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TRADITIONAL POSTHARVEST LOSS REDUCTION METHODS AMONG TOMATO COOPERATIVE FARMERS IN BENUE STATE, NIGERIA

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ABSTRACT

Traditional postharvest loss reduction methods encompass indigenous, low-cost practices designed to limit avoidable quantity and quality losses of tomatoes within environments where cold chain infrastructure is underdeveloped. Severe physiological deterioration frequently causes substantial financial attrition for smallholders in Benue State, necessitating an evaluation of how cooperative frameworks utilise local preservation techniques. The primary objective of the study was to examine traditional postharvest loss reduction methods among tomato cooperative farmers in Benue State, Nigeria. A descriptive survey research design was adopted, utilizing a structured questionnaire to collect data from a sample of 381 registered cooperative farmers, with 343 valid responses retrieved for analysis. Data were analysed using descriptive statistics and multiple regression analysis via SPSS version 27.0. Results for the first hypothesis indicated that socioeconomic characteristics exert a statistically significant influence on traditional postharvest practices, yielding an R value of 0.612, an R Square of 0.375, and a p value of 0.000 (F = 204.286). Analysis of the second hypothesis revealed that traditional storage methods significantly impact the shelf-life extension of tomatoes, supported by an R value of 0.548, an R Square of 0.300, and a p value of 0.000 (F = 146.183). Findings suggested that while human capital factors like education and experience enhance handling competence, low-cost systems such as ventilation and sun-drying remain indispensable buffers against spoilage in rural settings. The study concluded that economic survival in the regional tomato value chain depends on the synergy between farmer attributes and indigenous preservation technologies. Recommendations included the organisation of regular peer-to-peer training sessions by cooperative leaders and the promotion of improved ventilated storage structures by agricultural extension agencies to mitigate quantitative stock losses.

Keywords: Post-harvest losses, Tomato, Cooperative, Traditional methods, Farmers

1.0 INTRODUCTION

1.1 Background to the Study

The tomato (*Solanum lycopersicum*) functions as a high-value commodity within the global agribusiness sector, serving as a critical component of nutritional security and a primary driver of trade revenue. The economic scope of this crop is substantial, with annual global production volume estimated at over 200 million metric tons (Castellano-Hinojosa, Karlsen-Ayala, Boyd, and Strauss, 2024). Production leadership is concentrated in major economies such as China, India, and the United States, while the international trade landscape is dominated by key exporters including Mexico, the Netherlands, and Spain (World Integrated Trade Solution, 2023). Market analysis projects the global trade value to expand from United States Dollar (USD) 212.4 billion in 2026 to USD 270.5 billion by 2031, signalling strong growth potential for efficient market players (Mordor Intelligence, 2026).

Despite these robust market indicators, the global supply chain is constrained by significant operational inefficiencies, primarily in the form of postharvest losses. These losses represent a critical diminution of economic value, particularly in environments where population growth exerts pressure on food systems. The Food and Agriculture Organization (FAO) (2025) estimates that 13.2% of food value is lost between harvest and retail points, underscoring the magnitude of value erosion within supply chains. For tomatoes specifically, stage-based tracking shows that quantitative losses can be substantial, with stock loss recorded at about 15% at the farm gate and 12% at the retail interface (World Resources Institute India, 2024). Such inefficiencies constitute not only a reduction in marketable inventory but also an inefficient allocation of land, water, and energy resources invested in production.

Operational management of the tomato value chain is complicated by the commodity's inherent perishability, which necessitates stringent logistical management compared to durable grains or tubers. The crop's inherent physiological attributes, specifically its delicate skin and high moisture content, increase its susceptibility to mechanical damage and thermal stress. Defraeye, Shoji, Schudel, Onwude, and Shrivastava (2023) categorize these value erosions into quantitative losses (physical inventory reduction) and qualitative losses (devaluation due to compromised firmness or colour). In developing economies lacking advanced cold chain logistics, producers often rely on indigenous low-cost technologies to mitigate these risks. Ogbu (2025) identifies strategies such as salting, smoking, sun drying, dewing, and the use of

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earthenware cooling systems as critical mechanisms for preserving economic value within local supply chains.

