



PROFITABILITY ANALYSIS OF LATE WET SEASON TOMATO (LWST) PRODUCTION AMONG SMALLHOLDER PRODUCERS IN KADUNA STATE, NIGERIA

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ABSTRACT

The study analyzed the profitability of late wet season tomato (LWST) production in Kaduna State, Nigeria. A multi-stage sampling procedure was employed to select 296 tomato producers for this study. Primary data were collected using a well-structured questionnaire. Data collected were analysed using descriptive statistics, farm budgeting techniques, multiple regression. The finding revealed that the tomato producers were literate with mean age of 41years and were mostly married; majority of them had household sizes between 1 and 14 persons with a mean tomato production experience of 16years. The result also showed that an average total variable cost (TVC) of ₦352,784.4 per hectare was incurred while total revenue (TR) of ₦604,000 per hectare was realized with an operating ratio of 0.58 and a return per naira invested (ROI) of ₦0.71k. This implies that for every ₦1.00 invested, ₦0.71k was realized by the tomato producers. This revealed that late wet season tomato production was profitable in the study area. The result of factors influencing profitability revealed that years of experience, membership of association, farm size (ha) and extension visit were found to be significant at 1%, 5% and 10% levels of probability respectively. The study concludes that late wet season tomato producers operate on a small-scale with high productive potential. LWST was a lucrative enterprise with a number of parameters determining the enterprise profitability. The study recommended that Kaduna Agricultural Development Agency should increase the frequency and quality of extension visits, with a focus on disseminating best practices for late wet season tomato production.

Keywords: Profitability, Wet-season, Tomato, Producers

INTRODUCTION

Tomato (*Solanum lycopersicum*) is one of the most important horticultural crops globally, serving as a major source of vitamins, minerals, and antioxidants. It plays a significant role in agricultural economies, providing food security, employment, and income for millions of smallholder producers. In Sub-Saharan Africa (SSA), and particularly in Nigeria, tomato production is an essential livelihood activity, contributing to rural development and urban food systems (Seweje *et al.*, 2022). Tomato production in Nigeria stood at 3,693,722 tonnes and 3,798,939 tonnes in 2020 and 2019 respectively (Food and Agriculture Organization, 2020). The total area under tomato production in 2020 was 844, 445 hectares in Nigeria. The yield and average yield of tomato in Nigeria in 2020 were 43,471 hg/ha, and 10 to 30 metric tonnes/ha respectively (FAO, 2020). Despite the overall growth in production, there have been indications of a decline in average tomato yield per hectare in 2023 compared to the previous year (Nigeria Tomato Market report, 2025). This suggests that while total production volumes are increasing, the efficiency of production per unit area may be facing challenges. Nevertheless, Nigeria's tomato production has shown significant volumes in recent years, with projections indicating continued growth. However, the noted decrease in yield per hectare highlights the need for interventions aimed at improving production efficiency to sustain and enhance the sector's growth. Tomato production in Nigeria faces challenges of low productivity; which comes from the inability of producers to fully utilize available technologies. The late wet season tomato production method (popularly called *Dan-Danshi* in Hausa language), involves the cultivation of tomatoes at the end of the rainy season. It is a tradition practiced in Kaduna State, particularly in arable plots, where residual soil moisture plays a crucial role in sustaining tomato growth until harvest, although there is need for mild irrigation. Rain-fed farmlands are vulnerable to soil moisture deficits because water is



available only from rainfall events, and the capacity of individual producers to adapt to water deficits is limited. There is a need to understand the relationship between late wet season tomato production which is vital for sustainable agricultural practices.

Late wet season tomato production has gained popularity in recent time in Kaduna state to meet the high demand for fresh tomato for festivities around December to January coinciding with its harvest. It is projected that tomatoes play a significant role in Nigeria's national agricultural output, contributing approximately 3.68 million metric tons in 2022, positioning the country as one of the largest producers in Africa. Tomato production in Nigeria also faced low yield and productivity, inadequate improved technology, insufficient marketing and processing infrastructure, and high postharvest losses that is affecting the returns from the naira invested (Akinniran *et al.*, 2020). Notably, the yield and quality of tomato vary significantly depending on the production system used. Rainfed tomato production is particularly low-yielding and produces poor-quality output. In contrast, irrigation-based systems, while yielding better quality tomatoes, are capital-intensive, especially with the rising cost of fuel, which has reportedly increased production costs by up to 300% in regions like Kaduna State (HortiNigeria, 2024). Although the late wet season tomato production system offers a lower-cost alternative by utilizing residual soil moisture, it presents several challenges, including difficulties in adopting water conservation practices and achieving yields that are comparable to those of irrigated systems. This study seeks to bridge a critical gap in the literature by exploring the role of late wet season tomato farming in enhancing smallholder producers' incomes. Despite this substantial contribution, there is a notable lack of documented research and studies on the strategies underpinning this production.

