Impact of Post-Harvest Losses of Tomatoes on the Income and Poverty Level of Farmers in Gwer East, Benue State-Nigeria

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Abstract
This study examined the impact of tomato post-harvest losses on farmers' income and poverty levels in Gwer East Local Government Area of Benue State, Nigeria. The specific objectives were to identify the causes of post-harvest losses, examine their effects on farmers' income and assess their relationship with poverty status. A cohort survey design was adopted, with structured questionnaires, Focus Group Discussions and KoBo Collect employed for data collection. A sample of 397 farmers targeted but 385 valid responses were used for the analysis. Data were analysed using descriptive statistics, profitability analysis, regression and the Foster, Greer and Thorbecke (FGT) poverty framework. The findings identified inadequate storage and processing facilities, poor handling, inferior packaging and transportation difficulties as major causes of post-harvest losses. An estimated 25% of harvested tomatoes was lost, resulting in a gross revenue loss of ₦30,000 per farmer per season. Regression results indicated a significant negative relationship between post-harvest losses and farmers' income, while logistic regression revealed a significant positive association with poverty status. The study concludes that reducing post-harvest losses through improved storage, processing, packaging, transportation and extension services could enhance farmers' income and household welfare. It recommends investment in post-harvest infrastructure, affordable credit and targeted agricultural support programmes.

Keywords: *Post-harvest losses, tomato production, farmers' income, poverty, Gwer East.*

Introduction

Agriculture plays a vital role in Nigeria's economy by providing food, employment, income and livelihoods, particularly for rural households. Among agricultural commodities, horticultural crops, especially tomatoes (*Solanum lycopersicum*), are economically important because of their nutritional value, high demand and income-generating potential. Tomatoes are widely consumed and provide essential vitamins, particularly vitamins A and C. However, their high moisture content and delicate structure make them highly perishable and susceptible to post-harvest losses. Nigeria is the 14th largest tomato producer globally and the second largest in Africa, with an estimated annual production of 2.4 million tonnes (Federal Ministry of Agriculture, 2020). Despite this production capacity, the country remains a major importer of tomato paste due to inadequate

storage, processing and transportation facilities. Post-harvest losses in the tomato value chain are estimated to cost Nigeria about $15 billion annually (Nnamani & Afolabi, 2020). These challenges undermine farmers' income and the overall efficiency of the agricultural sector.

Benue State, popularly known as the Food Basket of the Nation, is one of Nigeria's major tomato-producing states. Its favourable agricultural conditions support commercial tomato production, although inadequate storage facilities, processing infrastructure and rural transportation continue to constrain the sector (Akura, 2020). Within the state, Gwer East Local Government Area is recognised for its suitability for large-scale tomato cultivation, making tomato farming an important source of livelihood and income for many rural households.

Despite its economic importance, tomato farming in Gwer East is constrained by considerable post-harvest losses, which involve reductions in the quantity and quality of produce between harvesting and consumption. Such losses result from poor handling, mechanical damage, inadequate storage, transportation difficulties and microbial contamination (Akor & Akor, 2024). Similarly, Yanjoh, Ugbabe and Terna (2024) identify inadequate storage facilities, poor transportation systems and inappropriate packaging as major causes of post-harvest losses among farmers in Benue State. Adepoju (2014) also highlights poor marketing channels and handling practices as contributing factors. Beyond reducing available food supplies, post-harvest losses negatively affect farmers' income, investment capacity and general welfare. Repeated losses reduce the financial returns from agricultural investments and may perpetuate rural poverty. Beeior, Iorlamen and Shabu (2024) demonstrate that adopting improved post-harvest value-addition technologies significantly enhances farmers' income and welfare. Similarly, Yami et al. (2025) emphasise that improved storage, transportation and processing practices can minimise losses and increase farmers' earnings. Consequently, given the importance of tomato production to rural livelihoods in Gwer East, it was necessary to examine the extent to which post-harvest losses affect farmers' income and poverty levels. Understanding this relationship provides useful evidence for developing appropriate interventions, improving agricultural value-chain efficiency and enhancing the economic welfare of tomato farmers.

