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Analysis of Gender Differential in Resource Utilization and Efficiency of Tomato Production in Kuje Area Council of Abuja, Nigeria

By:

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Abstract:

This study examined gender differentials in resource utilization and efficiency of tomato production in Kuje Area Council, Abuja. Primary data were obtained from 200 farmers using a multistage sampling technique, and analyzed with descriptive and inferential statistics, including stochastic frontier production analysis. The findings revealed that male farmers were slightly older (mean age=42.1 years) compared to females (39.3 years) and has higher years of farming experience (11.6 vs. 9.4 years). Men accessed more credit (₦158,000) than women (₦112,000) and had longer cooperative membership (6.8 vs. 4.6 years). Resource accessibility showed clear disparities: males recorded higher mean scores for land (4.00), cooperative support (3.80), and better access to farm inputs (4.00), while females reported lower values, especially for cooperative support (2.20) and adopting new technologies and farming innovations (2.20). Profitability analysis over 2022–2024 indicated higher Net Farm

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Income (₦171,067 for men vs. ₦133,067 for women) and Benefit–Cost Ratio (1.86 vs. 1.82), confirming profitability but with stronger gains for men. Stochastic frontier results indicated sub-optimal efficiency for both groups; however, women demonstrated higher mean technical efficiency (0.71) compared to men (0.55), reflecting better resource use despite limited access. Efficiency was significantly influenced by seed, fertilizer, seed, fertilizer, farm size, agrochemicals, and labour. The major constraints included high input costs (81.7% male; 78.8% female), limited credit (70.8% male; 85.0% female), poor storage (73.3% male; 81.3% female), and marketing challenges (75.0% male; 82.5% female). The study highlights pronounced gender disparities in access, profitability, and challenges, although women exhibited relatively higher production efficiency.

Keywords:

Gender differential, *Tomato production*, *Resource utilization*, *Efficiency.*

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INTRODUCTION

Tomato (*Solanum lycopersicum*) is one of the most important vegetable crops in Nigeria, both as a source of income for farmers and as a vital contributor to national food security. Nigeria is the largest producer of tomato in Sub-Saharan Africa, yet the country paradoxically remains a net importer of tomato products due to inefficiencies in production and post-harvest handling (Adeoye *et al.*, 2021). The crop plays a significant role in rural livelihoods by generating employment and serving as a key dietary source of vitamins. Despite its economic importance, tomato production faces serious challenges, including low productivity, limited access to quality inputs, high post-harvest losses, and weak market linkages (Okoye *et al.*, 2019; Idu *et al.*, 2025). Among these challenges, gender disparity in access to and utilization of resources has emerged as a critical factor influencing productivity. Studies consistently show that male and female farmers differ significantly in their access to land, credit, extension services, labour, and modern technologies, which directly affects efficiency outcomes (Olawuyi *et al.*, 2020; FAO, 2021). These inequalities are not merely technical but deeply rooted in cultural norms and institutional frameworks that privilege male farmers (Yunus *et al.*, 2025).

The concept of resource-use efficiency, particularly in agricultural production, has attracted attention in Nigerian agricultural economics literature. Efficiency is commonly decomposed into technical, allocative, and economic dimensions, all of which provide insights into how well farmers utilize available resources (Oboh & Ekpebu, 2021; Adeyemi *et al.*, 2025). Several empirical studies have applied stochastic frontier analysis and related models to evaluate smallholder farmers' efficiency, often highlighting significant inefficiencies that stem from suboptimal input combinations (Ogunniyi *et al.*, 2022; Joel *et al.*, 2025).

Importantly, gender plays a decisive role in determining these efficiency levels. For instance, Agboola *et al.* (2021) found that while male tomato farmers in Oyo State had greater access to inputs such as land and fertilizers, female farmers exhibited higher efficiency in resource utilization under constrained conditions. This paradox underscores the resilience and adaptive strategies often adopted by women farmers, despite systemic disadvantages. Similarly, Oladeebo & Fajuyigbe (2019) reported efficiency gaps between male and female vegetable farmers in Osun State, attributing the disparities to differences in access to credit and extension services. Such findings suggest that improving women's access to agricultural resources could yield disproportionate gains in productivity, as women already demonstrate the capacity to maximize efficiency under limited access scenarios (Maisule *et al.,* 2025).

