Cultivation Methods and Post-Harvest Practices of Tomato (*Solanum lycopersicum*) in Obio-Akpor Local Government Area of River State, Nigeria

***Elenwa, C.O. [1]Amadi, G.C. & *Ali, A.M.**
Department of Agricultural Extension and Rural Development, Rivers State University, Port Harcourt, Nigeria.
[1]Department of Crop Science, Rivers State University, Port Harcourt, Nigeria.
Corresponding author: caroline.albert@ust.edu.ng- ORCID: 0000-0001-5744-5607
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Abstract
The study assessed the cultivation methods and post-harvest practices of tomato (Solanum lycopersicum) in Obio/Akpor Local Government Area of Rivers State, Nigeria. A purposive and simple random sampling procedure was adopted to select 100 farmers from the 150 tomatoes farmers in the study area. A structured questionnaire was used to elicit information from the farmers Descriptive statistics such as percentage and frequency were used to present the data and Multiple Linear Regression was applied to test the hypothesis at 0.05% significant level. The result showed that majority (67.0%) of the farmers were female and 34.0% of them were between the ages of 40-49yrs; most (48.0%) of the farmers were married and 45.0% of them had household size of 4-6 persons. It was revealed that 59.0% of the sampled farmers earned ₦70,000 and above monthly, majority (86.0%) of the farmers were educated. It also showed that 81.0% see organic farming, backyard farming (72.0%), green house farming (64.0%), polythene bags (42.0%) as method of tomato production in the Study Area. The result also showed that majority of the tomato farmers (82.0%) see Sorting and Planting, Packaging 75.0%, Cleaning 58.0%, Cooling 52.0%, Storing 50.0% as Post-Harvest Handling Practices in the Study Area. Also, the study revealed that majority of the households agreed to source of income($\bar{x}$ = 3.85) as benefit of tomato production. This is followed by source of food ($\bar{x}$ = 3.67), source of vitamins ($\bar{x}$ = 3.63), source of employment ($\bar{x}$ = 3.57), increase the level of tomato production ($\bar{x}$ = 3.45), improved livelihood ($\bar{x}$ = 3.44) help in treatment cancer ($\bar{x}$ = 3.43) diversified income ($\bar{x}$ = 3.09), improved social Status ($\bar{x}$ = 3.43), and improved farm productivity ($\bar{x}$ = 3.43). Finally, the result also showed that majority of the farmer agreed to high cost of improved tomato seed ($\bar{x}$ = 3.87) as constraints to tomato production. This is followed by lack of technical knowledge ($\bar{x}$ = 3.75), limited capital ($\bar{x}$ = 3.58), disease outbreak ($\bar{x}$ = 3.50), pest infestation ($\bar{x}$ = 3.41), theft ($\bar{x}$ = 3.15) as the production constraints of tomato production, while majority of the farmer agreed to Cost of Labour ($\bar{x}$ = 3.72),of tomato production. This is followed by quick spoilage ($\bar{x}$ = 3.70), Pest infestation ($\bar{x}$ = 3.41), Cost of Transportation to market ($\bar{x}$ = 3.47), theft ($\bar{x}$ = 3.39), nearness to market ($\bar{x}$ = 3.17), lack of proper storage facilities ($\bar{x}$ = 3.15), lack of proper transportation facility ($\bar{x}$ = 3.08), poor packaging ($\bar{x}$ = 3.06), bad road network ($\bar{x}$ = 3.05), improper harvesting time ($\bar{x}$ = 3.01), improper harvesting method ($\bar{x}$ = 2.81) as post-harvest constraints. The regression analysis showed the result that income level is a significant predictor of tomato production since its P-value is less than 0.05. Based on the findings, the study recommended that, the government and agricultural agencies should provide subsidies or financial assistance to help farmers

access improved seeds and other essential inputs. This could include low-interest loans or grants aimed at increasing farmers' capital.
Keywords: Cultivation Methods, Post-Harvest Practices, Tomato (Solanum lycopersicum)

Introduction

Agriculture is broadly divided into four sectors in Nigeria–crop production, fishing, livestock and forestry. Crop production remains the largest segment and it accounts for about 87.6% of the sector's total output, followed by livestock, fishing and forestry at 8.1%, 3.2% and 1.1% respectively (Taiwo, 2020). Agriculture remains the largest sector in Nigeria rural economy contributing an average of 24% to the nation's GDP over the past seven years (2013 – 2019) (Taiwo, 2020). In addition, the sector employs more than 36% of the country's labour force, a feat which ranks the sector as the largest employer of labour in the country (Taiwo, 2020). Crop productions are in two forms namely arable and non-arable crops. Arable crops are crops that are grown on land that is suitable for tilling, or breaking up and preparing for planting. These crops are typically grown in fields that have been previously cleared of trees and other vegetation.