1.2 Statement of the Problem

Gwer East Local Government Area of Benue State has considerable potential for tomato production, income generation and poverty reduction. However, these prospects are undermined by significant post-harvest losses resulting from poor handling practices, inadequate storage and transportation facilities, and limited access to modern preservation technologies (Yanjoh et al., 2024). These losses reduce the quantity and quality of tomatoes available for sale, thereby lowering farmers' income and profitability. Consequently, farmers are often compelled to sell their produce at very low prices immediately after harvesting to avoid spoilage (Adepoju, 2014). Although the Benue State Government proposed establishing a tomato processing industry in Wannune to address this challenge, the facility is currently non-functional, leaving farmers with limited opportunities for processing and preservation.

The absence of effective storage and processing facilities also contributes to seasonal market gluts, price fluctuations and reduced financial returns. These challenges weaken farmers' investment capacity and may perpetuate rural poverty by limiting their ability to improve production and living conditions. Despite the significance of tomato production in Gwer East, there is limited empirical evidence establishing the extent to which post-harvest losses affect farmers' income and poverty levels. Existing studies have largely focused on general production constraints and post-harvest challenges without adequately examining their socioeconomic implications.

Therefore, this study seeks to investigate the extent of post-harvest losses and their effects on the income and poverty levels of tomato farmers in Gwer East Local Government Area of Benue State, with a view to providing evidence for appropriate interventions to improve farmers' livelihoods and promote sustainable agricultural development.

1.3 Objectives of The Study

The specific objectives of this study were to:

i. Examine the factors that cause post-harvest losses of tomatoes in Gwer East.
ii. Ascertain the impact of post-harvest losses of tomatoes on the income of farmers in Gwer East;
iii. Investigate the impact of post-harvest losses of tomatoes on the poverty level of farmers' in Gwer East.

1.4 Research Questions

The study seeks to provide answers to the following research questions:

i. What are the post-harvest management and practices that cause post-harvest losses of tomatoes in Gwer East?
ii. How does post-harvest losses of tomatoes impact on the incomes of farmers in Gwer East?
iii. What is the impact of post-harvest losses of tomatoes on the poverty levels of farmers in Gwer East?

1.4 Research Hypotheses

The following null hypotheses were formulated to guide this study:

$H_0$1: Post-harvest management and practices has no causal effect on post-harvest losses of tomatoes in Gwer East.
$H_0$2: Post-harvest losses of tomatoes have no impact on the incomes of farmers in Gwer East.
$H_0$3: Post-harvest losses of tomatoes have no impact on the poverty levels of farmers in Gwer East.

2.1 Conceptual Issues

2.1.1a Post-Harvest Losses

Post-harvest losses refer to quantitative and qualitative reductions in agricultural produce occurring between harvesting and consumption. These losses may arise during handling, storage, transportation, processing and marketing, resulting in reduced food availability, quality and economic value (Olayide et al., 2024; Yami et al., 2025). According to FAO (2018), these losses involve reductions in the quantity, quality, nutritional value, edibility and market value of food products. They may result in physical weight reduction, spoilage, nutritional deterioration and commercial losses, thereby reducing food availability and farmers' income.

2.1.1b Post-Harvest Loss of Tomato

Tomato (*Solanum lycopersicum*) is an economically important vegetable widely cultivated and consumed in Nigeria. However, its highly perishable nature makes it susceptible to mechanical damage, physiological deterioration and microbial spoilage during harvesting, handling, transportation and storage. These conditions contribute to quantitative and qualitative losses along the tomato value chain (Olayide et al., 2024; Yami et al., 2025). However, its high perishability makes it vulnerable to deterioration during handling, storage, transportation and marketing, resulting in post-harvest losses. These losses involve quantitative and qualitative reductions in the

weight, nutritional value, edibility, availability and market quality of tomatoes between harvesting and final consumption (De Lucia & Assennato, 2017; FAO, 2018).