The broad objective of the study was to analyze the Profitability of late wet season tomato production among smallholder producers in Kaduna state, Nigeria, while, the specific objectives were to:

- i. describe the socio-economic and institutional characteristics of the tomato producers,
- ii. estimate the costs and return of late wet season tomato production,
- iii. determine the factors influencing the profitability of late wet season tomato production in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted in Kaduna State and which has a total area of approximately 48,473.2 Square Kilometers. Its coordinates are between 09°20'N - 11°32'N and 06°15'E - 8°38'E has a population of 8,252,400 (NPC 2016) and is the third largest in the Federation after Kano and Lagos. It shares common boundary with Abuja and Six other States namely Kano, Katsina, Zamfara, Niger, Bauchi and Nasarawa States. The study area specifically covers Soba, Kudan, Kubau, Kauru, Ikara and Makarfi Local Government areas which are in the Northern part of the State. The mean annual rainfall as reported by National Bureau of Statistics (NBS) (2012) was 1,267.9 mm and reaches its peak in August. The annual temperature ranges from 27.2 - 36.3°C. The relative humidity is similarly variable, averaging between 15 - 25% in dry season and rising to between 48-84 percent in wet season. The area has a well-drained ferruginous tropical soil which is sandy clay to clay loam in texture. It has Fadama with dark grey vertisols which are highly valued for intensive agricultural activities, especially in dry periods, for gardening of tomatoes, chilies, sweet pepper, okra, onion, Irish potatoes and sugar cane. It also has the potential for livestock, forestry, and minerals such as granite, clay and kaolin for building.