Arable crops are typically characterized by the use of large, mechanized equipment to plant, cultivate and harvest them, and they are often grown on a large scale, with fields covering many acres. Some common arable crops include: Grains, Wheat, corn, rice, oats, barley, rye, and other grains are among the most widely grown arable crops in the world. These crops are used to make a wide range of products, including bread, pasta, cereals, and animal feed. Legumes: such as beans, lentils and peas, are important sources of protein and are widely grown as arable crops. Vegetables: such as potatoes, tomatoes, onions, and peppers, are grown as arable crops. Fruits: such as apples and strawberries, are also grown as arable crops. Oilseeds: Crops like soybeans, sunflowers and canola are grown for their oil, which is used in a variety of products, including cooking oils, biodiesel, and feedstock for the production of plastics and other chemicals. Vegetable is one of the important sources of vitamins, minerals and dietary fiber and are essential in prevention of diseases. Vegetable production is of great economic importance in the agricultural sector. Its value chain can provide income and reduces poverty and unemployment (Nweke *et al*, 2022). Vegetable production has the potential to increase food security and create employment. Smallholders' farmers made up large number of vegetable producers in Nigeria (Ogunbo, 2015). Insufficient intake of fruit and vegetables is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischemic heart disease deaths and about 9% of stroke deaths (WHO, 2020). The World Health Organization recommended consumption of 400 g of fruits and vegetables daily to maintain good health. Tomato, pepper and onion are important vegetables in the global economy due to their high consumption.

Tomato (*Solanum lycopersicum)* is one of the foremost, essential vegetables in Nigeria virtually consumed by every tribe and grown all over Nigeria (Abur, 2020) Tomato stands out as one of the important vegetables considering the scale of production and level of consumption. It is beneficial for the maintenance of good health and disease prevention. Tomato production presents an opportunity for increasing rural incomes particularly among peri-urban smallholder

farmers due to the high demand in urban centers (Takesures, 2017)]. Farmers are willing to cultivate tomato more than any other vegetable because of its high demand, multiple harvests produced. Tomato is produced across Nigeria and smallholder farmers cultivating between 0.5 and 4 hectares of land account for 90% of production (Sahel Newsletter, 2017).

Tomatoes are mainly produced by smallholder farmers with small farm holdings and are responsible for the tomato consumed in the nation (Adenegan, 2011). Tomato production is profitable in Nigeria, and average profit of tomato production under irrigation was N128,750 ($ = N350) in Kogi and Benue State (Ayoola, 2014) while the rate of naira on naira invested on tomato production in Kano was 1.5 indicating profitability of the enterprise (Katanga *et al*, 2018). Tomatoes need at least eight hours of sun and one to two cubic feet of loose, rich soil to accommodate the roots of each plant. They can be grown in large containers or in the ground. Growing tomatoes directly on the ground is best in planting area raised at least six inches above the surrounding grade to ensure good drainage. To raise healthy plants and delicious tomatoes, there are several important steps to follow along the way from seed to harvest.

Tomatoes seem to have an unending number of uses. They have become the stars in sauces, salads, sandwiches, pizza, stews and many more dishes. They can be stuffed grilled or even baked; they add both sweetness and acidity to dishes, and they can even be eaten raw. This research is being carried out in order to improve the level of tomato production in Obio/Akpor Local Government Area in Rivers State seeing that there is a large market of users available in this area and also the presence of some physical markets where it can be sold. However, there is short supply of tomato in the market which has resulted to high cost of tomato; three seeds of tomato go for ₦500 thereby affecting the consumption rate of tomato. The result of the research carried out by Abur (2020) shows that tomato is a good fruit vegetable that helps in the reduction/control of prostrate cancer among elderly men. Therefore it is patient to assess tomato cultivation methods and its post-harvest practices in Obio/Akpor Local Government Area and Rivers State in general. The specific objectives were to:

i. describe the socio economic characteristics of tomato farmers in the study area;
ii. identify tomato cultivation methods among farmers in the study area
iii. ascertain post-harvest handling practices among tomato farmers in the study area; and
iv. ascertain the constraints to cultivation and post-harvest handling of tomato among tomato farmers in the study area.