2.1.1c Farmers Income

Farmers' income could therefore be conceptualized as money that a person engaged in agricultural activities receives in exchange for his farm output. Farmers' income can be used for discretionary purposes involving purchase of farm implements, farm inputs, among others. On the other hand, income from farming can be defined as that, which is earned as result of farming operations which is sale of products. Farmer's income reflects their living and economic condition and standard. Adepoju (2014) reported that due to post harvest losses, less volume of product available for sale hence, low farmers income. Farmers of smallholder type typically have unstable income due to market risk and production risk, such that losses incurred post-harvest not only affect produce but also labour inputs, transport and marketing cost hence; profit is affected.

2.1.1d Concept of Poverty

The concept of poverty involves lack of income, lack of services and low living standard. It takes place in many dimensions, and it relates to agricultural production in rural area. As farmer get the less income from post-harvest loss they could not provide there need of food, health and education. The findings by Beeior et al (2024) have indicated that by addressing the post-harvest practice, income and poverty of farmers can be improved.

2.1.2 Relationship Between Post-Harvest Losses, Income, and Poverty

The post-harvest losses, farmers' income and the level of poverty among them are directly proportional to each other. When the extent of post-harvest losses is high, the amount of the produce that is sold decreases, resulting in reduction of farmers' income. When income is reduced, farmers become more likely to experience poverty. Adepoju (2014) observed that the welfare status of farmers experiencing high levels of post-harvest loss is lower compared to farmers who are better in managing the post-harvest stages. Yami et al. (2025) equally recorded increased farmer's income with adoption of better post-harvest technologies and livelihood.

2.2 Theoretical Framework

This study is anchored on the Sustainable Livelihoods Framework (SLF) and Agricultural Value Chain Theory. The two theories provide complementary explanations of how post-harvest losses affect tomato farmers' income and poverty levels in Gwer East Local Government Area of Benue State. The Sustainable Livelihoods Framework, developed by Chambers and Conway (1992) and popularised by DFID (1999), explains how households utilise available resources to sustain their livelihoods and overcome economic challenges. It identifies five livelihood assets: human, physical, financial, natural and social capital. In the context of tomato farming, post-harvest losses reduce farmers' financial capital through declining sales and income, while inadequate storage, transportation and processing facilities weaken their physical capital. These challenges increase farmers' vulnerability and undermine their livelihood security.

Similarly, Agricultural Value Chain Theory, based on Porter (1985) and Kaplinsky and Morris (2001), examines the interconnected activities involved in moving agricultural products from production to consumption. It emphasises the importance of efficient harvesting, handling, storage, processing, transportation and marketing in preserving product quality and improving profitability. Inefficiencies at these stages contribute to post-harvest losses and reduced farmers' earnings.

Both theories recognise the importance of infrastructure, technology and institutional support in improving agricultural performance and farmers' welfare. However, while the Sustainable Livelihoods Framework focuses broadly on household welfare, vulnerability and poverty, Agricultural Value Chain Theory concentrates on production processes, market efficiency and value addition. The former provides limited explanation of specific loss points along the value chain, while the latter gives insufficient attention to household poverty and livelihood vulnerability. Therefore, integrating the two theories provides a comprehensive foundation for this study. The Agricultural Value Chain Theory explains the causes and extent of post-harvest losses, while the Sustainable Livelihoods Framework explains their implications for farmers' income, livelihood security and poverty levels.

2.3 Empirical Review

The empirical studies reviewed (Olayide et al., 2024; Odeyemi et al., 2022; Arua et al., 2025; and Yami et al., 2025) generally agreed that tomato post-harvest losses result from poor handling, inadequate storage, transportation difficulties, inappropriate packaging and limited technical knowledge. They also established that improved storage, cooling facilities and packaging technologies could reduce losses and improve farmers' income.

However, the studies differed in their emphasis, with some focusing on harvesting and technical knowledge, while others examined transportation, storage and preservation technologies. A notable contradiction was that although improved technologies were found to reduce losses, their adoption remained constrained by high costs and limited availability. This suggests that technological effectiveness does not necessarily translate into widespread adoption among smallholder farmers. Despite these contributions, limited empirical attention has been given to the specific experiences of tomato farmers in Gwer East Local Government Area of Benue State. The present study therefore seeks to fill this geographical and contextual gap by examining the causes of post-harvest losses, preservation methods and their effects on farmers' income.

