ADOPTION OF POSTHARVEST LOSS MANAGEMENT STRATEGIES AND CONSTRAINTS AMONG FRUIT-VEGETABLE FARMERS IN KOGI STATE, NIGERIA

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Abstract
The study examined adoption of postharvest loss management strategies and constraints among fruit-vegetable farmers in Kogi State, Nigeria. A multistage sampling procedure was used to select 240 respondents from three agricultural zones purposively selected for this study. Primary data were collected using structured questionnaire and analyzed using descriptive statistics, such as frequencies, percentages and *mean. The findings showed that the respondents were predominantly within their economically active age group, with a mean age of 46 years. Most were married with 82.92%, 41.67 had formal education in secondary school, cultivated small-scale farms averaging 1.40 hectares* and *had an average farming experience of 8 years. A large proportion belonged to farmer associations with 65% and earned moderate monthly incomes of 38.33%. The study further showed that commonly adopted postharvest loss management strategies included sorting (86.25%), packaging (81.67%), grading (80.83%), harvesting at the appropriate maturity stage ((74.17%)* and *proper storage (71.67%). In contrast, the adoption of modern postharvest technologies such as refrigeration (46.25%), preservatives (46.67%), steaming (43.33%)* and *other improved technologies (29.17%) were relatively limited. The major constraints to the adoption of postharvest management includes inadequate access to improve crop varieties (90.83%), limited access to credit (79.58%), unstable electricity supply (77.50%), poor knowledge of appropriate harvesting techniques (73.33%), pest and disease infestation (71.67%), poor access to processing technologies (70.42%)* and *high production input costs (68.33%). This study concludes that although farmers widely adopt conventional postharvest management practices, the uptake of modern technologies remains constrained by financial, technical* and *infrastructural challenges. It therefore recommends improved access to credit, farmer training,* and *greater investment in postharvest infrastructure to reduce losses and enhance food security.*

Keywords: Adoptions, fruit-vegetable farmers, management, strategies, postharvest loss.

Introduction

Agriculture remains a primary source of food security, employment and livelihoods in rural areas of developing nations. Fruit vegetable crops are valuable agricultural commodities that provide essential nutrients, improve household diets and offer stable revenue for farming families. Production of fruit vegetables such as peppers, tomatoes, okra among others has grown in Nigeria due to rising consumption and their economic value. However, their perishable nature often causes high postharvest losses that reduce the benefits of production.

The quantifiable as well as qualitative decrease in agricultural output that takes place between harvest and final consumption is referred to as a postharvest loss (Kiaya, 2014). Fruit vegetables are particularly vulnerable to biological degradation, dehydration, microorganisms and mechanical wear and tear during handling, transport and storage because they continue to respire and stay biologically active after harvest, unlike many staple crops (Adhikari, 2021). Inadequate storage facilities, inadequate transport networks, weak market structures and restricted access to modern preservation methods all contribute to these losses in many developing nations.

Nigeria is one of the nations where, despite rising production, postharvest losses of fruits and

vegetables continue to be a significant problem. Large amounts of green vegetables, tomatoes, peppers and okra are wasted before they are used, which limits the returns on production investments, lowers farmer incomes and reduces food availability (Ohagwu *et al.*, 2024). According to Mohammed and Usman (2023), these losses have a serious impact on household welfare and food security, especially in rural agricultural communities whose primary source of income is agriculture.

Farmers use a variety of postharvest management strategies, including sorting, grading, packaging, and others to extend shelf life, increase market value, and to lower these losses. Effective postharvest management, according to Gayal and Singh (2017), entails a number of tasks that together reduce spoiling and preserve produce quality; these include harvesting, handling, packaging, transport, storage, and among others. However, farmers' expertise, access to funding, availability of suitable technologies, extension assistance and enabling infrastructure all play a major role in how successful these techniques are.

Many Nigerian smallholder farmers still rely on antiquated techniques that are frequently insufficient for reducing losses, despite the fact that awareness of better postharvest management techniques has grown recently. The adoption of modern postharvest technologies is nevertheless hindered by a number of factors, including limited access to financing facilities, subpar extension services, erratic electrical supply, poor handling and storage facilities, the expensive cost of upgraded technology and a lack of technical expertise. As a result, postharvest losses continue to be substantial, which lowers farm income, decreases the supply of food and increases economic waste. Despite the importance of fruit vegetable production in Kogi State, little empirical data is available regarding the particular postharvest management techniques being used by the farmers and the factors influencing their adoption. In order to create effective interventions and policies targeted at enhancing postharvest management and lowering losses, it is essential to address this gap.