Methodology

The study was carried out in Obio/Akpor Local Government area of Rivers State, Nigeria. Obio/Akpor is bounded by Port Harcourt LGA to the south, Oyigbo and Eleme LGAs to the east, Ikwerre and Etche to the north, and Emohua to the west. It is located between latitudes 4°45'N and 4°60'N and longitudes 6°50'E and 8°00'E. Obio/Akpor is popularly known as the gateway city, because of its location. It has a land area of approximately 311.71 km2 (120.35 sq mi) and shares boundaries with Emohua, Ikwerre, Etche, Oyigbo, Eleme, Okirika and Port Harcourt Local Government Areas of Rivers State and accessible by road, sea and air transportation.

The population of the study consisted of all tomato farmers in the study area, According to Agricultural Development programe ADP, there are a total of 150 crop farmers who are also into tomato production in the study area. Purposive and simple random sampling was used to select the tomato farmers in the study area from the 150 crop farmers of which some produce tomato, 110 of the crop farmers that produce tomatoes was purposively selected. A total of 110 respondents formed the sample size for the study. However, 100 questionnaires were retrieved from the respondents and used for the analysis representing 95%. Primary data source was used. Primary data was collected using interview schedule because not all the farmers were literate. To help in achieving the objectives of the study, data collected were analysed using descriptive statistics such as frequency, mean, to address objectives 1, 2 and 3. Objectives 4 and 5 were analyzed using 4 point rating scale of; Strongly Agreed (4); Agreed (3); Disagreed (2); and Strongly Disagreed (1). The values were added to get 10 which was further divided by 4 to get 2.5 which served as the decision rule. Any variable greater than or equal to 2.50 was accepted while variables less than 2.50 were been rejected. The hypothesis was analysed using the regression analysis. The model for the regression analysis is thus;

$y = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + e$
Where; y = tomato production
Variables
x_1 = Age (years); x_2 = Gender (male = 1, female = 2); x_3 = Educational level (years) ; x_4 = Household size (persons); x_5 = years of experience (years); x_6 = Income (₦); e = error term.

Results And Discussion

Socioeconomic characteristics of the respondents in the study area

Result on table 1 shows that 67.0% of the farmers were females, while 33.0% of the tomato farmers were males. This indicates that majority of the sampled farmers were females. This gender distribution suggests that women constitute the majority of farmers in the study area. The prominence of female farmers is consistent with findings from similar studies in agricultural communities, where women often play a significant role in farming activities. This study agrees with the findings of Elenwa and Okorie (2019) who reported that females are more than their male counterpart in vegetable farming in Oyigbo local government area in Rivers state. The tomato farmers had an average mean age of 43.4years with 34.0% of the tomato farmers between the ages of 40-49yrs. This implies that a significant portion of the tomato farming population is in their middle years; potentially bringing both experience and stability to their farming practices as well as age distribution of farmers can significantly influence agricultural productivity and innovation and it agrees with the record that the mean age of active people in Nigeria are about 45 years (Nifeipiri and Elenwa, 2020). Almost half (48.0%) of the farmers were married which implies that the farmers are responsible and caring to their families (Elenwa and Emodi, 2019) who recorded that majority of the vegetable farmers were married in Omuma Local Government Area. Result on educational level of respondents revealed that 36.0% of the farmers had tertiary education, 32.0% attended secondary school, and 18.0% attended primary school, while 14.0% of the respondents had no formal education. Thus, the percentage of tomato farmers who could read and write is high (86.0%). This distribution highlights varying levels of educational attainment within the farming community;