3.0 Methodology

3.1 Design of the Study

The study adopted a cohort survey design to investigate post-harvest losses among tomato farmers in Gwer East Local Government Area of Benue State. The design focused on experienced tomato farmers who could provide relevant information on production practices and post-harvest losses. Data were collected from respondents using structured questionnaires.

3.2 Study Area

The study was conducted in Gwer East Local Government Area of Benue State, Nigeria, located in the central part of the state, with a land area of approximately 2,294 km² and a population of 163,647 (2006 Census). The area is predominantly inhabited by the Tiv people, with other ethnic groups, including the Igede. Its tropical climate, fertile soils and relatively accessible road networks support agricultural activities and the transportation of farm produce. Agriculture constitutes the major economic activity, with crops such as yam, cassava, maize, rice, soybeans and vegetables, particularly tomatoes, widely cultivated. However, farming remains largely traditional, while poor rural road conditions and irregular electricity supply pose challenges to agricultural production, storage and preservation of farm produce.

3.3 Population and Sample Size

The study population covered all tomato growers in Gwer East Local Government Area of Benue State. According to Tor (2018), there is an estimated 54,278 tomatoes farmers in Gwer East Local Government Area. Hence, the study was premised on a population of 54,278. The population was broken down as follows:

Table 1: Population of Tomato Farmers in Gwer East Local Government Area

S/NO	Council Wards	Population
1.	Aliade/Mbalav	3249
2.	Mbabur	4112
3.	Ikyonov	5198
4.	Gee	4145
5.	Mbayom	5209
6	Akpachayi	4511
7	Mbasombo	3521
8	Ikwe	4231
9	Mbalom	5223
10	Gbemacha	6124
11	Shough	2135
12	Ugee	1893
13	Ikyorgbajir	2369
14	Mbakyaan	2358
	Total	**54,278**

Source: *Tor (2018).*

The sample was determined using Taro Yamane formula as follows:

$$n = \frac{N}{1 + N(e)^2}$$

$where$:

$n =$ The required sample size

$1 = constant$

$N =$ The population size

$e =$ The level of significance which indicates the confidence the researcher has on the sample that the sample elements drawn from a normal population have all the characteristics of the population and therefore, a reflection of that population (e = 5% or 0.05).

Therefore, the sample size was computed thus:

$$n = \frac{54{,}278}{1 + 54{,}278(0.05)^2}$$

$$n = \frac{54{,}278}{1 + 54{,}278(0.0025)}$$

$$n = \frac{54{,}278}{1 + 135.695}$$

$$n = \frac{54{,}278}{136.695}$$

= 397

The sample size for the study was 397 tomatoes farmers in Gwer East Local Government.

3.4 Sampling Technique

The study used simple random sampling technique to select the sample of 397 tomato farmers in the 14 council wards.

3.5 Instruments for Data Collection

Data were collected using structured questionnaires, Focus Group Discussions (FGDs) and the KoBoCollect digital data collection application. The instruments covered farmers' socio-economic characteristics, causes and magnitude of post-harvest losses, income and poverty indicators. KoBoCollect facilitated accurate data entry, efficient data management and GPS-based recording of farm and community locations, enabling spatial analysis of the effects of market distance and road conditions on post-harvest losses.

3.6 Instruments for Data Analysis

Data collected were analysed using descriptive statistics, frequency distribution tables and profitability analysis to address the research questions. Post-harvest losses were measured using the gravimetric method developed by Harris and Linbald (1978) and adopted by the Food and Agriculture Organization (FAO).

$$\% \text{ of Weight Losses} = \frac{(Und)-(DNu)}{U(Nd+Nu)} \times 100$$

where:
U = the weight of the undamaged fruits (kg of baskets)
Nu = the quantity of the undamaged fruits (no. of baskets)
D = the weight of the damaged fruits (kg of baskets)
Nd = the quantity of the damaged fruits (no. of baskets)
Hypotheses were tested using Multiple Linear Regression and logistic regression analysis. The poverty level of the tomato farmers was measured using the Foster, Greer and Thornbecke index which incorporates the poverty headcount ratio, poverty gap and the depth of poverty.
The Foster–Greer–Thorbecke (FGT) poverty index is given by the general formula:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\frac{(z-y_i)^\alpha}{z}$$

Where:
P_α = FGT poverty index
N = total number of individuals/households in the population
q = number of poor individuals (those with income below poverty line)
z = poverty line (income threshold)
y_i = income of the ith poor individual
α = poverty aversion parameter (takes values 0, 1, 2, etc.)

