



**PROFITABILITY ANALYSIS AND DETERMINANTS OF TOMATO OUTPUT IN
FEDERAL CAPITAL TERRITORY (FCT), ABUJA, NIGERIA**

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ABSTRACT

The study examined the profitability and determinants of tomato output in the Federal Capital Territory (FCT), Abuja, Nigeria. Primary data were collected from 80 tomato farmers across six Area Councils using purposive and proportionate random sampling techniques. Descriptive statistics, gross margin analysis, and Ordinary Least Squares (OLS) regression were used in achieving research objectives. The result showed that sampled farmers were predominantly male (65.0%), young (80.0%) with mean age of 33.7 years, and largely low experienced (73.8%) with six or fewer years in tomato farming. Gross margin analysis revealed a mean loss of ₦971,057 per season, a benefit-cost ratio of 0.786, and only 11.3% of farms achieving positive returns which stands as a sharp deterioration from the pre-fuel subsidy profitable baseline. Fuel price change was the most strongly perceived increase (Likert mean = 3.49; $t = 3.956$, $p < 0.001$). OLS estimation identified seed price change ($\beta = -0.473$, $p = 0.028$) and the composite constraint score ($\beta = 1.425$, $p = 0.002$) as the only statistically significant determinants of log yield. The study thus concluded that tomato farming unprofitability in the FCT was influenced by the prevailing input price conditions of fertilizer, fuel, labour, and agrochemical costs, and the seed price changes was the major determinant of declining tomato yield. The findings thus recommend targeted price stabilisation mechanisms, improved subsidy delivery, and credit access expansion to restore the viability of peri-urban tomato production.

Keywords: Input, Price, Profitability, Smallholder, Farmers, Tomato

INTRODUCTION

Tomato (*Solanum lycopersicum L.*) is ranked among the most economically significant vegetable crops globally, serving as a staple component of diets and an important source of vitamins, minerals, and antioxidants (Food and Agriculture Organization (FAO, 2021). In Nigeria, tomato occupies a central place in daily household food consumption particularly in the preparation of stews, soups, and sauces and is cultivated across a wide range of agro-ecological zones, from the semi-arid north to the humid south (Ugonna *et al.*, 2015). Despite being one of the largest tomato producers on the African continent, Nigeria paradoxically continues to struggle to meet domestic demand, which is growing steadily in tandem with rapid population growth and urbanisation. The Federal Capital Territory (FCT), Abuja, presents a particularly important context for studying tomato production. As a rapidly expanding urban and peri-urban region with rising consumer demand for fresh vegetables, the FCT depends substantially on smallholder tomato farmers operating in its rural and semi-urban areas to supply local markets. Studies have documented that tomato farmers in the FCT face constraints including high input costs, inadequate capital, poor road access, and weak price control mechanisms (Ajibare *et al.*, 2022). These challenges are further compounded by the volatility of input prices particularly fertilizers, seeds, agrochemicals, and hired labour which have intensified considerably in recent years due to macroeconomic pressures, foreign exchange instability, and supply chain disruptions.

Input costs constitute the dominant share of total production expenditure for smallholder farmers. When these costs rise faster than output prices, farm profitability declines sharply, creating disincentives for investment in production. In sub-Saharan Africa, fertilizer prices have more than tripled since early 2020, driven by global supply chain disruptions, the Russia-Ukraine conflict, and rising inflation (World Bank, 2022). Nigeria is particularly vulnerable as a net importer of fertilizer inputs (Bonilla-Cedrez *et al.*, 2021). These dynamics translate directly into reduced input application



rates, substitution of improved inputs for inferior alternatives, and ultimately, lower crop yields and food insecurity. Despite the economic significance of tomato in the FCT and the well-documented pressures on input markets, empirical research specifically examining how input price changes affect tomato production outcomes particularly during the post fuel subsidy in this territory remains limited. Most existing Nigerian studies focus on northern states such as Adamawa, Kaduna and Kano, where large-scale tomato production is concentrated, leaving a notable gap in evidence from the FCT.