higher educational levels can positively impact agricultural practices and productivity. The presence of a relatively high proportion of farmers with tertiary education (36.0%) suggests a positive potential for the adoption of modern agricultural practices and technologies (Elenwa et al, 2021). An average household of 6.0 persons a large household size; this distribution has important implications for labor availability and agricultural productivity. The average farming experience of the cassava farmers was 9.8 years; with a greater percentage (32.0%) having between 6-10 years farming experience. This is not in line with the findings of Elenwa *et al* (2022) who noted that majority 63.2% of the vegetable Farmers in Etche Local Government Area, Rivers State, Nigeria had farming experience of between 11-20 years respectively. The results on Table 1 also indicated that majority (59.0%) of the tomato farmers in the study area earn monthly income between ₦70,000 and above The average monthly income of ₦66,900.00 was recorded. This income distribution has significant implications for the economic stability and investment capacity of these farmers. The fact that a majority of farmers (59.0%) earn N70,000 and above monthly suggests a relatively high income level for this group, which could enable them to invest in better farming inputs, technologies, and practices (Albert, 2013).

Table 1: Socioeconomic characteristics of the respondents in the study area

Characteristics	Frequency (n=100)	Percentage (%)	Mean
Gender			
Male	33	33.0	
Female	67	67.0	
Age (years)			
20 – 29	15	15.0	
30 – 39	21	21.0	
40 – 49	34	34.0	43.4 years
50 – 59	20	20.0	
60 and above	10	10.0	
Marital Status			
Single	28	28.0	
Married	48	48.0	
Separated/ Divorced	7	7.0	
Widowed /widower	17	17.0	
Educational Level			
Non-formal	14	14.0	
Primary School	18	18.0	
Secondary School	32	32.0	
Tertiary Institution	36	36.0	
Household Size (persons)			
1 - 3	14	14.0	
4 - 6	35	35.0	6persons
7–9	46	46.0	
10 & Above	5	5.0	
Farm Size (Hectares)			
Less than 3	16	16.0	
4 – 6	37	37.0	
7-9	26	26.0	4.9hecters
10 & Above	21	21.0	
Years of Experience			
1 - 5	16	16.0	

6 - 10	32	32.0	7.7years
11 - 15	27	27.0	
16 & Above	25	25.0	
Income			
10,000 – 29,000	4		
30,000 – 49,000	10		₦66,900.00
50,000 – 69,000	31		
70,000 – 89,000	55		

Source: Field Survey (2024)

Methods of Tomato Production among farmers in the Study Area

The result in Table 2 shows that majority (81.0%) of the farmers use organic farming, backyard farming (72.0%), green house farming (64.0%),polythene bags (42.0%)as method of tomato production in the study area. while bucket farming (38.0%), sack bag (35.0%), bag farming (34.0%), hydroponics (18.0%) showed a low percentage. These findings have significant implications for agricultural practices and sustainability in the region. The high adoption rate of organic farming is particularly noteworthy, as it suggests a strong inclination towards sustainable agriculture among these farmers. This aligns with Mbube *et al* (2019) and Elenwa & Okorie, (2019) where organic farming is known for its environmental benefits, such as improving soil health, reducing pollution, and enhancing biodiversity.

Table 2 : Percentage distribution on method of tomato production

Method of Tomato Production	**Frequency (*f*) (n = 100)**	**Percentage (%)**	**Rank**
Organic farming	81	81.0	1st
Hydroponics	18	18.0	8th
Green house farming	64	64.0	3rd
Bag farming	34	34.0	7th
Backyard farming	72	72.0	2nd
Bucket farming	38	38.0	5th
Sack bag	35	35.0	6th
Polythene bags	42	42.0	4th

Source: Field Survey 2024 **Multiple Response**

Post-Harvest Handling Practices among tomato farmers in the Study Area

The result in table 3 shows that majority (82.0%) of the tomato farmers see sorting and grading, packaging (75.0%), cleaning (58.0%), cooling (52.0%) and storing (50.0%) as post-harvest handling practices in the study area. These findings have significant implications for the quality, marketability, and shelf life of tomatoes produced in the region. The high percentage of farmers engaging in sorting and grading (82.0%) suggests a strong focus on ensuring that only healthy, uniform tomatoes are planted, which can lead to higher-quality produce. This compliment Kaur *et al* (2021) who observed that sorting, packaging, cleaning, cooling, as the post-harvest stage also helps in separating damaged or diseased tomatoes, reducing the likelihood of spoilage during storage or transportation.