Interpretation of α:
$0\alpha = 0 \rightarrow$ Poverty Headcount Ratio (incidence of poverty)
$1\alpha = 1 \rightarrow$ Poverty Gap Index (depth of poverty)
$2\alpha = 2 \rightarrow$ Poverty Severity Index (inequality among the poor)

Expanded forms:

1. Headcount Index (α = 0):

$$P_0 = \frac{q}{N}$$

2. Poverty Gap Index (α = 1):

$$P_1 = \frac{1}{N}\sum_{i=1}^{q}\frac{z - y_i}{z}$$

3. Poverty Severity Index (α = 2):

$$P_2 = \frac{1}{N}\sum_{i=1}^{q}\frac{(z - y_i)^2}{z}$$

4.0 Results and Discussions

This chapter analyses the impact of tomato post-harvest losses on farmers' income and poverty levels in Gwer East LGA, using descriptive statistics, regression analysis and the FGT poverty framework. The analysis was based on 385 valid responses (97.0% response rate).

4.1.1 Socio-Economic Characteristics of Respondents

The socio-economic characteristics examined include sex, age, marital status, educational qualification and council ward. These characteristics provide background information about the tomato farmers whose responses form the basis of the analysis as in Table 2.

Table 2: Socio-economic characteristics of respondents (n = 385)

Variable	Category	Frequency	Percentage (%)
Sex	Male	238	61.8
	Female	147	38.2
	Total	385	100.0
Age	18–25 years	42	10.9
	26–30 years	76	19.7
	31–35 years	91	23.6
	36–40 years	83	21.6
	Above 40 years	93	24.2
	Total	385	100.0
Marital status	Single	71	18.4
	Married	286	74.3
	Widow/Widower	28	7.3
	Total	385	100.0
Education	Non-formal	84	21.8
	First School Leaving Certificate	103	26.8
	GCE/SSCE	116	30.1
	ND/NCE	48	12.5

HND/B.Sc. and above	34	8.8
Total	385	100.0

Source: Computed by the Researcher, 2026

The results in Table 2 indicates that tomato farming was predominantly undertaken by males (61.8%), with most respondents above 40 years (24.2%) and married (74.3%). Educationally, 30.1% had GCE/SSCE, while 21.8% had no formal education, indicating varying educational backgrounds that could influence farmers' adoption of improved post-harvest practices.

Objective One: Factors Responsible for Post-Harvest Losses of Tomatoes

Respondents were asked about factors affecting tomato production, harvesting, trading, wholesale and retail activities, processing and packaging. The responses are summarised in Table 3.

Table 3: Major factors responsible for post-harvest losses (multiple responses permitted)

Stage/Factor	Frequency	Percentage (%)
Production: crop diseases and pests	246	63.9
Production: drought/excessive sunshine	201	52.2
Production: inadequate farm implements	184	47.8
Harvesting: poor handling of fruits	291	75.6
Harvesting: injuries during harvesting	216	56.1
Harvesting: poor field sanitation	173	44.9
Trading: low prices due to poor quality	278	72.2
Trading: excess supply/market glut	264	68.6
Trading: distribution difficulties	231	60.0
Wholesale: delay in accessing produce	253	65.7
Wholesale: inadequate buyers	219	56.9
Retail: poor quality and rapid deterioration	276	71.7
Processing: inadequate storage facilities	315	81.8
Processing: lack of processing equipment/factories	302	78.4
Processing: limited knowledge of preservation	247	64.2
Packaging: use of inferior baskets/containers	289	75.1
Packaging: lack of skilled labour	174	45.2
Government/institutional: inadequate support and services	267	69.4

Source: Computed by the Researcher, 2026

Note: Respondents could identify more than one factor; percentages were calculated against the 385 valid respondents and therefore it was not sum to 100%.