This study therefore aims to fill this gap by empirically investigating the effects of farm input price changes on tomato production in the FCT, Abuja. The specific objectives are to: Describe the socioeconomic characteristics of tomato farmers in the FCT; Analyse the cost structure and profitability of tomato production in the study area; Determine the effect of farm input price changes on tomato output and farm income; Analyse the determinants of Tomato Output and identify the constraints associated with input price escalation facing tomato farmers and Coping strategies.

METHODOLOGY

Study Area

This study was conducted in the Federal Capital Territory (FCT), Abuja, Nigeria. The FCT is situated in the central geographical belt of Nigeria, lying approximately between latitudes 8°25'N and 9°25'N, and longitudes 6°45'E and 7°39'E. The territory covers approximately 7,315 square kilometres and comprises six Area Councils: Abuja Municipal, Gwagwalada, Kuje, Abaji, Bwari, and Kwali. The FCT has a tropical savannah climate characterised by two distinct seasons known as wet season from April to October and dry season from November to March with average annual rainfall of approximately 1,200mm and temperatures ranging between 24°C and 38°C.

Agriculture is a significant livelihood activity in the rural and peri-urban areas of the FCT's Area Councils, with tomato cultivation practised extensively across Abaji, Gwagwalada, Kuje, and Kwali Area Councils. The proximity to Abuja's urban centre creates robust market demand for fresh tomatoes and other vegetables, making peri-urban farming an economically important activity in the study area.

Research Design

The study adopts a cross-sectional survey research design with primary data collection from tomato farmers in the FCT. The design captures farm-level data collected on input use, input prices, production outcomes, and constraints faced by tomato farmers in the study area at once.

Population, Sampling and Data Collection

The target population comprised of all tomato farmers operating in the FCT across the major tomato-producing Area Councils. A purposive and proportionate random sampling techniques were employed. The first stage involved purposive selection of all area Councils in FCT namely Gwagwalada, Bwari, Kuje, Kwali, Abaji and AMAC for the study. In the second stage, a proportionate random sampling approach was used to select tomato farmers each from the area councils. In total, 96 tomato farmers were selected for the study. However, a total of eighty (80) respondents provided adequate responses valid for this study were used for analysis.

Method of Data Analysis

Data collected were analysed using descriptive statistics, gross margin analysis, and Ordinary Least Square Regression (OLS) model were estimated using STATA 17 statistical software.

Descriptive Statistics

Descriptive statistics such as frequencies, percentages, means, standard deviations were used to describe the socioeconomic characteristics of respondents, input use patterns, and the magnitude of input price changes. Likewise, Likert-scale responses on perceived effects of input price changes were analysed using mean scores and ranked accordingly.

Gross Margin Analysis

Gross margin analysis was employed to assess the profitability of tomato production. The gross margin (GM) was computed as:

$$GM = TR - TVC \quad \dots(1)$$



where TR is total revenue from tomato sales, and TVC is the total variable costs of production including expenditure on seeds, fertilizers, pesticides, herbicides, hired labour, irrigation, and transportation. The benefit-cost ratio (BCR) was computed.

Ordinary Least Square (OLS) (Effects of Input price changes on Tomato Output)

To determine the effects of input price changes on tomato output, an OLS regression based on a modified Cobb-Douglas production function framework were estimated. The model is specified as:
$$\ln(Q) = \beta_0 + \beta_1 \ln(P_f) + \beta_2 \ln(P_s) + \beta_3 \ln(P_p) + \beta_4 \ln(P_l) + \beta_5 \ln(P_{iw}) + \beta_6 \ln(F_z) + \beta_7 \ln(\text{Age}) + \beta_8 (\text{Edu}) + \beta_9 (\text{Ext}) + \beta_{10} (\text{CrD}) + \varepsilon \quad \dots (2)$$