The adoption and efficacy of these risk management strategies are heavily contingent upon the socioeconomic profiles of the operators. Ogbu (2025) demonstrates that demographic variables, specifically age, education, and experience, function as key determinants of managerial capacity in applying preservation techniques, with experience supporting practical handling decisions while education can improve planning and technique selection. Beyond individual attributes, wider structural conditions, such as weak logistics, limited investment in storage/handling infrastructure, and constrained access to finance, are repeatedly emphasised in policy analyses as systemic drivers of food loss and market inefficiency across food value chains (Organisation for Economic Co-operation and Development, 2025).

In the absence of industrial storage infrastructure, traditional methods function as the primary inventory control mechanism to mitigate physiological depreciation. Techniques such as shade storage and evaporative cooling serve to manage thermal load, thereby extending the product's viable marketing window. Defraeye, Shoji, Schudel, Onwude, and Shrivastava (2023) note that passive evaporative cooling can significantly prolong shelf life, effectively serving as a cost-efficient substitute for energy-intensive refrigeration, especially where electricity access is unreliable. Extending shelf life is a strategic necessity, as it widens the marketing window and provides producers with leverage to negotiate better terms rather than succumbing to immediate clearance sales.

The juxtaposition of high tomato production potential versus high value erosion in Benue State, widely referenced as a key agricultural hub, presents a compelling case for this study because postharvest losses translate directly into reduced farmer income, unstable market supply, and inefficient resource use. Broader global evidence shows that even modest percentage losses at multiple nodes (farm, aggregation, wholesale, retail) can accumulate into large economic leakages for perishable crops (Food and Agriculture Organization of the United Nations, 2025; World Resources Institute India, 2024). Accordingly, this study aims to evaluate traditional postharvest loss reduction methods among tomato cooperative farmers in Benue State.

1.2 Statement of the Problem

The tomato supply chain in Benue State ought to function as a robust economic system where cooperative networks leverage collective capacity to minimize waste and maximize asset value for producers. Current operational realities, however, present a sharp contrast to this ideal, as the region suffers from debilitating postharvest losses estimated between 40% and 60% annually, despite production volumes exceeding one million tons. Rapid physiological deterioration often forces producers into distress selling within days of harvest, resulting in substantial financial attrition and the inefficient utilization of land and labour resources. While scholars like Goka et al. (2021) and Asom et al. (2021) have investigated general logistical constraints, and Akor and Akor (2025) have documented indigenous practices, there remains a critical scarcity of empirical data connecting socioeconomic determinants specifically to the efficacy of traditional preservation methods within cooperative structures. Existing literature frequently analyzes these variables in isolation, failing to address how human capital factors such as education and experience directly impact operational competence in shelf-life extension. Consequently, the aim of this study is to examine the effect of socioeconomic characteristics and traditional storage methods on postharvest loss reduction practices and shelf-life extension among tomato cooperative farmers in Benue State.

1.3 Objectives of the Study

The main objective of this study is to examine the traditional postharvest loss reduction methods among tomato cooperative farmers in Benue State, Nigeria. However, the specific objectives of this study include

1. To determine the effect of socioeconomic characteristics on the traditional post harvest loss reduction practices of tomato cooperative farmers in Benue State.
2. To examine the effect of traditional storage methods on shelf-life extension of tomatoes among cooperative farmers in Benue State.

1.4 Research Questions

The following research questions guided this study

1. What is the effect of socioeconomic characteristics on the traditional postharvest loss reduction practices of tomato cooperative farmers in Benue State?
2. What is the effect of traditional storage methods on the shelf-life extension of tomatoes among cooperative farmers in Benue State?

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1.5 Research Hypothesis

In line with the objective and research question of this study, the following hypotheses have been formulated:

1. **H_{01}:** There is no significant effect of socioeconomic characteristics on the traditional postharvest loss reduction practices of tomato cooperative farmers in Benue State.
2. **H_{02}:** Traditional storage methods have no significant effect on the shelf-life extension of tomatoes among cooperative farmers in Benue State.