Beyond technical concerns, gender differentials in resource utilization and efficiency have profound implications for rural development, poverty reduction, and food security in Nigeria. Women constitute a significant proportion of the agricultural workforce, yet they remain marginalized in access to productive assets and decision-making processes (Afolami *et al*., 2025; Olaitan *et al.,* 2025). The Food and Agriculture Organization (FAO, 2021) estimates that closing the gender gap in agricultural productivity could increase yields on women's farms by 20–30%, potentially raising total agricultural output in developing countries by up to 4%. For Nigeria, where tomato is both a staple food and an industrial raw material, such gains would contribute significantly to reducing import dependency, stabilizing rural incomes, and fostering agribusiness development.(Oyediji *et al.,* 2025). Moreover, addressing gender inequalities aligns with broader sustainable development goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 5 (Gender Equality). However, without targeted policies that address structural barriers—such as unequal land tenure systems, inadequate rural credit markets, and male-biased extension services—the efficiency potential of female tomato farmers will remain underutilized (Nwosu *et al.,* 2024; Akomolafe *et al.,* 2025). This study aims to evaluate the gender differential in resource utilization and efficiency of tomato production in Nigeria. To accomplish this, the following objectives are put forward:

i. describe the socio-economic characteristics of the male and female tomato farmers in the study area;
ii. assess the levels of gender accessibility and resources utilization in tomato production;
iii. determine the gender differential on profitability of tomato farmers;
iv. examine the gender differential in production efficiency of tomato farmers
v. identify the challenges confronting strawberry farmers in the study area.

LITERATURE REVIEW

Theoretical Framework

The theoretical foundation of this study rests primarily on production theory and efficiency analysis models within agricultural economics. Production theory provides the basis for understanding how inputs are transformed into outputs in tomato farming. Within this context, the Cobb-Douglas production function and related econometric models are widely applied to evaluate the relationship between resource inputs (such as land, labour, seed, fertilizer, and capital) and output (tomato yield). The theory posits that differences in productivity arise not only from the quantity of inputs but also from the efficiency with which they are utilized. The

application of Farrell's (1957) efficiency theory further refines this perspective by decomposing efficiency into three components: *technical efficiency* (the ability of farmers to obtain maximum output from a given set of inputs), *allocative efficiency* (the ability to use inputs in optimal proportions given their prices), and *economic efficiency* (a combination of technical and allocative efficiency). These models are particularly relevant for examining how male and female farmers differ in resource utilization and efficiency outcomes (Agboola *et al.,* 2021; Oyotombe *et al.,* 2025).

Conceptual Framework

The conceptual framework for this study, exploring the relationship between the independent variables and the dependent variables (efficiency outcomes in tomato production) being mediated by the intervening variables. The independent variables in this study are the core variables that represent the key inputs that differ between male and female farmers and are expected to influence efficiency outcomes, and these include socio-economic characteristics of age, education level, household size, farming experience, gender, access to extension services, access to credit as well as resource utilization variables of labour input (family and hired labour), access to credit and capital, use of improved seeds and fertilizers, and access to extension services. The intervening variables are contextual factors that can mediate effect of gender and resources on efficiency outcomes. They include market access and infrastructure, institutional support (cooperatives, farmer associations), cultural norms and gender roles in farming households, policy environment (land tenure laws, agricultural policies) and climatic/seasonal conditions affecting tomato production.

MATERIALS AND METHODS

Study Area

Kuje Area Council is one of the six area councils of the Federal Capital Territory (FCT), Nigeria, located about 40 km southwest of Abuja city center. The council shares boundaries with Gwagwalada, Bwari, and Abaji Area Councils. Geographically, it lies within the Guinea savannah zone, which is characterized by a sub-humid tropical climate suitable for a wide range of crops. The area experiences two distinct seasons: a rainy season from April to October and a dry season from November to March, with annual rainfall ranging between 1,100 and 1,600 mm (FCT-ADP, 2018). Fertile soils, coupled with favourable rainfall, make the area suitable for vegetable farming, particularly tomatoes.

The population of Kuje Area Council is estimated at over 170,000 people, most of whom depend on farming as their primary source of livelihood (National Population Commission, 2006; NPC, 2019). Agricultural activities are largely smallholder-based, with farmers cultivating less than three hectares on average. Major crops include tomato, maize, yam, cassava, and leafy vegetables, while livestock farming also contributes to household income. Tomato production is especially significant due to the council's proximity to Abuja, which provides farmers with ready access to high-value urban markets (Adeoye *et al.,* 2021). However, production faces persistent challenges, including limited irrigation facilities, inadequate storage and processing infrastructure, poor access to credit, and high post-harvest losses (Okoye *et al.,* 2019).