where Q is total tomato output (kg); P_f is the price of fertilizer per bag (₦); P_s is the price of improved seed per sachet (₦); P_p is the price of pesticides/agrochemicals per litre (₦); P_l is the wage rate for hired labour per day (₦); P_{iw} is the cost of irrigation water per season (₦); F_z is farm size (in hectares); Age is farmer age (years); Edu is level of education (years of schooling); Ext is access to extension services (1 = yes, 0 = no); Crd is access to credit (1 = yes, 0 = no); β_0 is the intercept; β_1 to β_{10} are regression coefficients; and ε is the error term.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Table 1 reveals that tomato farmers in FCT are majorly male (65.0%) and the female constitute of about 35.0%. This male predominance in tomato cultivation across the FCT confirms persistent gender disparities in access to land, credit and productive inputs that have been widely documented in Nigerian agriculture. According to World Bank (2023) report, women plot managers in Nigeria produce approximately 30% less per hectare than male counterparts, and this shortfall primarily attributed to differential input access, limited participation in extension services and labour market disadvantages. The gender distribution findings is consistent with the (85.0%) male dominance reported among smallholder tomato farmers in Kogi State by Usman (2022) and corroborates the (74.7%) male participation found among contract and non-contract tomato farmers in the same region. Similarly, majority (66.3%) of the respondents were married while (33.8%) of them single. The high proportion of married individuals used for this study further indicate the respondents were respected individuals. Also, majority of them (63.8%) fall within the 21–35 years age bracket and were young adults in their economically active years with a mean age of 33.74 years. This is consistent with the findings of Ajibare *et al.* (2022), who reported a mean farmer age of approximately 36 years in a comparable FCT-based tomato study using 100 respondents, and aligns with evidence from Wollburg *et al.* (2024) that younger smallholders tend to dominate vegetable crop systems across sub-Saharan Africa (SSA). The positive skew in age with only 12.6% of farmers aged above 45 years could imply progressive exit from tomato farming among older generations, an indication of intergenerational transfer of production knowledge and adaptive capacity under input price stress. In addition, the mean formal education was 13.47 years, which is equivalent to NCE/OND education level attained by the majority (33.8%). The result closely followed by HND/B.Sc. or higher degree qualifications (30.0%), so that nearly two-thirds of farmers have some form of tertiary-level qualification. About (20.0%) of the respondents attained primary education and below. This is a notably high educational profile for a smallholder farming population further reinforces the peri-urban character of the FCT, where proximity to government institutions, universities and urban labour markets creates a more educated working-age population. This corroborates the findings of Ajibare *et al.* (2022) who also reported that majority of tomato farmers in FCT attained moderate to high educational level. This shows that FCT farmers are generally literate and likely receptive to evidence-based extension messages.

Furthermore, majority (73.8%) of the farmers had not more than six (6) years of experience in tomato farming. The mean farming experience was 5.49 years. This confirms substantial heterogeneity and predominantly less experienced tomato farmers majority in the study area. This pattern resonates with Wollburg *et al.*, (2024) who reported declining total factor productivity (−3.5%/year) in SSA smallholder systems partly attributable to shallow experience bases. The practical implication is thus heightened vulnerability to input price shocks among newer entrants who might lack the adaptive management capacity and market networks developed through sustained production experience.



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Likewise, findings on farming systems show (51.3%) of respondents operate under combined rain-fed and irrigated systems, (36.3%) practice exclusively rain-fed agriculture, and only (12.5%) practice irrigation alone. Combined-system farmers hold a productivity advantage during dry spells as irrigation access allows continued production when rain stops, though with higher running cost of fuel and other infrastructure costs. Furthermore, (48.8%) of tomato farmers use both family and hired labour, 31.3% of them use family labour and 20.0% of them used only hired labour.



Table 1: Distribution of Respondents based on Socioeconomic Characteristics

Category	Sub-category	Frequency	Percentage (%)	Mean
Sex	Male	52	65.0	
	Female	28	35.0	
Marital Status	Married	53	66.3	
	Single	27	33.8	
Age (years)	21 – 25	14	17.5	33.7 years
	26 – 30	18	22.5	
	31 – 35	19	23.8	
	36 – 40	13	16.2	
	41 – 45	6	7.5	
	46 – 50	7	8.8	
	51 and above	3	3.8	
Farming Experience (years)	1 – 3 years (beginner)	30	37.5	5.5 years
	4 – 6 years (developing)	29	36.2	
	7 – 10 years (intermediate)	14	17.5	
	11 – 15 years (experienced)	4	5.0	
	16 years and above (veteran)	3	3.8	
Education Level	Primary Education	16	20.0	13.5 years
	Junior Secondary School (JSS)	5	6.2	
	Senior Secondary School (SSS/WAEC)	8	10.0	
	NCE / OND (Post-secondary diploma)	27	33.8	
	HND / B.Sc. and above	24	30.0	
Farming System	Both (combined)	41	51.3	
	Rain-fed	29	36.3	
	Irrigated	10	12.5	
Labour Type	Combination	39	48.8	
	Family	25	31.3	