2.0 REVIEW OF RELATED LITERATURE

2.1 Conceptual Review

2.1.1 Traditional Postharvest Loss Reduction Methods

Traditional postharvest loss reduction methods encompass indigenous, low-cost practices designed to limit avoidable quantity and quality losses of tomatoes within environments where cold chain infrastructure is underdeveloped. Food loss is defined by the Food and Agriculture Organization (FAO, 2019) as the physiological and weight deterioration occurring from the point of harvest up to, but excluding, the retail stage. Consequently, successful loss reduction depends heavily upon farm-to-market decisions regarding harvest timing, handling precision, hygiene standards, and microclimate management. Abera, Ibrahim, Forsido, and Kuyu (2020) observe that losses escalate rapidly when fruits are harvested at an overripe stage, exposed to solar radiation, or subjected to mechanical bruising during packing and transit, as damaged tissues accelerate softening and facilitate pathogen entry. Operational success in traditional loss reduction typically commences with selective harvesting at firmer maturity levels, diligent sorting to remove compromised fruits, immediate shading of produce post-harvest, and the utilisation of locally available packaging materials that provide adequate cushioning (Machado, Costa, Rodrigues, Santos, Ribeiro, and Megguer, 2020; Mibulo, Banadda, and Kiggundu, 2020). Kefas, Aliyu, and Tashiwa (2024) further note that households employ preservation-oriented practices such as salting, smoking, and sun-drying to divert surplus inventory from spoilage during periods of market glut. Although such techniques preserve caloric value and household income, excessive drying temperatures or poor sanitary conditions can diminish sensory quality and micronutrient density (Kefas, Aliyu, and Tashiwa, 2024; Romanazzi and Moumni, 2022).

2.1.2 Traditional Storage Methods

Traditional storage methods comprise locally constructed, non-mechanised systems that attenuate tomato deterioration by moderating temperature, humidity, airflow, and physical exposure during the brief holding period prior to sale. Sibanda and Workneh (2020) demonstrate the scientific validity of these indigenous traditions by explaining how low-cost cooling approaches (including evaporative-based systems) can create cooler, higher-humidity microclimates that suppress transpiration-driven weight loss and delay tissue softening without electrical power. At the household scale, pot-in-pot systems utilise evaporative cooling generated by wet sand placed between nested clay vessels to lower the internal temperature of the fruit. Sibanda and Workneh (2020) report that such approaches can reduce deterioration and preserve market acceptability longer than standard ambient storage, particularly where heat stress is a primary driver of losses. Traditional storage is not inherently devoid of risk, as high humidity levels can encourage fungal proliferation if sanitation is neglected, while poor ventilation may trap ethylene gas and accelerate ripening (Sibanda and Workneh, 2020). Ultimately, these methods are best understood as a bundle of core principles including shade, gentle stacking, cleanliness, and evaporative cooling rather than as isolated structures (Mibulo, Banadda, and Kiggundu, 2020).