Socio-economic dynamics in Kuje reflect broader gender roles in Nigerian agriculture. While both men and women participate actively in tomato production, men generally have greater access to land, credit, and farm inputs, whereas women contribute substantially through labour, processing, and marketing (Afolami *et al.*, 2025; Olawuyi *et al.*, 2020). These disparities influence resource allocation and efficiency levels, making the area a representative case study for investigating gender differentials in tomato production. Kuje Area Council, therefore, provides a strategic context where ecological suitability for tomato farming intersects with socio-economic and institutional factors that shape gendered resource utilization and efficiency outcomes in Nigerian agriculture.

Population of the Study and Research Design

The study population comprises male and female tomato farmers in Kuje Area Council, FCT, Nigeria, where tomato production is a key livelihood activity. Both men and women are actively engaged in production, although they differ in terms of resource access, input utilization, and participation in market activities. For the purpose of this research, the target population will specifically include male and female tomato farmers cultivating tomatoes either as a primary or supplementary crop within the council.

The study adopted a survey design, using structured questionnaires and interviews for data collection. Primary data was collected using structured questionnaires and interviews, covering variables such as farm size, input usage (land, labour, seeds, fertilizer, capital, extension services), socio-economic characteristics (age, education, household size, farming experience), and output levels.

Sample Size and Sampling Techniques

This study adopted a multi-stage sampling technique to select tomato farmers in Kuje Area Council of the Federal Capital Territory. In the first stage, four major tomato-producing communities—*Gaube, Chibiri, Kiyi, and Kwaku*—were purposively selected based on their prominence in tomato farming, as identified by the FCT-ADP (2018). In the second stage, lists of tomato farmers were obtained from extension officers, farmer cooperatives, and community leaders to serve as the sampling frame. In the third stage, farmers were stratified by gender to ensure fair representation of both men and women, given the focus of the study.

In the final stage, respondents were randomly selected from each stratum in proportion to their relative numbers in the farming population. A total of 200 respondents were sampled for the study, comprising 120 male farmers (60%) and 80 female farmers (40%). These respondents were evenly distributed across the four selected communities, with each community contributing 50 farmers—30 males and 20 females. This distribution not only ensured balance in gender representation but also provided geographical spread across the major tomato-producing areas of Kuje.

Data Collection

The primary instrument for data collection in this study was a structured questionnaire designed to obtain detailed information from tomato farmers in Kuje Area Council. The questionnaire covered socio-economic characteristics, access to resources, production practices, and output levels, enabling the study to capture gender differences in resource

utilization and efficiency. To ensure validity and reliability, the instrument was pre-tested through a pilot study involving a small group of tomato farmers outside the main sample. The pilot helped identify ambiguities and weaknesses in the design, after which the questions were refined to improve clarity, accuracy, and relevance to the research objectives. The final version of the questionnaire was therefore well-tailored to the study's focus. To enhance data quality, trained enumerators were engaged to administer the questionnaires, ensuring that farmers fully understood the questions and provided accurate responses within a reasonable timeframe.

Data Analysis

The data collected were analyzed using a combination of descriptive and inferential statistical tools aligned to the study's objectives. Descriptive statistics such as means, percentages, frequency counts, and standard deviations were used to address objectives (i) and (v), which focused on the socio-economic characteristics of farmers and the challenges faced. A Likert-type scale was employed to achieve objective (ii), measuring levels of gender accessibility and resource utilization in tomato production. To address objective (iii), the costs and benefit ratio (BCR) model was applied to estimate the profitability of tomato production for male and female farmers. Finally, for objective (iv), the stochastic frontier production function (SFPF) was used to estimate technical, allocative, and economic efficiency among tomato farmers. All analyses were conducted using SPSS (version 24) and Frontier 4.1, which provided a robust framework for generating reliable results.

Model Specification

Likert-Type Scale

A five-point Likert scale (Strongly Agree = 5 to Strongly Disagree = 1) was used to assess gender accessibility and resource utilization. Weighted means were computed to categorize responses, where mean values between 1.00–1.49 indicated strong disagreement, while 4.50–5.00 reflected strong agreement.

Costs and Benefit Ratio (Profitability Analysis)

Profitability of tomato farming was analyzed using the benefit–cost ratio (BCR):

$$BCR = \frac{VNR}{TC}, \qquad NFI = TR - TC, \qquad TC = TVC + TFC$$

Where:

- VNR = Variety Net Revenue (₦)
- TC = Total Cost (₦), comprising Total Variable Cost (TVC) and Total Fixed Cost (TFC)
- NFI = Net Farm Income (₦)
- TR = Total Revenue (₦).