Category	Sub-category	Frequency	Percentage (%)	Mean
Primary Occupation	Hired	16	20.0	
	Farming	37	46.3	
	Trading	22	27.5	
	Civil service	21	26.3	
Total		80	100.0	

Source: Field Survey, 2026

Profitability Analysis (Gross Margin) and Benefit-Cost Ratio

Table 2 shows the mean total variable input cost (₦1,409,650) exceeded mean gross revenue (₦438,593). This indicates a mean gross margin of -₦971,057 per season. The benefit-cost ratio (BCR = 0.786) is well below the break-even threshold of 1.0, thus, for every naira spent on variable inputs, tomato farmers only recovered about 79 kobo in revenue. The result further show, only 9 of 80 farms (11.3%) recorded a positive gross margin. The standard deviation of the gross margin (₦2,109,494) exceeds twice the absolute mean loss, which indicates majority operate at a loss. These figures are against the findings Ajibare *et al.* (2022) who reported a positive gross margin and a BCR above 1.0 for FCT tomato farmers using a comparable cross-sectional survey design. However, the study was conducted during the pre- fuel subsidies removal & forex unification crisis. The transition from profitable to loss-making within approximately two years is a direct consequence of the input price escalation. Similar finding by Wolde *et al.* (2024) reported a cost-benefit ratio of 0.83 when full production costs including irrigation water were included, highlighting that the financial fragility of smallholder tomato farming under rising input costs is not specific to Nigeria but shows a broader structural challenge in irrigated horticulture across SSA.

Table 2: Summary of Profitability Indicators (N = 80)

Indicator	Mean (₦)	Std. Dev. (₦)	Minimum (₦)	Maximum (₦)
Total variable input cost	1,409,650	2,390,598	37,900	11,650,000
Gross revenue from sales	438,593	1,381,936	300	10,500,000
Gross margin (GM = TR-TVC)	-971,057	2,109,494	-9,822,345	5,334,500
Cost per hectare (₦/ha)	1,264,820	1,845,310	4,430	13,350,000
Benefit-cost ratio (BCR)	0.786	0.894	0.009	3.210
Profitable farms (GM > 0)	9 of 80 (11.3%)	—	—	—

Source: Field Survey, 2026

Note: GM = Gross Margin; TR = Total Revenue; TVC = Total Variable Cost

Perceived Effect of Input Price Changes on Tomato Production

Table 3 shows (90.0%) of the farmers reported profit reduction, this is followed by significant cost increases (86.3%), adverse effects on farm budgeting (85.0%), and discouragement of farm expansion (83.8%). Similarly, about (48.8%) reported that output had actually decreased, while (28.8%) reported stable output and (22.5%) reported an increase respectively. These response rates are consistent with the World Bank (2024) survey findings across five SSA countries that shows widespread profit compression, input use reduction and investment suppression among smallholders following the 2021–2022 fertilizer and fuel price shocks.



Table 3: Perceived effect of Input price changes on Tomato Production

Perceived Effect	Frequency (n)	Percentage (%)
Input costs increased significantly	69	86.3
Farm budgeting adversely affected	68	85.0
Profit reduced or eliminated	72	90.0
Farm expansion plans discouraged	67	83.8
Output decreased	39	48.8
Output remained stable	23	28.8
Output increased despite price rises	18	22.5

Source: Field Survey, 2026

Determinants of Tomato Yield in FCT

Figure 1 shows the Cobb-Douglas production function estimated in log-linear form was jointly significant ($F = 4.743$, $p < 0.0001$) and explained 27.5% of the variation in log tomato yield ($R^2 = 0.275$; adjusted $R^2 = 0.170$). Heteroscedasticity-consistent (HC3) standard errors were applied following detection of heteroscedasticity via the Breusch-Pagan test. The Ramsey Reset test confirmed no functional form misspecification ($p = 0.143$). The result of OLS shows two variables (seed price changes and constraint score) attained statistical significance and were the determinants of tomato yield in the study area.