The findings identify inadequate storage facilities (81.8%), lack of processing equipment (78.4%) and poor harvesting and packaging practices (75.6% and 75.1%) as major causes of tomato post-harvest losses. This indicates that losses occur across the value chain, largely due to inadequate infrastructure, poor handling and limited preservation facilities.

4.4.2 Assessment of Post-Harvest Management Practices

Table 4: Post-harvest management practices and perceived adequacy

Practice/condition	Adequate n (%)	Inadequate n (%)
Careful sorting and grading	151 (39.2)	234 (60.8)
Use of appropriate packaging containers	119 (30.9)	266 (69.1)
Availability of temporary storage	96 (24.9)	289 (75.1)
Access to suitable transportation	142 (36.9)	243 (63.1)
Timely access to markets/buyers	158 (41.0)	227 (59.0)
Access to processing/preservation facilities	63 (16.4)	322 (83.6)
Access to agricultural extension advice	137 (35.6)	248 (64.4)

The findings in Table 4 reveals inadequate post-harvest facilities, with 83.6% reporting insufficient processing and preservation facilities, 75.1% inadequate storage and 69.1% insufficient packaging materials. This highlights the need for improved storage, processing and preservation infrastructure to reduce tomato post-harvest losses.

4.4.3 Objective Two: Impact of Post-Harvest Losses on Farmers' Income

The analysis considers the quantity harvested, quantity lost, sales revenue and the estimated financial value of losses as illustrated in Table 5.

Table 5: Average tomato production and post-harvest loss per farmer per season

Indicator	Mean estimate
Tomatoes harvested (50kg basket equivalents)	24.0 baskets
Tomatoes lost (50kg basket equivalents)	6.0 baskets
Tomatoes available for sale	18.0 baskets
Estimated proportion lost	25.0%
Average selling price per 50kg basket	₦5,000
Estimated gross sales without losses	₦120,000
Estimated actual gross sales after losses	₦90,000
Estimated gross revenue foregone	₦30,000

Source: Computed by Researcher, 2026

The findings in Table 5 indicates an average seasonal harvest of 24 baskets per farmer, with six baskets lost, representing a 25% post-harvest loss. At ₦5,000 per basket, this translates to an estimated gross revenue loss of ₦30,000 per farmer per season, highlighting the negative effect of post-harvest losses on farmers' income.

Table 6: Respondents' assessment of the effect of post-harvest losses on income

Statement	Mean	Std. Dev.	Decision
Post-harvest losses reduce the quantity of tomatoes available for sale	4.31	0.78	Agree
Damaged tomatoes are sold at lower prices	4.18	0.84	Agree
Losses reduce the total income earned from tomato farming	4.27	0.81	Agree
Losses make it difficult to recover production costs	4.02	0.91	Agree
Losses reduce the money available for the next farming season	4.11	0.87	Agree
Grand mean	4.18	0.84	Agree

Source: Computed by Researcher, 2026

The findings (grand mean = 4.18) in Table 6 shows strong agreement that post-harvest losses negatively affect farmers' income, particularly by reducing marketable quantities (mean = 4.31) and total earnings (mean = 4.27). This suggests that tomato deterioration and wastage significantly undermine farmers' sales revenue.

4.4.4 Objective Three: Impact of Post-Harvest Losses on Farmers' Poverty Level

The analysis considers the reported effects of reduced income on household welfare, including food, healthcare, education, savings and the ability to reinvest in farming as reflected in Table 7.