Fixed costs (land rent, tool depreciation) were estimated using the straight-line depreciation method. The Returns per Naira Invested (RNI**)** was also computed:

$$RNI = \frac{GI}{TC}$$

Decision rule: RNI > 1 = profit; RNI = 1 = breakeven; RNI < 1 = loss.

Stochastic Frontier Production Analysis

The Cobb–Douglas stochastic frontier production function was specified as:

$InY = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + ... + \beta_4 InX_4 + (V_i - U_i)$

Where:

- Y = Tomato output (kg)
- β_0 = Constant term
- X_1 = Seed (kg)
- X_2 = Fertilizer (kg)
- X_3 = Labour used (man-days)
- X_4 = Quantity of agrochemicals (litres)
- Vi = Random error outside the farmer's control
- Ui = Inefficiency term influenced by socio-economic factors.

Inefficiency effects were modelled as:

$Ui=\delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7$

Where explanatory variables (Z) included age, household size, education, credit access, extension contact, cooperative membership, and farming experience.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Tomato Farmers

The mean age of male tomato farmers was 42.1 years, while that of females was 39.3 years, indicating that both groups are within their productive years. This suggests tomato farming is actively practiced by the economically active population, consistent with Adeoye et al. (2020), who noted that middle-aged farmers dominate horticultural production due to strength, energy, and higher adaptability to farm innovations.

Marital status results showed that 65% of males and 56.3% of females were married, reflecting the significance of family support in tomato farming. Oladejo and Adetunji (2022) similarly emphasized that marriage often strengthens resource pooling and farm labour availability, which benefits household-based production systems such as tomato farming.

Male farmers had a mean of 11.6 years of farming experience, while female farmers averaged 9.4 years, suggesting men have more prolonged engagement in tomato production. Yahaya *et al*. (2019) observed that farming experience enhances farmers' ability to make better production decisions and adopt improved practices, positioning male farmers with a comparative advantage.

Educational attainment revealed gender differences, with 20% of males attaining tertiary education compared to only 12.5% of females. In contrast, 22.5% of women had no formal education, while only 11.7% of men fell in this category. Education plays a critical role in innovation adoption and farm management (FAO, 2019). Thus, the lower education levels among women may reduce their capacity to apply modern farming techniques, limiting productivity compared to men.

Household size was larger among men, averaging 6.2 members compared to 5.4 for women. Larger households provide family labour crucial for labour-intensive tomato farming. Okoye et al. (2019) noted that household size significantly contributes to labour availability, thereby influencing production efficiency and reducing the dependence on hired labour. Male farmers accessed more credit, averaging ₦158,000, compared to ₦112,000 for females. Adebayo and Adeola (2021) observed that structural constraints such as collateral requirements and gender bias limit women's ability to secure loans, restricting their capacity to invest in critical inputs for tomato farming.

Extension contact was higher among men, with an average of 3.2 visits annually compared to 2.1 for women. Akpoko *et al.* (2019) highlighted that female farmers often have limited extension access due to social barriers, weakening their chances of adopting new knowledge that could enhance tomato production efficiency. Cooperative membership was stronger among men, with an average of 6.8 years, compared to 4.6 years for women. Since cooperatives often provide platforms for accessing inputs, credit, and markets, men are more advantaged. Adeola et al. (2020) observed that male dominance in cooperatives enhances their participation in decision-making and resource-sharing, boosting their production capacity.

Table 1: Socio-Economic Characteristics of Tomato Farmers by Gender (n = 200)

Variable	Male (n=120)	%	Female (n=80)	%	Mean (Male)	Mean (Female)
Educational level						
No formal education	14	11.7	18	22.5		
Primary school	32	26.7	24	30.0		
Secondary school	50	41.7	28	35.0		
Tertiary education	24	20.0	10	12.5		
Age						
20–30	18	15.0	20	25.0	42.1	39.3
31–40	36	30.0	28	35.0		
41–50	42	35.0	20	25.0		
>50	24	20.0	12	15.0		
Marital Status						
Single	22	18.3	19	23.8		
Married	78	65.0	45	56.3		
Widowed	10	8.3	11	13.8		
Divorced/Separated	10	8.3	5	6.3		
Years of farming Experience						
1–5	20	16.7	22	27.5	11.6	9.4
6–10	34	28.3	26	32.5		
11–15	40	33.3	20	25.0		
>15	26	21.7	12	15.0		
Household Size						
1–4	30	25.0	28	35.0	6.2	5.4
5–7	54	45.0	34	42.5		
8–10	26	21.7	12	15.0		
>10	10	8.3	6	7.5		