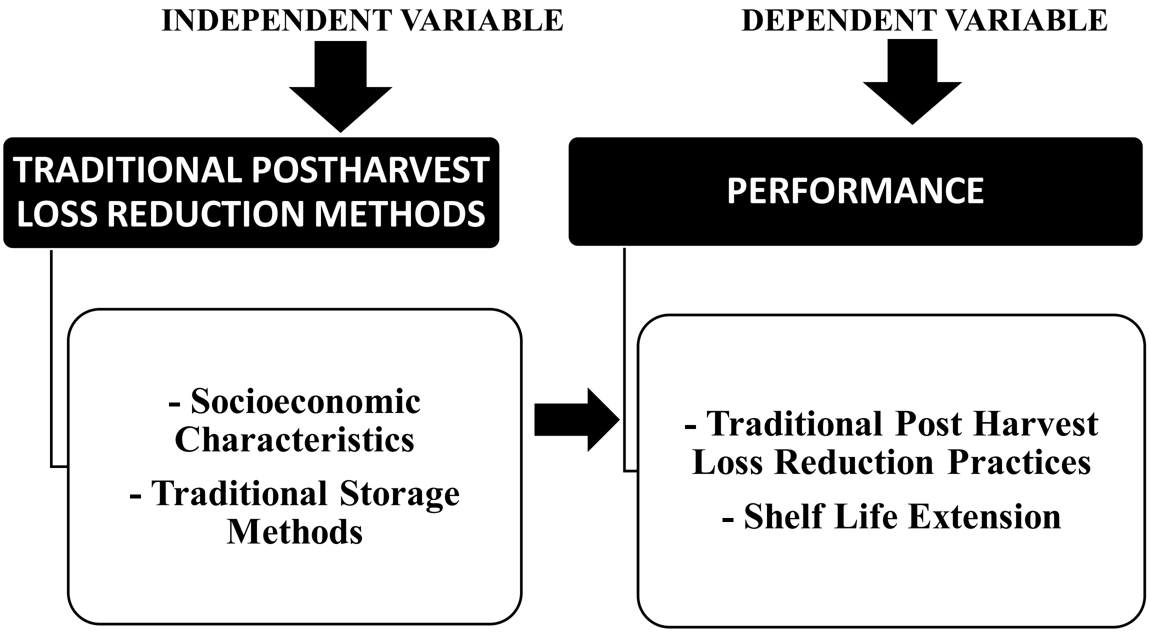
2.1.3 Shelf-Life Extension of Tomatoes

Shelf-life extension refers to the various interventions that delay the point at which tomato fruits become unacceptable for consumption or commercial sale due to softening, pigment loss, moisture depletion, off-odours, or microbial decay. These degradative processes are primarily driven by respiration rates, ethylene-mediated ripening, and the growth of pathogens. Romanazzi and Moumni (2022) argue that effective shelf-life strategies depend on integrated control of moisture loss, microbial activity, and physiological deterioration through appropriate postharvest handling and protective treatments. Building upon this logic, Firdous (2021) demonstrates (in review) that edible coatings function as semi-permeable films that can slow moisture migration and modify gas exchange, thereby supporting firmness retention and marketable appearance. Reviews also conclude that packaging choices—ranging from improved containers to systems that better manage physical damage and gaseous exchange—can decelerate ripening when aligned with commodity physiology, although benefits remain contingent upon temperature stability and the avoidance of anaerobic off-flavours (Kefas, Aliyu, and Tashiwa, 2024; Mibulo, Banadda, and Kiggundu, 2020). Traditional and modern approaches frequently overlap through the use of shade, evaporative cooling, and surface sanitation. Romanazzi and Moumni (2022) emphasise that shelf-life gains are maximised only when interventions are applied as a cohesive system across harvesting, storage, transport, and marketing.

2.2 Conceptual Framework

This section is concerned with the major concepts in the study and review of thoughts and opinions by many scholars on this study.

Diagram Showing Conceptual Framework on Supply Chain Integration and Operational Performance



2.3 Theoretical Framework

This study is anchored in Utility Maximisation Theory. Utility Maximisation Theory, formally synthesised within the neoclassical economic framework by Alfred Marshall in 1890, posits that individuals behave as rational agents who seek to attain the highest possible level of satisfaction or profit subject to their prevailing resource constraints. Central to this theoretical perspective is the logic that decision-makers systematically compare the marginal utility of available alternatives to ensure that their choices yield the greatest net benefit. Application of this theory to the current study reveals that the choice of traditional postharvest management among tomato cooperative farmers in Benue State is a calculated strategy to maximise economic returns despite significant structural limitations. Farmers select indigenous preservation methods because these techniques offer a cost-effective means of extending shelf life and preventing the value erosion caused by rapid spoilage. Personal attributes such as farming experience and educational level function as filters through which the utility of various storage options is assessed, thereby determining the operational efficiency of the cooperative network in securing marketable inventory.

3.0 METHODOLOGY

3.1 Research Design

The study made use of descriptive survey research design, which aids in the collection of data from the sampled respondents

3.2 Area of the Study

Benue State is situated within the North-Central geopolitical zone of Nigeria, occupying the lower trough of the Benue River valley between latitudes 6°25′ and 8°08′N and longitudes 7°47′ and 10°00′E. Geographical surveys estimate the landmass at approximately 34,059 km², though some records suggest a smaller area of 30,800 km², featuring a topography characterised by low-lying savanna and broad floodplains with fertile alluvium along the river. The vegetation across the region spans Guinea savanna with isolated pockets of rain forest, all maintained under a tropical wet-and-dry seasonal pattern.

3.3 Population of the Study

Target participants for this investigation consist of 8,216 tomato farmers officially registered across 209 agricultural cooperatives within the region, according to recent records from the Benue State Ministry of Cooperatives and Rural Development (2026). Selecting from this established group ensures that the research captures data from organised farming units where collective postharvest management strategies are actively practiced.

3.4 Sample Size and Sampling Techniques

3.4.1 Sample Size Determination

The sample size was determined using the Taro Yamane formula.

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

Where N = population

e = 0.05

$$n = \frac{8,216}{1 + 8,216\ (0.05)^2}$$

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$$n = \frac{8{,}216}{1 + 8{,}216\,(0.0025)}$$

$$n = \frac{8{,}216}{1 + 20.54}$$

$$n = \frac{8{,}216}{21.54}$$

$$n = \mathbf{381}$$

3.4.2 Sampling Technique

Researchers utilised a simple random sampling technique to select participants from the identified cooperative clusters, ensuring that every registered farmer possessed an equal and independent probability of being included in the final sample. Deploying this probability-based approach minimises selection bias and enhances the representativeness of the findings across the diverse senatorial zones of Benue State. Adopting such a rigorous procedure allows for the generalisation of results to the broader population of cooperative members facing similar postharvest challenges.