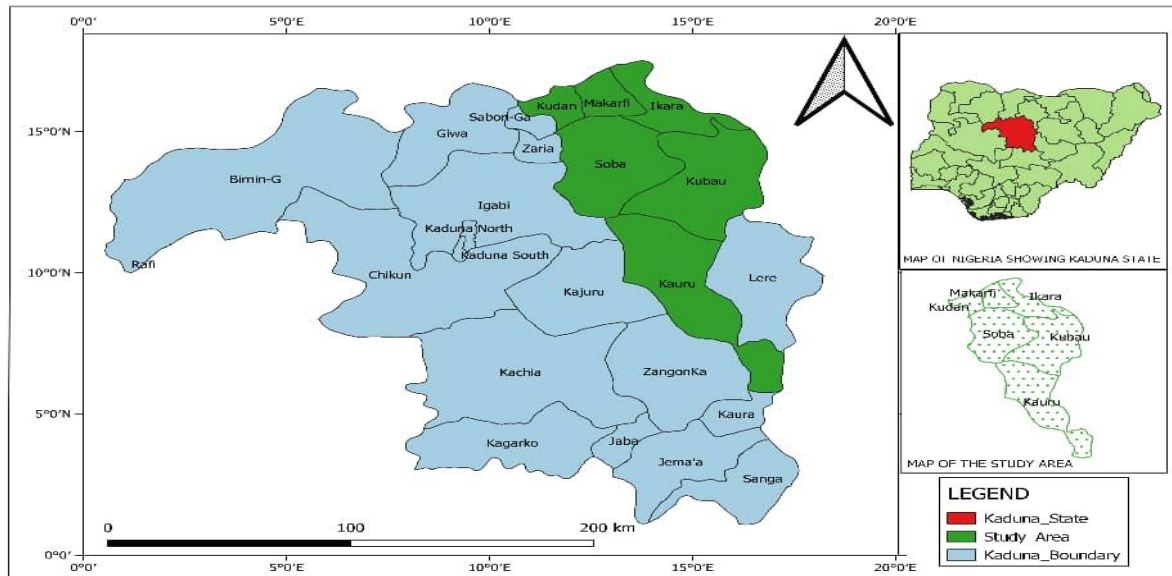


Figure 1: Map of Kaduna State Showing the Study Area

Sampling Procedure and Sample Size

A multi-stage sampling procedure was employed for the study area. The first stage involved purposive selection of six (6) Local Government Areas (LGAs), due to their popularity in late wet season tomato production (LWSTP). The second stage involved purposive selection of two (2) villages from the selected LGAs due to concentration of tomato producers in the villages. The third stage involved simple random sampling of 296 tomato producers using the slovin’s formula from a sample frame of 1140 tomato producers. Within each selected village, a random sample of tomato producers utilizing the LWSTP method was drawn from the production clusters. The sampling frame for different LGAs and villages was gotten from the Kaduna State Agricultural Program (KADP), as shown on Table 1. The sample size for the study was determined following Slovin's (1960) formula. It can be mathematically expressed as: $n = N / (1 + N e^2)$

Where: n = Number of samples, N = Total population and e = Error tolerance (level 0.05)

N signifies the total population. This meticulous sampling approach ensures the representation of various production clusters and provides a comprehensive overview of the LWSTP tomato production in the study area.

$$n = \frac{x * N}{X} = \frac{80 * 296}{1140} = 21$$

$$150 * 296 = 39$$

$$1140$$

n = sample size/village

x= population of producers

X= Total population of producers

N = Desired sample size for the study



Table 1: Sampling of Tomato Producers in the Study Area

LGAs	Villages	Population Size	Sample Size
Soba	Rahama	80	21
	Gimba	150	39
Ikara	Kurmin kogi	80	21
	Tashan Hassan	60	16
Kubau	Anchau Gari	120	31
	Kuzuntu	90	23
Kauru	Kauru	70	18
	Dandaura	150	39
Makarfi	Mayere	70	18
	NasarawaDoya	90	23
Kudan	Kudan	60	16
	Hunkuyi	120	31
Total	6	12	1,140
			296

***Source:** Preliminary Survey, Kaduna State Agricultural Development Agency, 2023

Method Of Data Collection

Primary data were collected for the study using a structured questionnaire which was administered to the respondents by the researcher with the help of well-trained enumerators. Data were collected for the 2023 cropping season. Data collected include socioeconomic factors, inputs committed to tomatoes production under LWSTP method, Sales record, income, expenditure and consumption. The data collection lasted for 1 month.

Analytical Techniques

Data collected were analysed using descriptive statistics, Gross margin analysis, and ordinary least square regression (OLS).

Model specification

Gross Margin (GM) analysis was employed to analyse the cost and returns from late wet season tomato production. This was used to evaluate the Costs and Returns of individual enterprises. The Gross Margin per hectare was estimated using the following relationships

$$GM = TR - TVC \dots\dots\dots (i)$$

$$TR = Y * P \dots\dots\dots (ii)$$

Where:

GM = Gross Margin (₦/ha)

TR = Total Revenue (₦/ha)

TVC = Total Variable Cost (₦/ha)

Y = Output of Tomato (kg)

P = Unit price of Tomato (₦)

$$\text{And } TVC = \sum P_i X_i \dots\dots\dots (iii)$$

Where:

P_i = unit price of the ith input (₦)

X_i = total quantity of the ith input per hectare

∑ = summation sign

Explicitly presented as:

$$TVC = P_1X_1 + P_2X_2 + P_3X_3 + P_4X_4+ P_5X_5 \dots\dots\dots(iv)$$

P₁ =Unit price of Seed input used for production of late wet season tomato (₦)

X₁ = Quantity of seed/seedlings used for the production of late wet season tomato (kg).

P₂ = Price of organic fertilizer input used for the production of LWSTP (₦).

X₂ = Quantity of organic fertilizer used for the production of LWSTP (Kg).

P₃ = Price of chemical fertilizer input used for the production of LWSTP (₦).

X₃ = Quantity of chemical fertilizer used for the production of LWSTP (Kg).

P₄ = Price of pesticides input used for the production of late wet season tomato (₦).



X_4 = Quantity of pesticides used for the production of LWSTP (litre).
 P_6 = Wage rate of labour for the production of LWSTP (₦).
 X_6 = Quantity of labour used for Production of LWSTP (man-day).