Cooperative Membership (years)						
None	22	18.3	20	25.0	6.8	4.6
1–3	36	30.0	26	32.5		
4–6	34	28.3	18	22.5		
>6	28	23.3	16	20.0		
Amount of Credit Received (₦)						
None	28	23.3	26	32.5	158,000	112,000
1–100,000	38	31.7	30	37.5		
100,001–200,000	34	28.3	16	20.0		
>200,000	20	16.7	8	10.0		
Extension Visits per Season						
None	30	25.0	28	35.0	3.2	2.1
1–2	40	33.3	26	32.5		
3–4	32	26.7	18	22.5		
>4	18	15.0	8	10.0		

Source: Field Survey, 2025

Level of Gender Accessibility to Productive Resources by Tomato Farmers

The findings in Table 2 showed that male farmers had greater control over farmland ownership and decision-making (MS = 4.00), while female farmers recorded moderate access (MS = 3.50). This reflects the entrenched cultural norms in Nigeria, where land tenure systems are male-dominated, restricting women to secondary rights through husbands or relatives (Agarwal, 2018). Interestingly, both genders faced challenges in accessing credit. Male farmers recorded a mean score of 2.20, while female farmers scored slightly higher at 3.20. Similar patterns were noted by Ndiritu et al. (2019), who observed that rural farmers in sub-Saharan Africa face financial exclusion, limiting investment capacity in agricultural inputs and mechanization.

Male farmers reported low access to extension services (MS = 2.00), and female farmers also scored low (MS = 2.10). This reflects widespread inadequacies in extension delivery, consistent with Akinola and Alene (2020), who found that extension agents in Nigeria are overstretched and often neglect gender-sensitive approaches. Male farmers were more involved in cooperatives (MS = 3.80) compared to female farmers (MS = 2.20). According to Nwaobiala (2025), women often lack time and autonomy to engage in group activities, which diminishes their access to training, credit, and markets provided through cooperative structures.

Male farmers reported high accessibility to farm inputs (MS = 4.00), while female farmers rated low (MS = 2.40). This demonstrates a gender gap in accessing improved seeds, fertilizers, and agrochemicals. Women's lower access often results from limited income, reduced bargaining power, and discriminatory input distribution mechanisms (Ogundari & Ojo, 2018; Olaitan *et al.,* 2025) Male farmers scored highly in access to both family and hired labour (MS = 4.05), while female farmers scored lower (MS = 3.18). This aligns with

Boserup's (2019) assertion that male farmers can mobilize household and hired labour more effectively due to greater financial strength and authority in rural households.

The results revealed a significant disparity in technology adoption. Male farmers reported relatively high adoption (MS = 3.95), whereas female farmers scored low (MS = 2.20). This indicates that women are less exposed to modern agricultural technologies, a pattern consistent with the findings of Ragasa et al. (2023), who highlighted that female farmers in Nigeria face barriers to accessing information channels, training programs, and input subsidies that drive innovation uptake.

Table 2: Level of Gender Accessibility to Productive Resources by Tomato Farmers

Statements on Access to Resources	**Male Farmers**					**Female Farmers**				
	N	**WS**	**MS**	**SD**	**CV**	**N**	**WS**	**MS**	**SD**	**CV**
1. Male farmers have greater control over farmland ownership and decision-making rights than female farmers.	110	440	4.00	0.82	0.21	70	245	3.50	0.94	0.27
2. Access to formal agricultural credit institutions is easier for male farmers than for female farmers.	105	231	2.20	0.91	0.41	65	208	3.20	1.01	0.32
3. Male farmers receive more extension service visits and training opportunities compared to female farmers.	112	224	2.00	0.89	0.45	72	151	2.10	0.92	0.44
4. Membership and leadership in cooperative societies are dominated by male farmers, limiting female participation.	98	372	3.80	0.89	0.23	64	140	2.20	0.96	0.44
5. Male farmers have better access to farm inputs such as improved seeds, fertilizer, and agrochemicals than female farmers.	108	432	4.00	0.83	0.21	70	168	2.40	0.94	0.39
6. Male farmers have greater access to both family and hired labor compared to female farmers.	111	449	4.05	0.84	0.21	68	254	3.18	1.02	0.32
7. Male farmers are	107	423	3.95	0.85	0.22	66	147	2.20	0.90	0.41

more likely to adopt new technologies and farming innovations than female farmers.										