The objective of this research is to examine the adaption of postharvest loss management strategies and constraints among fruit-vegetable farmers in Kogi State, Nigeria. The goals are therefore: To describe the socio-economic characteristics of the fruit-vegetable farmers in the study area; to identify the post harvest loss management strategies utilized by the farmers; to identify the constraints limiting the adoption of postharvest loss management by the farmers in the study area. The result should be of great assistance to various groups, including policymakers, extension agents, development organizations, and researchers, as they design appropriate interventions that will help lower postharvest losses and improve postharvest handling as well as management for rural farmers within Nigeria.

Methodology

Study area

This study was carried out in Kogi State, Nigeria. The State is located between latitudes $6^0$30'N and $8^0$48'N and longitudes $5^0$23'E and $7^0$48'E. Kogi State shares boundaries with Kwara, Ondo, Ekiti, Niger, Benue, Nasarawa, Anambra, Enugu and Edo State, as well as the Federal Capital Territory. The State experiences a tropical climate characterized by annual rainfall ranging from 1,016mm to 1,524mm and moderate temperatures, creating favourable conditions for the cultivation of a wide range of fruit and vegetable crops.

Sampling Procedure and Data Collection

A multistage sampling technique was employed to select the respondents for the study. In the first stage, three agricultural zones were purposively selected because of their high level of fruit-vegetable production. In the second stage, two Local Government Areas were randomly selected from each agricultural zone. This was followed by the random selection of wards and farming communities within the selected Local Government Areas. Finally, 240 fruit vegetable farmers were randomly selected to participate in this study. A structured questionnaire was administered directly to the selected farmers, to obtain data from the farmers in this study area.

Analytical Techniques

The data were collected and analyzed using descriptive statistics such as frequency and percentages. These were used to summarize farmers' socio-economic characteristics, postharvest loss strategies adopted and the major constraints the farmers faced in adoption of improved postharvest management practices.

Socioeconomic Characteristics of Fruit-Vegetable Farmers

Table.1: Socioeconomic Characteristics of Fruit-Vegetable Farmers (n=240)

Variables	Frequency	Percentage	Mean
Age (Years)			
20 –29	21	8.75	
30 -39	53	22.08	
40 -49	72	30.00	46 years
50 – 59	60	25.00	
>60	34	14.17	
Sex			
Male	122	50.83	
Female	118	49.17	
Marital Status			
Single	2	0.83	
Married	199	82.92	
Divorced	23	9.58	
Widowed(er)	16	6.67	
Educational Level			
No formal Education	45	18.75	
Primary Sch.	63	26.25	
Secondary Sch.	100	41.67	
Tertiary	32	13.33	
Household size (No. of persons)			
1-5	113	47.08	
6-10	106	44.17	6 persons
>10	21	8.75	
Farming Experience (Years)			
1-10	178	74.17	
11-20	55	22.92	8 years
>20	7	2.92	
Farm size (Hectare)			
0.01-2.00	195	81.25	
>2.00	45	18.75	1.40 hectares
Primary Occupation			
Yes	96	40.00	
No	144	60.00	
Extension contact			
Contact	116	48.33	
No contact	124	51.67	
Membership Association			
Member	156	65.00	
Non-member	84	35.00	

Monthly income (Naira)			
≤100,000	6	2.50	
100,001-300,000	41	17.08	N141,525.00
300,001-500,000	38	15.83	
500,001-700,000	63	26.25	
> 700,000	92	38.33	₦635,825:40

Source: Filed Survey (2026)

Table 1 shows that most (20.00%) of the fruit-vegetable producers (30.00%) were between the ages of 40 and 49, with a mean age of 46. This suggests that the majority of respondents were in their productive and economically active years, a time of life that is frequently linked to increased physical stamina, farming expertise and a readiness to adopt new agricultural technologies. This result is in line with Adekunle and Ogunleye (2021), Bello *et al.* (2022) and Oladimeji and Abdullahi (2020), who found that middle-aged farmers dominate horticultural production because of their greater inclination to adopt improved agricultural practices, managerial experience and physical strength.

The respondents' gender distribution showed that there were almost equal numbers of men (50.83%) and women (49.17%). This indicates that both men and women actively participate in the production of fruits-vegetables in this study area, with gender having little bearing. The findings corroborate those of Nwosu and Okeke (2013) and FAO (2021), who saw a rise in female involvement in horticulture production due to its compatibility with domestic duties and comparatively short production cycles.

The majority of the respondents have formal education, according to their educational profile. In particular, just 18.75% had no formal education, whereas 41.67% had secondary education, 26.25% had primary education and 13.33% had higher education. The farmers' comparatively high literacy rate implies that they are better able to comprehend and implement better production and postharvest management techniques, as well as take advantage of extension services. This result supports the findings of Rahji and Fakeyode (2019) and Eze *et al.* (2022), who found that secondary education is the most common among smallholder vegetable farmers in Nigeria as it enhancing their decision-making and information processing capacity.