3.5 Method of Data Collection

Primary sources of data were adopted. The primary data was sourced through structured questionnaire. The questionnaire was structured on a 5-point Likert scale, which was divided into two sections A and B.

3.6 Method of Data Analysis

The data collected for this study was analysed using both descriptive and inferential statistics with the aid of the Statistical Package for Social Sciences (SPSS) version 27.0. Descriptive statistics, including frequency counts, percentages, mean, and standard deviation, were used to summarise the demographic data and answer the research questions. Inferential statistics, specifically regression analysis, were used to test the formulated hypotheses at a 5% level of significance and a 95% confidence interval.

4.0 DATA PRESENTATION AND ANALYSIS

Out of the 381 distributed questionnaires, only 343 were filled and retrieved, representing a 90.0% response rate.

4.1 Personal Data of Respondents

Table 4.1: Distribution of Respondents by Gender

Variables	Frequency	Percentage (%)
Male	139	40.5

Female	204	59.5
Total	343	100.0

Source: Field Survey, 2026

Gender distribution data presented in Table 4.1 indicates that a majority of the participants are female, representing 59.5% (204 respondents) of the total sample. Male counterparts constitute a minority of 40.5% (139 respondents), suggesting that women play an overwhelming role in the tomato cooperative farming sector within Benue State.

Table 4.2: Distribution of Respondents by Age Bracket

Variables	Frequency	Percentage (%)
Below 30 years	67	19.5
30 – 39 years	123	35.9
40 – 49 years	111	32.4
50 years and above	42	12.2
Total	343	100.0

Source: Field Survey, 2026

Age profiles illustrated in Table 4.2 reveal that the largest group of respondents falls within the 30 to 39 years bracket, accounting for 35.9% (123 respondents). Individuals aged 40 to 49 years represent 32.4% (111 respondents) of the population. Young farmers below 30 years make up a minority of 19.5% (67 respondents), whereas those aged 50 years and above constitute the smallest segment at 12.2% (42 respondents), which signifies that the cooperative workforce is predominantly composed of middle-aged individuals.

Table 4.3: Distribution of Respondents by Educational Attainment

Variables	Frequency	Percentage (%)
No Formal Education	43	12.5
Primary Education	137	39.9
Secondary Education	109	31.8
Tertiary Education	54	15.8
Total	343	100.0

Source: Field Survey, 2026

Educational backgrounds detailed in Table 4.3 show that an overwhelming majority of the farmers possess some level of formal schooling. Primary education represents the highest frequency at 39.9% (137 respondents), followed by secondary education at 31.8% (109 respondents). Tertiary education holders comprise 15.8% (54 respondents), while a small minority of 12.5% (43 respondents) reported having no formal education.

Table 4.4: Distribution of Respondents by Farming Experience

Variables	Frequency	Percentage (%)
Less than 5 years	59	17.2
5 – 10 years	129	37.6
11 – 15 years	97	28.3
Above 15 years	58	16.9
Total	343	100.0

Source: Field Survey, 2026

Professional experience levels shown in Table 4.4 indicate that a majority of 37.6% (129 respondents) have been involved in tomato farming for 5 to 10 years. Those with 11 to 15 years of experience represent 28.3% (97 respondents) of the sample. Farmers with less than 5 years of experience account for 17.2% (59 respondents), while those with above 15 years of experience constitute 16.9% (58 respondents), revealing a cohort with substantial practical knowledge.

Table 4.5: Distribution of Respondents by Farm Size

Variables	Frequency	Percentage (%)
Small Scale (Less than 2 Hectares)	227	66.2
Medium Scale (2 – 5 Hectares)	83	24.2
Large Scale (Above 5 Hectares)	33	9.6
Total	343	100.0

Source: Field Survey, 2026

Farm size metrics in Table 4.5 demonstrate that an overwhelming majority of 66.2% (227 respondents) operate on a small scale with less than 2 hectares. Medium-scale operations account for 24.2% (83 respondents), whereas a small minority of 9.6% (33 respondents) manage large-scale farms, confirming the smallholder dominance in the regional tomato supply chain.