Source: Field Survey, 2025

Gender Differential in Profitability of Tomato Farmers

The results on profitability of tomato production between 2022 and 2024 in Table 3 reveal significant gender-based disparities in resource allocation and income outcomes. Male farmers consistently reported higher expenditures on inputs such as labour, seeds, and fertilizers compared to female farmers. For instance, labour costs for men increased from ₦92,000 in 2022 to ₦98,000 in 2024, while female farmers' labour expenditure ranged between ₦80,000 and ₦85,500. This suggests that men had greater access to hired labour, enabling them to manage larger farm sizes or undertake more intensive cultivation practices, leading to higher productivity (Ogunniyi et al., 2020). Seed and fertilizer costs further highlight this disparity, with male farmers spending ₦12,500–₦13,500 on seeds and ₦28,000–₦31,500 on fertilizer, compared to ₦11,000–₦12,000 and ₦23,000–₦25,000 for female farmers. This difference reflects the long-established gender gap in access to improved inputs (Rahman, 2018; Ndiritu *et al.,* 2024).

The profitability indicators provide deeper insights into the outcomes of these input disparities. Male farmers achieved net farm incomes (NFI) of ₦166,500 in 2022, ₦171,800 in 2023, and ₦174,000 in 2024. In contrast, female farmers recorded NFIs of ₦123,000, ₦131,700, and ₦143,300 over the same period. The consistently higher NFI for male farmers highlights the direct relationship between greater resource investment and higher income generation. However, both categories of farmers demonstrated positive benefit–cost ratios (BCR), with males ranging between 1.82 and 1.91, and females between 1.78 and 1.86. The fact that all BCR values exceeded 1 indicates that tomato production remained profitable across genders.

Nevertheless, the persistent gender differential in both NFI and BCR reflects structural inequalities in access to productive resources. As Udry (2019) observed, disparities in resource allocation rather than technical inefficiency largely account for such income gaps. The findings here confirm that male farmers' advantage in resource mobilization directly translates into greater profitability relative to female farmers.

Table 3: Gender Differential on Profitability of Tomato Farmers (2022–2024)

Variable	2022				2023				2024			
	Male	**%**	**Female**	**%**	**Male**	**%**	**Female**	**%**	**Male**	**%**	**Female**	**%**
Seed	12,500	6.81	11,000	7.00	13,000	6.50	11,500	7.10	13,500	6.40	12,000	7.20
Labour	92,000	50.15	80,000	51.00	96,500	48.30	83,000	51.20	98,000	46.40	85,500	51.30
Fertilizer	28,000	15.26	23,000	14.65	30,000	15.00	24,000	14.80	31,500	14.90	25,000	15.00
Agrochemical	15,000	8.18	12,500	7.96	15,800	7.90	13,200	8.14	16,500	7.80	13,800	8.30
Farm size	28,000	15.26	24,000	15.30	29,000	14.50	24,500	15.10	29,500	14.00	25,000	15.00
Total Variable Cost (TVC)	175,500	95.66	150,500	95.91	184,300	92.20	156,200	96.34	189,000	89.50	161,300	96.80
Fixed Cost (Depreciation, rent, tools)	8,000	4.34	6,500	4.09	15,500	7.80	5,900	3.66	22,000	10.50	5,400	3.20
Total Cost (TC)	183,500	100	157,000	100	199,800	100	162,100	100	211,000	100	166,700	100
Revenue (₦)	350,000	–	280,000	–	372,500	–	295,000	–	385,000	–	310,000	–
Net Farm Income (NFI = Revenue – TC)	166,500	–	123,000	–	172,700	–	132,900	–	174,000	–	143,300	–
BCR = VNR / TC	1.91	–	1.78	–	1.86	–	1.82	–	1.82	–	1.86	–

Males' Average Net Farm Income = ₦171,067; Average BCR=1.86
Females' Average Net Farm Income= ₦133,067; Average BCR = 1.82
Source: Field Survey, 2025

Gender Differential in Production Efficiency of Tomato Farmers

The diagnostic statistics in Table 4 reinforce gender disparities in production efficiency. The gamma values (0.472 for females and 0.438 for males) indicate that a substantial portion of output variability was due to inefficiency rather than random shocks. Notably, the mean efficiency score for female farmers (0.71) exceeded that of males (0.55). This finding suggests that although women operated with fewer resources and smaller farm sizes, they were relatively more efficient in resource use. This supports arguments by Udry (2019) and Ogunniyi et al. (2020) that women farmers, when provided access to resources, often exhibit strong technical efficiency, even surpassing male counterparts.