Most respondents lived in households of one to ten persons, averaging six members per household. This implies that many farming households have access to family labour, which can reduce the cost of hired labour and support farm operations. Similar observations were made by Ibrahim and Musa (2022) and Sani *et al.* (2020), who reported that larger household's sizes provide an important source of labour for smallholder farming systems.

With respect to farming experience, 74.17% of the respondents had between 1 and 10 years of experience in fruit vegetable farming with an average of 8 years. This suggests that many of the farmers are relatively recent participants in the enterprise but have acquired sufficient practical experience to improve their farming and postharvest management practices. This finding agrees with Adebayo *et al.* (2021) and Umar and Hassan (2023), who reported that vegetable farming attracts relatively young farmers and that farming experience enhances productivity and postharvest management efficiency.

This finding also showed that fruit vegetable production in the study area is largely carried out on a small scale. About 81.25% of the respondents cultivated between 0.01 and 2.00 hectares of land, with an average farm size of 1.40 hectares. This confirms the dominance of smallholder farming, which is characteristic of vegetable production in Nigeria. This finding is in line with Oyinbo*et al.*(2020) and FAO (2022), who identified smallholder farming as a defining characteristic of vegetable production systems in Nigeria.

Membership of farmer associations was relatively high, with 65.00% of the respondents belonging to one or more farmer groups or cooperatives. Participation in such organization provides opportunities for information sharing, access to credit, farm inputs, training and collective

marketing, all of which can encourage the adoption of improved postharvest management practices. This observation supports the finding of (2019) and FAO (2021), who emphasized the role of farmer organizations in improving access to inputs, credit, information, marketing opportunities and postharvest management practices.

Income distribution showed that a good number of farmers 38.33% earned above N700,000 and 26.25% above N500,000. This indicates that fruit-vegetable farming can be quite profitable, particularly for those with strong market connections and good production and postharvest practices. Nwalieji and Uzuegbunam (2020) and Adeyemo *et al.* (2023) reached similar conclusions, reporting that market access and efficient postharvest management substantially improve earnings for horticultural farmers.

Postharvest Loss Management Strategies Adopted by Fruit Vegetable Farmers

This finding indicates that fruit vegetable farmers in Kogi State adopted a range of postharvest loss management strategies to minimize losses occurring after harvest.

Table 2: Postharvest Loss Management Strategies Adopted by Fruit Vegetable Farmers (n=240)

Post-harvest handling Technologies	Frequency (*)	Percentage
Sorting	207	86.25
Packaging	196	81.67
Grading	194	80.83
Harvest at maturity stage	178	74.17
Storage	172	71.67
Grinding	166	69.17
Drying	130	54.17
Minimize handling	126	52.50
Use of sharp tools not hand	124	51.67
Use of preservatives	112	46.67
Refrigeration	111	46.25
Steaming	104	43.33
Use of modern postharvest technology	70	29.17

(*) = Multiple response

Source: Filed Survey (2026)

Sorting ranked highest among postharvest practices, with 86.25% of farmers separating damaged produce from healthy ones right after harvest. This shows that most growers understand how sorting prevents contamination, slows decay and improves the quality of produce they take to market. Arah*et al.* (2022) and Kitinoja and Alhassan (2021) both confirmed that proper sorting boosts both quality and profitability.

Packaging and grading followed closely, adopted by 81.67% and 80.83% of farmers respectively. Packaging cushions vegetables from bruises and mechanical damage during transport, while grading creates uniform products that appeal more to buyers. Kasso and Bekele (2023) reported that both strategies reduce waste and increase consumer acceptance.

Harvest timing also mattered to many farmers, with 74.17% picking their produce at the right maturity stage. These growers clearly know that harvesting too early or too late shortens shelf life and lowers market value. Gustavsson *et al.* (2020) and Olayemi*et al.* (2021) made similar points about the importance of correct timing.

Storage was another key strategy, adopted by 71.67% of farmers to keep produce fresh before sale. Proper storage slows deterioration, keeps pests at bay and extends how long produce stays saleable. Elik*et al.* (2022) observed that good storage practices are essential for maintaining product

quality.

For preservation and adding value, 69.17% of farmers used grinding and 54.17% used drying. Both methods remove moisture, making produce easier to store and less prone to spoilage. Sarker*et al.* (2020) found drying particularly useful for rural farmers and Adeoye *et al.* (2020) noted that these practices increase storage life and household earnings.

Fewer farmers adopted practices like minimizing handling (52.50%) or using sharp tools instead of hand harvesting (51.67%). Yet these simple measures help reduce bruising, cuts and other mechanical damage. Kitinoja and Barrett (2020) emphasized that using the right tools can significantly cut postharvest losses.

