as key productivity drivers, while education, extension contact, and experience reduced inefficiency, rejecting hypotheses that socio-economic and production factors have no impact. However, severe constraints, including lack of government support, limited credit access, and high mechanization costs, pose significant barriers. These findings align with the Stochastic Frontier Production Theory and Theory of Constraints, highlighting the need to address inefficiencies and bottlenecks to optimize productivity. The study recommends policy interventions such as improved credit access, enhanced extension services, and input subsidies to mitigate constraints and leverage productivity drivers. By addressing these challenges, Kogi State can enhance maize production, contributing to Nigeria's agricultural transformation and food security goals.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed to enhance the productivity and profitability of smallholder maize farming in Kogi State, Nigeria:

i. **Enhancing Credit Access:** Policymakers should facilitate low-interest credit schemes through microfinance institutions to address the severe constraint of limited credit access (mean = 4.29), enabling farmers to invest in inputs.
ii. **Strengthening Extension Services:** there should be increase the frequency and quality of extension contacts (only 37.33% had contact) to disseminate modern farming techniques, as extension significantly reduces inefficiency.
iii. **Subsidizing Inputs:** Subsidies should be provide for seeds, fertilizers, and agrochemicals to reduce high input costs (mean = 3.81), in order to boost productivity.
iv. **Promotion of Mechanization:** Government should develop affordable mechanization programs to address high mechanization costs (mean = 4.20), thereby reducing labour costs and increasing efficiency.
v. **Improving Infrastructure:** Government should invest in rural road networks to lower transportation costs (7.28% of variable costs), thereby enhancing market access.

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