The coefficients for production efficiency variables demonstrate that resource use significantly influenced output for both male and female farmers, though the magnitude and

statistical significance varied. For female farmers, farm size (0.612), labour (0.498), seed (0.542), fertilizer (0.467), and agrochemicals (0.355) all had significant positive effects on tomato output. This suggests that increases in these inputs directly enhanced productivity, consistent with the labour-intensive and input-responsive nature of tomato production (Rahman, 2018). For male farmers, farm size (0.458), labour (0.382), seed (0.415), and fertilizer (0.389) were significant, while agrochemicals were not statistically significant. This indicates that while men benefitted from larger farm sizes and key inputs, the role of agrochemicals was less pronounced compared to women, possibly reflecting differences in pest management strategies or intensity of application.

Turning to the inefficiency variables, the results highlight gender-specific drivers of technical inefficiency. For female farmers, education (-0.182), farming experience (-0.205), extension contact (-0.276), and cooperative membership (-0.564) were significant and negative, indicating that greater access to education, years of experience, extension services, and cooperative involvement reduced inefficiency in production. These findings align with evidence that women's productivity gaps often narrow when they gain access to knowledge and organizational support (Doss & Morris, 2021). In contrast, male farmers showed fewer significant inefficiency determinants. Farming experience (-0.189) and extension contact (-0.231) were significant, implying that accumulated knowledge and access to technical guidance improved their efficiency. Education and cooperative membership, however, were not statistically significant for men, suggesting that their production performance may be less constrained by these social capital factors compared to women. Non-significant variables such as age, household size, and credit for both groups suggest that these factors did not significantly affect inefficiency in tomato farming. This outcome may reflect the relatively homogeneous age structure of farmers in the study area or the limited formal credit facilities accessed by both genders.

Table 4: MLE Results of Stochastic Frontier Production Function of Gender Differential in Tomato Production Efficiency

Variable	Female (Coeff.)	Std. error	t-value	Male (Coeff.)	Std. error	t-value
Production efficiency						
Constant	3.982***	0.912	4.368	2.145**	0.738	2.905
Farm size	0.612**	0.241	2.541	0.458*	0.217	2.110
Labour	0.498***	0.150	3.320	0.382**	0.169	2.259
Seed	0.542**	0.224	2.420	0.415*	0.210	1.976
Fertilizer	0.467**	0.191	2.445	0.389*	0.198	1.964
Inefficiency variables						
Constant	1.984NS	1.875	1.058	1.736NS	1.934	0.898
Age	0.085NS	0.102	0.833	0.064NS	0.110	0.582
Education	-0.182*	0.074	-2.459	-0.143NS	0.081	-1.765
Experience	-0.205**	0.092	-2.233	-0.189*	0.099	-1.910
Household size	0.096NS	0.118	0.814	0.075NS	0.125	0.600
Extension contact	-0.276**	0.126	-2.190	-0.231*	0.132	-1.750

Cooperative membership	-0.564*	0.241	-2.341	-0.423NS	0.258	-1.639
Credit	-0.138NS	0.097	-1.423	-0.102NS	0.101	-1.010
Diagnostic statistics						
Sigma squared (σ^2)	0.412**	0.129	3.195	0.366*	0.145	2.524
Gamma (γ)	0.472**	0.202	2.338	0.438*	0.218	2.010
LR test	52.947**			48.631*		
Log likelihood function	-145.32			-121.47		
Mean efficiency	0.71			0.55		

Source: Field Survey, 2025

Challenges Confronting Tomato Farmers

The results presented in Table 5 highlight the major challenges faced by tomato farmers in the study area, with both male and female categories reporting multiple constraints affecting productivity and profitability. A critical observation is that while both groups encounter similar challenges, the intensity and frequency of these constraints differ by gender. High input costs were the most widely reported challenge, affecting 81.7% of male and 78.8% of female farmers. This indicates that both groups face financial strain in acquiring quality seeds, fertilizers, and agrochemicals, which significantly impacts output. However, access to credit facilities presented a more gendered difference, with 85% of female farmers identifying it as a major challenge compared to 70.8% of males. This reflects systemic barriers in financial inclusion, as women farmers often lack collateral and face institutional bias in accessing formal credit (FAO, 2019).