All output (weight of tomato sampled baskets will be established) will be measured in kilogram (Kg). There are other ratios associated with Gross Margin analysis which were analyzed as follows:

GR = TVC/GFI (v)

Where:

GR = Gross Ratio

TVC = Total Variable Cost of tomato produced

GFI = Gross Farm Income for tomato

OR = TVC/GFI(vi)

OR = Operating Ratio for tomato production.

TVC = Total Variable Cost of tomato production.

GFI = Gross Farm Income for tomato production.

RNI = GFI/TC (vii)

RNI = Return to Naira Invested in tomato production.

GFI = Gross Farm Income for tomato production.

TC = Total Cost of tomato production.

Ordinary Least Square (OLS)

The Ordinary Least Square (OLS) multiple regression was used to determine the factors influencing the profitability of tomato producers in the study area. Four functional forms of the multiple regressions were fitted. These are linear, semi-log, double log and exponential functions. The lead equation was chosen based on *apriori* theoretical expectations, magnitude of the coefficient of multiple determinations (R^2) and statistical significance of the coefficient.

$Y_{ij} = X\beta + U$ (viii)

The linear form of the multiple regression model can be expressed in the following model:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \dots + \beta_{10}X_{10} + u$(ix)

Where;

Y = Net returns (Gross margin), X_1 = Age (years), X_2 = Gender (Male=1, Female=0), X_3 = Household size (number of household members), X_4 = Education (No. of years spent in formal schooling), X_5 = Years of experience (years), X_6 = Membership of Association (Yes=1, 0= otherwise), X_7 = Farm Size (ha), X_8 = Credit access (1= access, 0 =no access), X_9 = Extension Visit (number/month), X_{10} = Access to Market Information (Yes=1, No= 0), β_0 = Constant, β_1 - β_{11} = Parameters to be estimated.

U = Stochastic error term

RESULT AND DISCUSSION

Socio-economic Characteristics of Tomato Producers

The results in Table 2 revealed that 81.73% of the tomato producers were within the age bracket of 25-41 years, with a mean age of 41 years. This implies that majority of the producers were still in their active and productive age. This age category has the capacity to withstand farm stress and, perhaps explore on how best they can improve their productivities. Producers who are in their active age are innovative and motivated individuals who can cope with challenges that may emanate from LWST tomato farming activities and might be willing to adopt effective adaptation measure against climate change and variability. This finding is in line with Oremo (2013) who reported that young to medium aged producers were mostly engaged were on the active age who are mostly engaged in food crop production than the old aged producers. Majority (88.16%) of the producers had household sizes between 1 and 14 and a mean of 7 persons. This shows that the LWST producers had relatively large household sizes and hence, the contribution of family labour for tomato production will tend to be high leading to a decrease in demand for hired labour by the producers. The mean household size does



tertiary education, while 0.36% had adult education in the study area. Majority (69.94%) of the tomato producers had some form of formal educational qualification, while, 30.06% had Quranic educational qualification. Thus, producers in the study area could access information necessary to help them improve on their farming activities.

Table 3: Qualitative Socio-economic Characteristics of Tomato Producers.

Variables	Frequency	Percentage (%)
Sex		
Male	291	98.3
Female	5	1.7
Marital Status		
Single	42	14.2
Married	246	83.10
Widow	2	0.68
Divorced	6	2.02
Educational Level		
Primary	72	24.32
Secondary	101	34.12
Tertiary	32	10.81
Adult	2	0.69
Quranic	89	30.06
Access to Credit		
Access	92	31.08
No Access	204	68.91
Membership of Cooperative		
Member	195	65.87
Non-member	101	34.12
Extension Contact		
Contact	213	71.95
No Contact	83	28.05

Source: Field Survey, 2023

n=296

Credit is necessary for the acquisition of inputs and payment of casual labour, it shows that 68.91% of the tomato producers do not have access to credit, while 31.08% had access to credit facilities. This shows that tomato producers are challenged in accessing credits and other productive resources due to their access to financial institute. Majority (71.8%) of the tomato producers had the services of the extension workers during this cropping season and therefore the producers are likely to be technically efficient. This implies that the majority of the producers have access to extension agents who can educate them on the best tomato farming practice and introduce innovation to them. The membership of cooperative results shows that 65.87% of the tomato producers belong to one cooperative or the other, while 34.12% do not belong to cooperative society in the study area. This contributed to their low access to credit facilities as cooperative society is an important source of informal finance to rural producers (Falola *et al.*, 2022). This result implies that producers that belong to cooperative society tends to enjoy certain benefits than their counterparts who are non-members.