The least adopted postharvest loss management strategies were refrigeration (46.28%), use of preservatives (46.67), steaming (43.33%) and modern postharvest technologies (29.17%). The low level of adoption of these practices suggests that access to improved postharvest technologies remains limited among smallholder farmers. Otekunrin*et al.* (2021) reported that inadequate cold storage infrastructure limits refrigeration adoption in Nigeria. Similarly, FAO (2022) noted that access to cold chain facilities remains a major challenge across Sub-Saharan Africa. Affognon*et al.* (2021) further reported that financial and institutional limitations restrict access to modern postharvest technologies among African farmers.

Constraints to Adoption of Postharvest Management Strategies

This study revealed that respondents faced several constraints that limited their effective adoption of postharvest management strategies.

Table 3: Constraints to Adoption of Postharvest Management Strategies among Farmers (n=240)

Variables	Frequency (*)	Percentage
Inadequate improved varieties	218	90.83
Lack access to credit	191	79.58
Unstable electricity supply	186	77.50
Poor knowledge of harvest techniques	176	73.33
Pest and diseases	172	71.67
Poor access to processing techniques	169	70.42
High cost of input	164	68.33
Poor modern harvesting equipment	164	68.33
Inadequate market access	160	66.67
Tradition/belief	155	64.58
High transportation cost	121	50.42
Mass illiteracy	119	49.58
Inadequate extension services /training	117	48.75
High marketing cost	113	47.08

(*) = Multiple response

Source: Filed Survey (2026)

This finding indicate that inadequate access to improved varieties was the most critical constraint to the adoption of postharvest management strategies, as reported by 90.83% of the respondents. Farmers explained that many of the fruit vegetable varieties available to them are highly prone to deterioration, pest infestation and physical damage during handling and storage, resulting in substantial postharvest losses. This finding support Basole*et al.* (2021) and FAO (2023), who emphasized the importance of improved varieties in reducing postharvest losses and extending shelf life.

Limited access to credit was identified by 79.58% if the respondents as another major challenge. Financial limitations prevent farmers from investing in essential postharvest facilities such as improved storage, quality packaging, processing equipment and reliable transport. These financial barriers, along with unstable electricity supply cited by 77.50% of farmers, continue to hinder adoption of better practices. Without reliable power, farmers cannot effectively use storage and preservation facilities, leading to higher losses, lower income and reduced capacity to invest in improvements.

Poor knowledge of harvesting techniques (73.33%) and limited access to processing methods (70.42%) also emerged as key constraints. Many farmers lack the technical skills needed to manage produce after harvest. Affongnam*et al.* (2015) and the FAO (2023) stressed that education and training are vital for successful technology adoption. Other constraints included pests and diseases (71.67%), lack of modern harvesting equipment (68.33%) and high input costs (68.33%). Reliance on traditional tools exposes fruit vegetables to mechanical damage, increasing spoilage and reducing quality.

Market-related challenges further constrained adoption. These included poor market access (66.67%), traditional beliefs (64.58%), high transport costs (50.42%), low literacy (49.58%), weak extension services (48.75%) and high marketing costs (47.08%). Together, these factors limit farmers' access to improved technologies, markets and advisory services, discouraging effective practices. Addressing postharvest losses will require a comprehensive approach that tackles technological, financial, institutional and infrastructural barriers through greater investment in technology, credit, markets, infrastructure and farmer education.

Conclusion and Recommendations

The study examined the adoption of postharvest loss management strategies and constraints among fruit-vegetable farmers in Kogi State, Nigeria. It shows that the farmers are mostly middle-aged, with an average age of about 46 years, indicating that they are in their active and productive years. Both male and female farmers are almost equally involved in production, and most of them are married, suggesting strong household responsibility in farming activities. The farmers are fairly educated, with the majority having at least primary or secondary education. This study further concludes that postharvest losses among fruit vegetable farmers are very common and widespread the causes of these losses are numerous and interconnected. The most important factors include crop injury during handling, improper sorting, poor storage systems, inadequate credit access, poor transportation facilities, pest and disease attacks, lack of proper packaging knowledge, and weak extension services. Farmers adopt several postharvest management strategies such as sorting, grading, packing, proper storage, harvesting at maturity, drying, and grinding. Finally, the major constraints to adopting improved postharvest management strategies include lack of improved varieties, limited access to credit, poor knowledge of handling techniques, inadequate extension services, high input and transportation costs, pest and disease problems, and weak market access. Since farmers already adopt basic practices like sorting, grading, packaging, and storage but have low adoption of modern technologies, it is therefore recommend that government should promote modern postharvest technologies through subsidies and demonstration centre in the study area.

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