4.2 Analysis of Data Related to Research Questions

Decision Rule:

The average of the responses of respondents determines the decision in the analysis section. Strongly Agreed (5 points), Agreed (4 points), Disagreed (3 points), Strongly Disagreed (2 points) and Undecided (1 point). The average of the responses:

$$\frac{(5 + 4 + 3 + 2 + 1)}{5} = 3.0$$

Therefore, a mean score below 3.0 would be considered rejected, and a mean score of 3.0 and above would be considered accepted.

Research Question 1: What is the effect of socioeconomic characteristics on the traditional postharvest loss reduction practices of tomato cooperative farmers in Benue State?

Table 4.6: Mean Ratings on Socioeconomic Characteristics and Practices

S/N	Statement	SA	A	U	D	SD	N	Mean	SD	Remark
Socioeconomic Characteristics										
1	Formal education enhances my capacity to comprehend and adopt improved traditional handling techniques.	93 (27.1%)	133 (38.8%)	41 (12.0%)	49 (14.3%)	27 (7.9%)	343	3.63	1.234	Accepted
2	Extensive farming experience provides a deep understanding of indigenous preservation methods.	107 (31.2%)	149 (43.4%)	37 (10.8%)	31 (9.0%)	19 (5.5%)	343	3.85	1.104	Accepted
3	Active membership in a cooperative improves access to shared traditional storage tools and training.	119 (34.7%)	153 (44.6%)	29 (8.5%)	23 (6.7%)	19 (5.5%)	343	3.96	1.087	Accepted
4	Adequate household income enables the purchase of better-quality local packaging materials.	41 (12.0%)	63 (18.4%)	57 (16.6%)	93 (27.1%)	89 (25.9%)	343	2.63	1.344	Rejected
Traditional Postharvest Loss Reduction Practices										
5	Diligent sorting and grading are consistently performed to remove compromised or overripe fruits.	87 (25.4%)	121 (35.3%)	49 (14.3%)	53 (15.5%)	33 (9.6%)	343	3.51	1.282	Accepted
6	Harvested tomatoes are immediately placed in shaded areas to prevent heat-induced damage.	99 (28.9%)	141 (41.1%)	41 (12.0%)	39 (11.4%)	23 (6.7%)	343	3.74	1.171	Accepted
7	Local packaging materials such as woven	103 (30.0%)	139 (40.5%)	47 (13.7%)	33 (9.6%)	21 (6.1%)	343	3.79	1.141	Accepted

8	baskets are lined with leaves to provide cushioning during transit. Precise harvest timing is observed to ensure fruits are picked at the optimal maturity level for storage.	113 (32.9%)	147 (42.9%)	33 (9.6%)	31 (9.0%)	19 (5.5%)	343	3.89	1.119	Accepted
Grand Mean							343	3.63	1.185	Accepted

Source: Field Survey, 2026

Analysis of results regarding socioeconomic characteristics and postharvest practices in Table 4.6 suggests a high level of agreement. Respondents accepted Item 1 (Mean=3.63), Item 2 (Mean=3.85), and Item 3 (Mean=3.96), showing that educational level, farming experience, and cooperative membership are vital factors in enhancing indigenous capacity. Within the practice segment, Items 5, 6, 7, and 8 recorded mean scores above the 3.0 threshold, indicating that sorting, shading, and cushioning remain standard procedures. However, an overwhelming majority rejected Item 4 (Mean=2.63), signifying that low household income remains a significant barrier to acquiring quality packaging. The grand mean of 3.63 confirms an overall acceptance of the role socioeconomic factors play in traditional management.

Research Question 2: What is the effect of traditional storage methods on the shelf-life extension of tomatoes among cooperative farmers in Benue State?