Seed price change coefficient ($\beta = -0.473$) significant at ($p = 0.028^{**}$) shows a one-unit increase in the perceived seed price change would bring about a 47.3% reduction in log tomato yield, *ceteris paribus*. This further shows seed price escalation as the most consequential individual input cost driver for yield under the present conditions. This finding is consistent with theoretical predictions by (Bonilla-Cedrez *et al.*, 2021) from production theory seed quality and quantity are foundational, non-substitutable inputs that determine the upper bound of achievable yield irrespective of other management decisions. Practically, higher seed prices constrain both the quantity applied and the quality of varieties accessible to resource-limited farmers. This is particularly relevant in the FCT context, where Ugonna *et al.* (2015) reported limited access to certified improved tomato varieties as a persistent structural constraint in Nigeria's tomato value chain.

The composite constraint score coefficient ($\beta = 1.425$) significant at ($p = 0.002^{***}$) exhibits a large, positive, and highly significant effect on log yield. This counterintuitive result reflects a well-documented report by (Wollburg *et al.*, 2024; Liverpool-Tasie *et al.*, 2017) that farmers who are actively engaged in commercial vegetable production and therefore experience and report more binding constraints tend to be larger-scale, more commercially oriented operators with higher absolute yields. This positive association between constraint awareness and yield is not evidence that constraints enhance productivity; rather, it indicates that the most productive farmers are precisely those sufficiently engaged in commercial production to recognise and articulate constraints clearly. This interpretation is supported by the positive (though non-significant) OLS coefficient for farming experience ($\beta = 0.063$), which increases with commercial engagement.