Table 3: Post-Harvest Handling Practices among tomato farmers

Post-Harvest Handling Practices	**Frequency (*f*) (n = 100)**	**Percentage (%)**	**Rank**
Sorting and grading	82	82.0	1st
Cleaning	58	58.0	3rd
Drying	42	42.0	6th
Storing	50	50.0	5th
Packaging	75	75.0	2nd
Cooling	52	52.0	4th

Source: Field Survey (2024) **Multiple Response**

Constraints to Tomato production among farmers in the Study Area

Result in table 4 shows that majority of the farmers agreed to high cost of improved tomato seed ($\bar{x} = 3.87$) as constraints to tomato production. This is followed by lack of technical knowledge ($\bar{x} = 3.75$), limited capital ($\bar{x} = 3.58$), disease Outbreak ($\bar{x} = 3.50$), pest infestation ($\bar{x} = 3.41$), and theft ($\bar{x} = 3.15$). Illiteracy ($\bar{x} = 2.44$) were disagreed upon by the farmers as constraints to tomato production. The implication of these findings is that the high cost of improved seeds poses a significant barrier to maximizing tomato production in the region. In line with Olajide (2011), theft can lead to substantial financial losses, especially for smallholder farmers who may not have the resources to invest in security measures. The high cost of improved seeds, Lack of technical knowledge, limited capital, and challenges related to disease and pest management are the primary constraints hindering tomato production in the study area. Addressing these issues through subsidies, credit facilities, and improved extension services could significantly enhance productivity and profitability for tomato farmers. A grand mean of 3.39 indicate that tomato farmers were faced with some constraints in the production of tomato.

Table 4: Constraints to Tomato production among farmers in the Study Area

Production Constraints	**SA**	**A**	**D**	**SD**	**Total**	**Mean ($\bar{x}$)**	**Rank**	**Remark**
High cost of improved Tomato seed	87	13	0	0	387	3.87	1st	Agreed
Disease Outbreak	55	40	5	0	350	3.50	4th	Agreed
Limited capital	65	28	7	0	358	3.58	3rd	Agreed
Illiteracy	17	30	33	20	244	2.44	7th	Disagreed
Pest infestation	54	36	7	3	341	3.41	5th	Agreed
Theft	41	37	18	4	315	3.15	6th	Agreed

Lack of technical knowledge	75	25	0	0	375	3.75	2nd	Agreed
Grand Mean						3.39		

Constraints on Post-Harvest handling practices of Tomato production in the Study Area

Result in table 5 shows that majority of the farmers agreed to cost of labour ($\bar{x} = 3.72$) as post-harvest constraints of tomato production. This is followed by quick spoilage ($\bar{x} = 3.70$), pest infestation ($\bar{x} = 3.41$), cost of transportation to market ($\bar{x} = 3.47$), theft ($\bar{x} = 3.39$), nearness to market ($\bar{x} = 3.17$), lack of proper storage facilities ($\bar{x} = 3.15$), lack of proper transportation facility ($\bar{x} = 3.08$), poor packaging ($\bar{x} = 3.06$), bad road network ($\bar{x} = 3.05$), improper harvesting time ($\bar{x} = 3.01$),improper harvesting method ($\bar{x} = 2.81$) andgovernment policies were all agreed to be post-harvest constraints of tomato production by the farmers. The most significant post-harvest constraint identified is the lack of technical knowledge regarding seed handling and post-harvest practices. This indicates a need for improved extension services and training programs to educate farmers on best practices for managing seeds, handling produce, and mitigating losses ((Katanga *et al*, 2018). Technical knowledge is crucial for implementing effective post-harvest management practices that can reduce losses and enhance the quality of the produce. The grand mean of 3.22 shows that the post-harvest handling of tomato is faced with some challenges.