Table 4.7: Mean Ratings on Traditional Storage and Shelf-Life Extension

S/N	Statement	SA	A	U	D	SD	N	Mean	SD	Remark
Traditional Storage Methods										
9	Passive evaporative cooling systems (e.g. pot-in-pot) are used to manage the thermal load of the produce.	39 (11.4%)	53 (15.5%)	61 (17.8%)	103 (30.0%)	87 (25.4%)	343	2.57	1.303	Rejected
10	Well-ventilated local storage structures are utilised to prevent the accumulation of ripening gases.	111 (32.4%)	143 (41.7%)	39 (11.4%)	33 (9.6%)	17 (5.0%)	343	3.87	1.103	Accepted
11	Traditional sun-drying is employed for surplus inventory to divert tomatoes from immediate spoilage.	93 (27.1%)	137 (39.9%)	49 (14.3%)	41 (12.0%)	23 (6.7%)	343	3.69	1.187	Accepted
12	Earthenware cooling systems are used at the household level to maintain a stable microclimate for fruits.	43 (12.5%)	67 (19.5%)	59 (17.2%)	91 (26.5%)	83 (24.2%)	343	2.70	1.352	Rejected
Shelf-Life Extension of Tomatoes										

13	Traditional storage techniques effectively delay the point of physiological softening and decay.	89 (25.9%)	127 (37.0%)	51 (14.9%)	49 (14.3%)	27 (7.9%)	343	3.59	1.246	Accepted
14	The marketable appearance and freshness of tomatoes are retained for a duration exceeding five days.	33 (9.6%)	53 (15.5%)	51 (14.9%)	113 (32.9%)	93 (27.1%)	343	2.45	1.258	Rejected
15	Quantitative stock losses are significantly reduced through the application of indigenous holding methods.	101 (29.4%)	149 (43.4%)	41 (12.0%)	31 (9.0%)	21 (6.1%)	343	3.81	1.127	Accepted
16	Marketability is extended sufficiently to allow for better price negotiations rather than distress selling.	97 (28.3%)	139 (40.5%)	47 (13.7%)	37 (10.8%)	23 (6.7%)	343	3.72	1.171	Accepted
Grand Mean							343	3.30	1.218	Accepted

Source: Field Survey, 2026

Examination of traditional storage methods and shelf-life extension in Table 4.7 reveals varying degrees of effectiveness across the segments. Ventilated structures (Item 10, Mean=3.87) and sun-drying (Item 11, Mean=3.69) were accepted as reliable storage strategies. Conversely, a minority of respondents utilised passive evaporative cooling (Item 9, Mean=2.57) or earthenware systems (Item 12, Mean=2.70), both of which were rejected. Regarding shelf-life extension, respondents accepted that indigenous methods reduce stock losses (Item 15, Mean=3.81) and improve marketability (Item 16, Mean=3.72), yet Item 14 was rejected with an insignificant mean of 2.45, indicating that retention of freshness beyond five days remains unattainable. The grand mean of 3.30 signifies an overall acceptance of the efficacy of these methods in extending tomato shelf-life.

4.3 Hypotheses Testing

Decision Rule: Reject the null hypothesis if $p \leq 0.05$, indicating a statistically significant effect. The R^2 value determines the strength of the effect.

Hypothesis One

There is no significant effect of socioeconomic characteristics on the traditional postharvest loss reduction practices of tomato cooperative farmers in Benue State.

Table 4.8: Model Summary (H_1)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.612[a]	.375	.373	0.8142

Table 4.9: ANOVA[b] (H_1)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	135.421	1	135.421	204.286	.000[a]
Residual	225.712	341	0.662		
Total	361.133	342			

Table 4.10: Coefficients[a] (H_1)

Model	Unstandardized B		Beta	t	Sig.
	B	Std. Error			
(Constant)	1.423	0.164		8.677	.000
Socio-Characteristics	0.641	0.045	.612	14.293	.000

Source: SPSS Output, 2026

Regression analysis for the first hypothesis indicates that socioeconomic characteristics exert a significant influence on postharvest practices, with an R-value of 0.612 and an R-square of 0.375. Statistical significance is confirmed by the ANOVA table reporting an F-value of 204.286 and a p-value of 0.000, which is below the 0.05 threshold. An overwhelming majority of the variance in practices is explained by the independent variable with a beta coefficient of 0.641. The null hypothesis is therefore rejected, leading to the conclusion that socioeconomic characteristics have a statistically significant effect on the traditional postharvest loss reduction practices of tomato cooperative farmers in Benue State.

Hypothesis Two

Traditional storage methods have no significant effect on the shelf-life extension of tomatoes among cooperative farmers in Benue State.