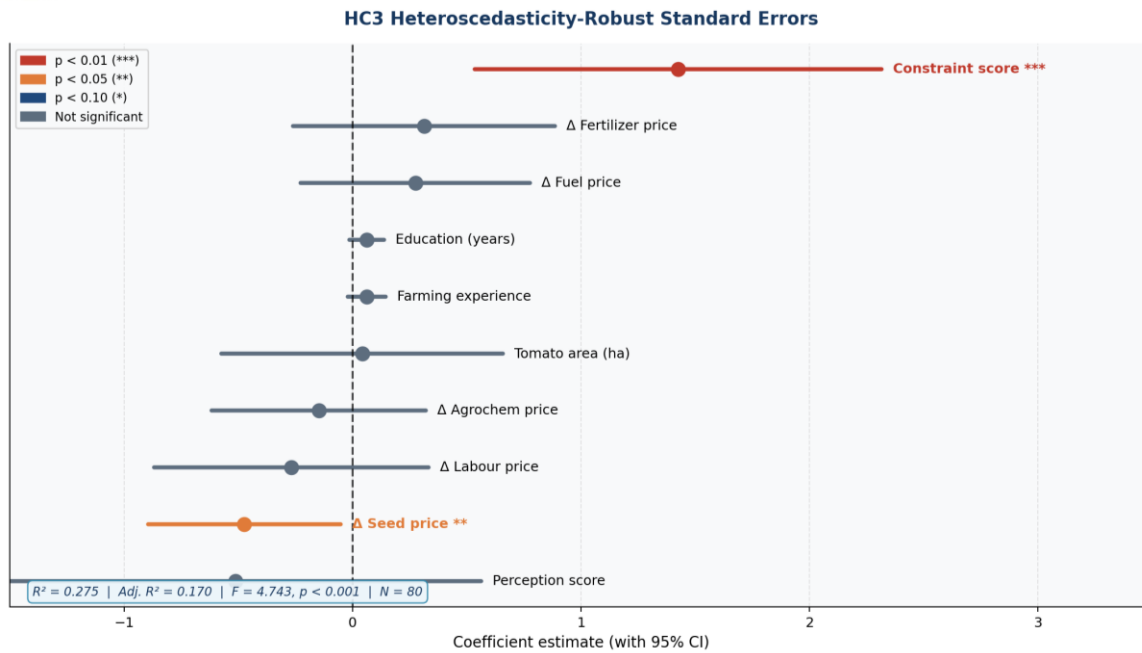


Figure 1: Determinants of Tomato Yield (kg/ha)
Source: Field Survey, 2026

Constraints Severity and Coping Strategies

Figure 2a shows market price instability emerged as the most severely rated constraint (mean = 3.02), followed by limited credit access (2.80), high fertilizer prices (2.73), high agrochemical prices (2.61), high labour wages (2.59) and weak extension service delivery (2.52). The ranking of price instability above the absolute level of input prices indicates that the unpredictability of input costs which disrupts farm budgeting, discourages capital investment and distorts planting decisions is a more severe problem than the costs themselves. This mirrors findings from World Bank (2024) and Njoroge *et al.* (2023) who identified price volatility and credit constraints as the primary structural barriers to smallholder input use and farm investment across SSA.

Furthermore, in response to rising input costs, Figure 2b shows farmers deployed increased family labour most frequently (mean = 3.23), followed by substitution with organic manure (3.08) and outright reduction in purchased input quantities (3.02). Crop diversification (2.84) and farm size reduction (2.81) ranked lower. Formal borrowing was the least frequently used strategy (mean = 2.35), consistent with the high severity rating placed on credit constraints that which most farmers cannot rely on further due to its inaccessibility. Taken together, these responses constitute a pattern of downward intensification that Wollburg *et al.* (2024) characterise as a poverty trap dynamic common across SSA smallholder systems, that is, rational short-term response to price shocks which simultaneously generates the low productivity and perpetuates vulnerability to future shocks. The third-ranked strategy input quantity reduction (mean = 3.02) reinforces a direct transmission mechanism from input price rises to the yield reductions observed in the OLS model result.

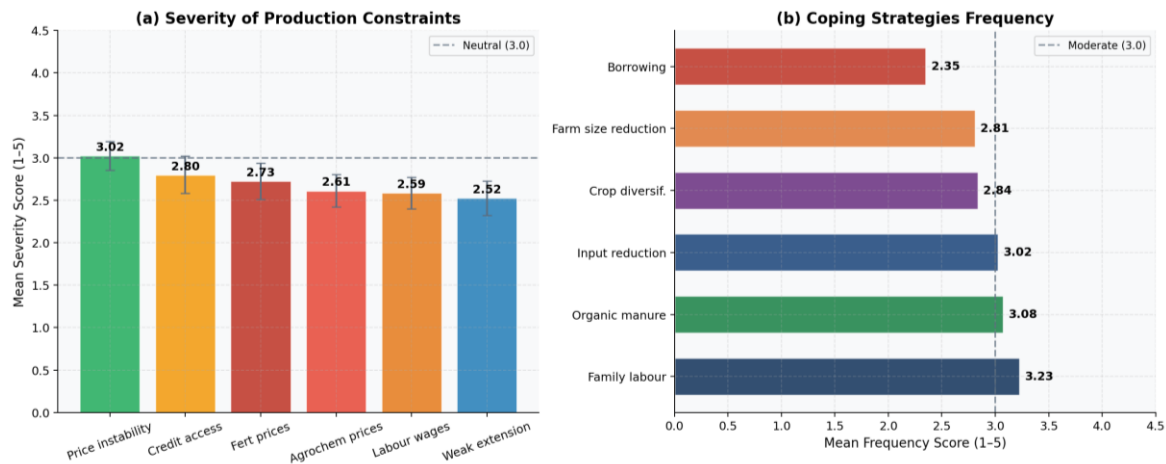


Figure 2: Production Constraints Severity and Coping Strategies

Source: Field Survey, 2026

CONCLUSION AND RECOMMENDATION

This study revealed that tomato farming in the FCT under prevailing input price conditions is not profitable, with 88.7% of the sampled respondents recording net losses and a mean benefit-cost ratio of 0.786. Also, seed price changes emerged as the major input cost driver of yield reduction, while the broader profitability crisis arises from simultaneous pressure across fertilizer, fuel, labour, and agrochemical costs, confirmed by OLS analysis. Farmers' responses through cost-cutting strategies were not enough to mitigate the cycle of declining output. By and large, policy intervention such as efficient input price subsidy programmes, accessibility of agricultural credit and the price regulation are recommended to re-engineer the disrupts investment planning across all six Area Councils in FCT.

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