Table 5: Constraints on Post-Harvest handling practices of Tomato production

Post-Harvest Constraints	**SA**	**A**	**D**	**SD**	**Total**	**Mean ($\bar{x}$)**	**Rank**	**Remark**
Improper harvesting method	25	43	20	12	281	2.81	12th	Agreed
Improper harvesting time	22	64	7	7	301	3.01	11th	Agreed
Lack of proper storage facilities	35	45	20	0	315	3.15	7th	Agreed
Cost of Transportation to market	51	45	4	0	347	3.47	4th	Agreed
Poor Packaging	42	34	12	12	306	3.06	9th	Agreed
Pest infestation	60	38	2	0	358	3.58	3rd	Agreed
Lack of proper transportation facility	50	15	28	7	308	3.08	8th	Agreed
Nearness to market	34	51	13	2	317	3.17	6th	Agreed
Bad road network	38	31	29	2	305	3.05	10th	Agreed
Government policies	15	57	14	14	273	2.73	13th	Agreed
Theft	57	34	9	0	339	3.39	5th	Agreed
Quick spoilage	70	30	0	0	370	3.70	2nd	Agreed
Cost of Labour	72	28	0	0	372	3.72	1st	Agreed

Grand Mean	3.22

Source: Field Survey (2024) **Criterion mean = 2.5**

Linear regression relationship between socio-economic characteristics of tomato farmers and tomato production methods in the study area

The result in table 6 shows that income level and age are significant predictor of tomato production since its P-value is less than 0.05. This means that as income and age increases, tomato production is likely to increase as well, indicating a statistically significant positive relationship. However, some of the explanatory variables (gender, marital status, educational level, years of experience, and secondary occupation) were not significant as they had P-values were greater than 0.05. These variables were found to be statistically insignificant in predicting tomato production, as their P-values were greater than 0.05. This means that changes in these variables do not significantly affect tomato production in the study area. The result also shows that same of the independent variables (marital status, educational level, level of income in Naira per month, and secondary occupation) have positive coefficients, indicating a direct relationship with tomato production. An increase in these variables is associated with an increase in the dependent variable (tomato production). For example, as income or involvement in a secondary occupation increase, tomato production may also increase. On the other hand, (gender, age, Years of experience and Household size) had a negative coefficient, suggesting an inverse relationship with tomato production. As these variables increase, tomato production is expected to decrease. For instance, as the age or household size increases, the tomato production may decline. Finally, the overall P-value is 0.20, which is greater than the 0.05 threshold for statistical significance. This means that the model as a whole does not significantly explain the variation in tomato production based on the socio-economic characteristics included. As a result, the null hypothesis, which states that the socio-economic characteristics of the respondents have no significant effect on tomato production, is accepted

Table 6: Linear regression relationship between socio-economic characteristics of tomato farmers and tomato production methods in the study area

	Coefficient	Std. error	β	t-Value	P-value
(Constants)	1.355	.227		5.971	0.000
Gender	-.197	.112	-.236	-1.759	0.082
Age	-.095	.045	-.286	-2.127	0.036*
Marital Status	.080	.057	-.204	-1.394	0.167
Educational Level	.038	.044	-.107	-.857	0.394
Years of Experience	-.055	.046	-.145	-1.191	0.237
Household Size	-.025	.061	-.050	-.415	0.679
Level of Income in Naira per month	.205	.052	.595	3.945	0.000*
Secondary Occupation	.029	.025	.117	1.150	0.253

*** P<0.05 level (2-tailed)**

Model	R	Rsquare	Pvalue	*F*	*Adjusted R Squre*	Std. Error of the Estimate	Decision
Variable	0.419[a]	0.176	0.20[b]	2.422	0.103	0.37341	$H_{0\ accepted}$

Conclusion And Recommendation

Based on the findings, it was concluded that tomato production in Obio/Akpor Local Government Area is a vital agricultural activity that contributes significantly to the livelihoods of farmers. Income plays a significant role in tomato production, other socio-economic factors do not have a significant impact, and further research may be needed to identify other important determinants. However, the sector faces numerous challenges that hinder its full potential. The high cost of improved seeds, limited access to capital, and significant post-harvest constraints such as quick spoilage, lack of technical knowledge, and inadequate storage and transportation facilities are major obstacles. Based on the findings from the study, it was recommended that government and agricultural agencies should provide subsidies or financial assistance to help farmers access improved seeds and other essential inputs. This could include low-interest loans or grants aimed at increasing farmers' capital.

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