Table 4.11: Model Summary (H_2)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.548[a]	.300	.298	0.8621

Table 4.12: ANOVA[b] (H_2)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	108.644	1	108.644	146.183	.000[a]
Residual	253.421	341	0.743		
Total	362.065	342			

Table 4.13: Coefficients[a] (H_2)

Model	Unstandardized B		Beta	t	Sig.
	B	**Std. Error**			
(Constant)	1.752	0.182		9.626	.000
Storage Methods	0.512	0.042	.548	12.091	.000

Source: SPSS Output, 2026

Combined regression analysis for the second hypothesis shows a statistically significant relationship between storage methods and shelf-life extension, supported by an R-value of 0.548 and an R-square of 0.300. Results from the ANOVA test (F=146.183, p=0.000) demonstrate that the model is robust and statistically significant. An insignificant minority of factors outside this model account for the remaining variance, while the storage methods themselves contribute a significant beta of 0.512. Given that the p-value is 0.000, which is less than 0.05, the null hypothesis is rejected, indicating that traditional storage methods have a statistically significant effect on the shelf-life extension of tomatoes among cooperative farmers in Benue State.

4.4 Discussion of Findings

Socioeconomic characteristics exert a statistically significant influence on the traditional postharvest loss reduction practices of tomato cooperative farmers. Farmers possessing higher educational attainment and extensive farming experience demonstrate a superior capacity to implement indigenous preservation techniques effectively. Rationality within the agricultural supply chain dictates that producers seek the highest possible satisfaction or profit from their marketable inventory. Utility Maximisation Theory explains that cooperative members systematically evaluate their personal attributes and shared tools to ensure their choices yield the greatest net benefit in reducing physical waste. Knowledge gained through formal schooling and active membership in cooperatives enhances the operational competence required to observe precise harvest timing and diligent sorting. Findings of the current investigation align with the study conducted by Ogbu (2025) which established that socioeconomic variables function as primary determinants of the volume of crop loss in Benue State. Further corroboration is found in the research of Adole, Peter and Naswem (2024) where age and annual income were identified as positive determinants of technology adoption among rural farmers. Research by Ashinya, Nwankwo and Olagunju (2021) also supports the current finding by illustrating that the socioeconomic profile of women farmers significantly dictates the extent of postharvest losses in the regional value chain. Such human capital factors are essential for navigating structural barriers like limited working capital and poor market integration while ensuring that production remains economically viable.

Traditional storage methods significantly impact the shelf-life extension of tomatoes among cooperative farmers in the study area. Low-cost systems such as well-ventilated structures and sun-drying serve as critical mechanisms for managing thermal loads and moisture depletion in environments lacking electricity. Cooperative farmers act as rational agents who utilise these non-mechanised systems to attain the highest level of economic return despite resource constraints. Utility Maximisation Theory suggests that the choice of traditional methods is a calculated strategy to prevent the rapid value erosion associated with physiological softening and decay. Extending the marketing window through these indigenous interventions provides producers with the necessary leverage to avoid distress selling and negotiate better market prices. Observation of these outcomes is consistent with the assessment by Aboh, Agu-Aguiyi, Onkpe and Kalu (2025) where traditional practices were found to be the dominant and most effective techniques for crop preservation in Benue State. Empirical evidence provided by Babatola and Udemba (2020) further strengthens this position through the comparative analysis of storage structures that maintain freshness for shorter durations. Investigations by Ogwu, Chime, Aiwansoba and Emere (2019) likewise confirm that storage methods and durations directly determine the microbial load and overall rate of spoilage in tomato fruits. Although specific advanced traditional structures like pot-in-pot systems are less common, the general application of shade and ventilation remains fundamental for securing marketable inventory within the local supply chain.

5.0 Conclusion

Economic survival within the Benue State tomato value chain remains precariously dependent upon the synergy between farmer attributes and indigenous preservation techniques. The study established that human capital factors and low-cost storage structures are indispensable for mitigating postharvest attrition. Farmers who possess extensive experience and cooperative support are better positioned to utilise traditional methods for extending marketability and reducing stock losses. Achieving food security and income stability in the region requires a strategic focus on these local efficiencies until modern industrial infrastructure becomes widely accessible.

5.1 Recommendations

Based on the findings of this study, the following recommendations are proposed

1. Cooperative leaders should organise regular peer-to-peer training sessions to facilitate the transfer of indigenous handling knowledge among members. Sharing successful traditional techniques within the group will strengthen the collective capacity to reduce quantitative stock losses and improve negotiation power.
2. Agricultural extension agencies must design and promote improved versions of local ventilated storage structures that are affordable for small-scale producers. Providing technical guidance on enhancing traditional systems will offer a sustainable alternative to expensive refrigeration for farmers operating in regions with limited electricity.

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