Costs and Return Analysis of Late Wet Season Tomato Production in the Study Area

Table 4 provides a comprehensive breakdown of the costs and returns associated with late wet season tomato (LWST) production, offering key insights into both the cost structure and profitability. It showed that the second largest variable cost is inorganic fertilizer, which accounts for 33.12% of the Total Variable Costs (TVC), amounting to ₦116,864. This expenditure on fertilizers shows the important role that soil fertility plays in achieving optimal tomato yields, especially under the late wet season conditions, where nutrient demands are heightened by the crop's growth cycle. Seeds, which represent 9.06% of the TVC, total ₦31,972.80. The cost reflects the need for high-quality, disease-resistant tomato seeds to ensure strong plant establishment and ultimately high yields. The cost of organic fertilizer is notable as well, contributing 10.62% to TVC with an expenditure of ₦37,500.



This suggests that the integration of organic fertilizers is a significant aspect of the production system, potentially enhancing soil health and improving long-term farm sustainability. Labour costs, which span across various stages of production from transplanting to sorting and packaging account for 38.47% of the total variable costs, amounting to ₦135,800.1. These costs highlight the labour-intensive nature of tomato farming, where activities such as weeding, pesticide application, and harvesting are crucial for pest management, crop health, and quality production. The figures echo the findings of Adeyemo *et al.* (2016), who identified labour as a significant cost component in tomato production in Nigeria, especially during the wet season. The total revenue generated from tomato sales was ₦604,000, based on an average price of ₦80 per kilogram from the sale of 7,550 kilograms.

The gross margin of ₦251,215.9 indicated that after covering the variable costs, the producers still retain a substantial amount of income profit. This figure aligns with Omonona *et al.* (2010), who observed a positive gross margin in Nigerian crop farming, confirming the viability of such production systems under appropriate management. The operating ratio of 0.58 suggests that only 58% of the revenue goes towards covering the variable costs, which is a favorable indicator of efficiency. Furthermore, the Return on Investment (ROI) of ₦0.71 indicates that for every ₦1 invested, the farmer earns a ₦0.71 return, reflecting a moderate profitability but one that still presents substantial financial sustainability potential.

Table 4: Costs and Return Analysis of Late Wet season Tomato Production (Ha)

Variables	Quantity	Unit Costs (₦)	Total Costs (₦)	%TVC
Variable Costs				
Seeds(grams)***	480	66.61	31972.80	9.06
Organic fertilizer(25kg/bag)	150	250	37500	10.62
Fertilizer (kg)	220	531.12	116864	33.12
Pesticides (ltrs)	1.5	2125.67	3188.50	0.90
Sub-total			189525.3	
Labour costs				
i. Transplanting	10	1000	10000	2.83
ii. Fertilizer application	9	1200	10800	3.06
iii. Weeding	12	2000	24000	6.80
iv. Pesticides Application	2	4000	8000	2.26
vi. Harvesting	12	3000	36000	10.20
vii. Sorting	8	4000	32000	9.07
viii. Packaging	3	5000	15000	4.25
ix. Transportation			27459.10	2.11
Sub-total			163,259.1	100
Total Variable Costs			352784.4	100
Total Revenue	7550	80	604,000	
Gross Margin			251,215.9	
Operating ratio			0.58	
Return Per Naira Invested (ROI)			0.71	

Source: Field Survey, 2023. * note producers bought seeds to raise seedlings **

Distribution of Tomato Producers based on Gross Margin

Table 5 presents a distribution of gross margins for late wet season tomato producers, broken down into five profitability classes. This analysis helps to understand the spread of profit levels among the tomato producers in the study area.

Table 5: Distribution of Late Wet Season Tomato Producers Profitability

Variable	Frequency	Percentage
Gross Margin		
89,000-135,000	70	23.64
136,000– 182,000	53	17.90
183,000-229,000	90	30.40
230,000-276,000	68	23.0
277,000-323,000	15	5.06
Min.	89,000	
Max.	321,000	
Mean	251,215.9	
S.D	66,561.65	

Source: Field Survey, 2023.

The results reveals that the minimum profit was ₦89,000, indicating the lowest profitability level, while the maximum profit was ₦321,000, indicating that some tomato producers were able to achieve relatively high profitability, possibly due to scale, market access, or advanced farming techniques. Moreover, 23.64% of the tomato producers fell within ₦89,000 - ₦135,000 class. This shows that a significant portion of producers earn relatively lower gross margins, potentially reflecting challenges such as high production costs and inefficient farming practices.