Table 7: Perceived consequences of post-harvest losses for household welfare

Welfare indicator	Frequency	Percentage (%)
Difficulty meeting household food needs	278	72.2
Difficulty paying healthcare expenses	251	65.2
Difficulty paying children's school expenses	239	62.1
Reduced household savings	306	79.5
Reduced ability to purchase farm inputs	294	76.4
Dependence on borrowing or informal support	227	59.0
Sale of produce at distress prices	283	73.5

Source: Computed by Researcher, 2026

The results in Table 7 shows that post-harvest losses negatively affect farmers' livelihoods, particularly by reducing household savings (79.5%), limiting the purchase of farm inputs (76.4%) and forcing distress sales (73.5%). They also undermine food security and access to healthcare, thereby affecting household welfare and future agricultural production.

4.4.5 Foster-Greer-Thorbecke Poverty Measures

Considering a monthly per-capita welfare poverty line of ₦30,000, the FGT results are presented in Table 8.

Table 8: Foster-Greer-Thorbecke poverty measures

Poverty measure	FGT parameter	Estimate	Interpretation
Poverty headcount ratio	$\alpha = 0$	0.62 (62.0%)	62% of households are below the assumed poverty line
Poverty gap index	$\alpha = 1$	0.28 (28.0%)	Average normalised income shortfall across the population
Poverty severity index	$\alpha = 2$	0.16 (16.0%)	Captures the severity and inequality of poverty among poor households

Source: Computed by Researcher, 2026

The FGT results in Table 8 indicates a poverty incidence of 62.0%, poverty gap of 28.0% and poverty severity of 16.0%, suggesting widespread poverty and varying levels of deprivation among farmers.

4.5.1 Hypothesis One

$H_0$1: Post-harvest management and practices have no causal effect on post-harvest losses of tomatoes in Gwer East.

A multiple linear regression model with the estimated percentage of post-harvest loss as the dependent variable and selected post-harvest management conditions as explanatory variables has been presented in Table 9.

Table 9: Multiple regression estimates for determinants of post-harvest losses

Variable	Coefficient (B)	Std. Error	t-value	p-value
Constant	18.420	2.310	7.974	0.000
Inadequate storage facilities	4.260	0.910	4.681	0.000
Poor handling practices	3.180	0.840	3.786	0.000
Inferior packaging materials	2.740	0.790	3.468	0.001
Long distance to market	1.960	0.720	2.722	0.007
Poor road condition	2.310	0.810	2.852	0.005
Limited extension contact	1.420	0.680	2.088	0.038
Model summary and overall significance				
R	0.681			
R-squared	0.464			
Adjusted R-squared	0.455			
F-statistic	54.62			
Model p-value	0.000			
Number of observations	385			

Source: Computed by Researcher, 2026

The regression results in Table 9 shows that the explanatory variables jointly account for 46.4% of variations in tomato post-harvest losses, with the model statistically significant ($F = 54.62$, $p < 0.05$). Inadequate storage, poor handling, inferior packaging, market distance, poor roads and limited extension contact significantly increase losses; therefore, the null hypothesis was rejected.

4.5.2 Hypothesis Two

$H_0 2$: Post-harvest losses of tomatoes have no impact on the incomes of farmers in Gwer East.

A multiple linear regression model was used to examine the relationship between post-harvest loss and farmers' income as in Table 10

Table 10: Regression estimates for the effect of post-harvest losses on farmers' income

Variable	Coefficient (B)	Std. Error	t-value	p-value
Constant	108,450	8,920	12.158	0.000
Post-harvest loss (%)	-1,185	245	-4.837	0.000
Farm size	2,460	1,010	2.436	0.015
Quantity harvested	1,720	390	4.410	0.000
Average selling price	6.340	1.870	3.390	0.001
Access to extension services	4,280	1,960	2.184	0.030
Model summary and overall significance				
R	0.624			
R-squared	0.389			
Adjusted R-squared	0.381			
F-statistic	48.11			
Model p-value	0.000			
Number of observations	385			

Source: Computed by Researcher, 2026

The regression results in Table 10 indicates that the explanatory variables explain 38.9% of the variation in farmers' income. Post-harvest losses have a negative and statistically significant effect on income ($\beta = -1,185$, $p < 0.05$), while quantity harvested, selling price, farm size and extension access have positive effects. Therefore, the null hypothesis was rejected.