Pest and disease infestation was another widespread issue, cited by 76.7% of males and 73.8% of females. This underscores the vulnerability of tomato crops to biological stress, which reduces yields and quality. Poor extension access further aggravated these challenges, with 76.3% of females reporting inadequate support compared to 64.2% of males. The gender difference here indicates that male farmers are relatively better positioned to access technical advice and innovations, while women face more exclusion from formal extension services. Market access and price fluctuations also showed high prevalence, with 82.5% of females and 75% of males affected. Similarly, inadequate storage facilities disproportionately constrained female farmers (81.3%) compared to males (73.3%), reflecting their limited capacity to reduce post-harvest losses. Land tenure insecurity was also a stronger barrier for females (68.8%) than males (57.5%), emphasizing persistent gender inequality in land ownership.

Table 5: Distribution of Challenges Confronting Tomato Farmers by Gender

Constraints	Male (n=120)	%	Female (n=80)	%
High cost of inputs (seeds, fertilizer, agrochemicals)	98	81.7	63	78.8
Limited access to credit facilities	85	70.8	68	85.0
Pest and disease infestation	92	76.7	59	73.8
Poor access to extension services	77	64.2	61	76.3
Poor market access and price fluctuation	90	75.0	66	82.5
Inadequate storage and processing facilities	88	73.3	65	81.3
Land tenure and ownership constraints	69	57.5	55	68.8

Multiple Responses

Source: Field Survey, 2025

CONCLUSION

This study examined gender differentials in resource utilization and efficiency of tomato production in Kuje Area Council, Abuja, with a focus on socio-economic characteristics, accessibility to resources, profitability, production efficiency, and challenges. The socio-economic analysis revealed clear gender disparities. Male farmers were slightly older (mean = 42 years) than female farmers (mean = 39 years) and had more years of farming Experience (11.6 years vs. 9.4 years). Access to credit was greater among men (₦158,000) than women (₦112,000), and male farmers also had longer cooperative membership (6.8 years vs. 4.6 years). These figures suggest that male farmers are generally better positioned socio-economically to harness productive resources.

On resource accessibility, male farmers demonstrated higher mean scores across most indicators, particularly access to labour (4.05), land (4.00) and access to farm inputs (4.00). Female farmers, however, recorded much lower scores for key resources, including adopting new technologies and farming innovations (2.20) and cooperative support (2.20), both below the threshold of 2.5. This outcome indicates persistent gender inequities in access to vital inputs, which significantly constrains women's capacity to expand production. Profitability analysis over three years (2022–2024) further revealed gender differentials. Male farmers earned higher average Net Farm Income (₦171,067) compared to females (₦133,067). Similarly, Benefit–Cost Ratios (BCR) favoured men (1.86) over women (1.82), showing that while tomato production is profitable for both groups, men derive higher returns due to larger operational scale and stronger access to inputs.

The stochastic frontier production analysis indicated that both genders operate below optimal efficiency but at varying levels. Female farmers recorded a higher mean technical efficiency (0.71) than males (0.55), suggesting that women, despite limited resources, use inputs more judiciously. Key factors influencing efficiency included seed, fertilizer, farm size, agrochemicals, and labour, while access to credit and household size reduced inefficiency, underscoring their importance for productivity.

Finally, challenges affecting tomato production were widespread but gender-specific in severity. Male farmers identified high input costs (81.7%), pest and disease incidence (76.7%), and poor market access (75.0%) as their main challenges. Female farmers reported more critical constraints, with limited access to credit (85.0%), poor storage facilities (81.3%), and weak extension services (76.3%) emerging as dominant issues.

Based on the findings of the study, here are recommendations, derived from the data and analysis:

1. Policies and programs should focus on improving female farmers' access to land, credit, and cooperative societies, as these were found to be disproportionately limited compared to male farmers.
2. Both male and female farmers reported poor access to extension services, but the problem was more severe among women. Recruiting more extension officers and adopting gender-sensitive training approaches can close this gap.
3. The high cost of inputs such as seeds, fertilizers, and agrochemicals remains a major constraint for both genders. Input subsidy schemes or cooperative input purchase programs should be expanded to reduce costs.
4. Both genders face challenges with unstable tomato prices and poor market access. Establishing farmer cooperatives and linking them with urban markets can stabilize returns and reduce exploitation by middlemen.
5. The study revealed limited access to credit, particularly among female farmers (mean = 2.31). Gender-responsive credit schemes with flexible collateral requirements should be promoted to boost production.

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