Factors Influencing the Gross Margin of Late Wet Season Tomato Production

Table 6 presents the results of the factors influencing the net returns of tomato producers. The semi-log model statistics revealed an adjusted R² value of 0.38 implying that 38% of the variation in the estimated model has been explained by the socio-economic factors of the producers and the remaining 60% was as a result of random error. The F-Value of the estimated model was 15.20 and significant at 1% level of probability which further proved the reliability and validity of the estimated model. The constant value of the regression model was highly significant at 1% level of probability; considering the fact that solely secondary variables were included in the model, inclusion of primary variables such as tomato seed, fertilizer, pesticides and labour can change the statistical significance of the estimated parameters. The result further indicates that farming experience significantly contributes to tomato profitability at a 1% level of significance. The obtained coefficient suggests a positive association between producers' experience and tomato profitability. This can be attributed to the likelihood of experienced producers engaging in economic transactions more effectively, leading to higher profitability. This aligns with the findings of Wairimu *et al.* (2015), who observed a similar influence of farming experience on cash crop profitability among smallholder tea producers in Kenya.

Table 6: Factors Influencing the Gross margin of the Late wet Season Tomato Production

Variable	Parameters	Coefficient	Std. error	t-stat	Sig
Constant	b ₀	3.034	0.284	10.685	0.000***
Age (years)	b ₁	-0.002	0.003	-0.724	0.470
Sex	b ₂	0.046	0.066	0.696	0.484
Household Size	b ₃	0.001	0.005	0.202	0.864
Education(years)	b ₄	-0.004	0.004	-1.000	0.382
Experience(years)	b ₅	0.205	0.086	2.393	0.018***
Mem. Of Assoc.	b ₆	0.081	0.037	2.205	0.028**
Farm Size(ha)	b ₇	0.487	0.077	6.324	0.000***
Access to Credit	b ₈	0.023	0.036	0.649	0.517
Extension Visits (No.)	b ₉	0.084	0.041	2.048	0.043**
Access to market Information	b ₁₀	0.061	0.037	1.669	0.096*
R ²	0.405				
R ² -adjusted	0.385				
F-value	15.203				0.000***
Durbin Watson	1.970				

*** Significant at 1% (p<0.01), ** at 5% (p<0.05), * at 10% (p<0.10). Source: Field Survey 2023.



Furthermore, membership of associations significantly influences the profitability of LWSTP tomato producers at a 5% significance level. The positive coefficient implies that producers benefit financially from collective organization or group efforts. Forming such groups enables producers to negotiate better market prices for their produce, enhancing their profitability. Farm size was seen as a crucial factor influencing tomato profitability, with results indicating a significant effect at a 5% probability level. Larger farms tend to yield higher profits due to potential economies of scale. This finding corroborates with Bongiwe's (2013) study on vegetable production in Swaziland, which highlighted the importance of farm size in productivity and profitability.

Furthermore, access to extension by tomato producers exhibit a positive and statistically significant influence at a 5% level. This underscores the importance of producers' access to extension services in enhancing profitability. Moreover, access to market information significantly influences tomato profitability at a 10% level of significance. The coefficient to access to market information shows that a unit increase in market information will lead to 6.1% increase in profitability of tomato producers. Market information encompasses knowledge of input and output prices, which helps mitigate risks and optimize decision-making. This result is in line with argument of Siziba *et al.* (2011) regarding the risk-reducing benefits of market information. Similarly, Martey *et al.* (2012) emphasized the importance of market information in enabling effective planning and commercialization of smallholder agriculture.

CONCLUSION AND RECOMMENDATION

Based on the findings, it can be concluded that most of individuals engaged in LWSTP were within the youth age group that is active and productive suggesting potential for long term sustainability in tomato production. The study also shows that Late wet season tomato production is profitable enterprise that is a capable of improving the livelihood of producers in the study area. The study recommends that financial institutions and Government should provide affordable financial support and credit facilities to tomato producers. Non-governmental organizations and private organization should encourage female producers to participate in late tomato production. Kaduna Agricultural Development Agency should increase the frequency and quality of extension visits, with a focus on disseminating best practices for late wet season tomato production.

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