4.5.3 Hypothesis Three

$H_0$3: Post-harvest losses of tomatoes have no impact on the poverty levels of farmers in Gwer East. A binary logistic regression was used where the dependent variable which was to determine poverty status (1 = poor; 0 = non-poor). Post-harvest loss and selected household and farm characteristics were used as explanatory variables.

Table 11: Logistic regression estimates for poverty status

Variable	Coefficient (B)	Std. Error	t-value	p-value
Post-harvest loss (%)	0.058	0.016	13.14	0.000
Seasonal tomato income	-0.00003	0.00001	9.00	0.003
Household size	0.112	0.045	6.19	0.013
Farm size	-0.184	0.079	5.43	0.020
Extension access	-0.391	0.180	4.72	0.030
Constant	-0.624	0.510	1.50	0.221
Model summary and overall significance				
Number of observations	385			
Likelihood ratio chi-square	39.72			
Model p-value	0.000			
Pseudo R-squared (Nagelkerke)	0.214			
Classification accuracy	71.4%			

Source: Computed by Researcher, 2026

The logistic regression results in Table 11 indicates that post-harvest losses significantly increase farmers' likelihood of being poor (B = 0.058, OR = 1.060, $p < 0.05$). Higher income and access to extension services are associated with reduced poverty odds, while larger household size increases them. Therefore, the null hypothesis was rejected, indicating a significant association between post-harvest losses and farmers' poverty status.

4.7 Discussion of Findings

The findings of the study indicate that inadequate storage and processing facilities, poor handling and inferior packaging are major contributors to tomato post-harvest losses. These findings are consistent with Yanjoh, Ugbabe and Terna (2024), Goka et al. (2021) and Tesfaye (2019), who identified inadequate infrastructure and poor post-harvest practices as major causes of tomato deterioration. The implication is that improving storage facilities, processing infrastructure, packaging materials and handling practices could substantially reduce losses and increase the quantity of tomatoes available for sale.

Furthermore, the negative relationship between post-harvest losses and farmers' income agrees with the findings of Ayandiji, Adeniyi and Omidiji (2020) and Low and Lamb (2020). This implies that reducing post-harvest losses could improve farmers' earnings, strengthen household savings and enhance their capacity to invest in future production. Similarly, the significant association between post-harvest losses and poverty status supports the Sustainable Livelihoods Framework and the findings of Akura (2020). The implication is that reducing tomato losses could contribute to poverty reduction by improving household income, food security and general welfare. It also highlights the need for targeted agricultural extension services, improved rural infrastructure and accessible preservation technologies to strengthen farmers' livelihoods in Gwer East.

Inclusive, the findings suggest that reducing tomato post-harvest losses is not merely an agricultural concern but also an important strategy for improving rural income and reducing poverty.

Conclusion

The study concludes that tomato post-harvest losses constitute a major challenge to farmers' income and economic wellbeing in Gwer East Local Government Area of Benue State. The findings identify inadequate storage and processing facilities, poor handling and packaging, transportation difficulties and weak institutional support as major contributing factors. These losses reduce farmers' marketable produce and earnings, thereby limiting household savings, access to basic needs and investment in future agricultural production. Consequently, reducing post-harvest losses through improved storage, processing, packaging, transportation infrastructure and agricultural extension services is essential for increasing farmers' income, improving household welfare and reducing poverty.

Recommendations

Based on the three specific objectives and findings of the study, the following recommendations are made:

1. **Improvement of post-harvest management practices:** The Benue State Government and relevant agricultural agencies should provide affordable storage and processing facilities, promote improved packaging materials and train tomato farmers on proper harvesting, handling, sorting and preservation techniques to minimise post-harvest losses.
2. **Strengthening of farmers' income:** Government and financial institutions should provide affordable credit, strengthen farmers' cooperative societies and improve rural roads, transportation and market information systems. These measures would reduce produce wastage, improve market access and increase farmers' earnings.
3. **Reduction of poverty among tomato farmers:** Government should introduce targeted agricultural empowerment and poverty-reduction programmes through improved extension services, access to modern technologies, financial support and processing opportunities to enhance household income, savings and general welfare.

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