

Assessment of Strategies Used by Merchants for Postharvest Loss Control of Pawpaw and Banana in Kano, State, Nigeria

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Abstract

This study assessed strategies adopted by pawpaw and banana marketers to reduce postharvest losses (PHLs) in selected markets in Kano Metropolis, Kano State, Nigeria. Specifically, it described the socio-economic characteristics of marketers and examined strategies used to mitigate PHLs at different stages of the marketing chain. A multi-stage sampling technique was used to select 159 pawpaw marketers, comprising 39 wholesalers and 120 retailers, and 120 banana marketers, comprising 19 wholesalers and 101 retailers, from three markets. Primary data were collected through structured questionnaires administered by personal interviews and analysed using frequencies, percentages, means, and standard deviations. Poor market patronage was identified as a major cause of PHLs. Strategies adopted to mitigate this included buyer persuasion (32.5%), advertisement (30.0%), attractive packaging (22.5%), and price reduction (20.0%). Other prominent causes included inadequate transportation, obsolete storage facilities, pest and disease infestation, and adverse weather conditions. Commonly adopted mitigation practices included the use of jute bags, storage under shade, selection of suitable transport vehicles, and training in improved postharvest management. The findings highlight significant gaps in transportation and storage infrastructure and limited access to improved management skills. Strengthening market and transport infrastructure, expanding access to affordable storage facilities, and providing targeted training in modern postharvest management practices are recommended to reduce PHLs and improve the efficiency and profitability of pawpaw and banana marketing in Kano Metropolis.

Keywords: Assessment, Merchants, Loss Control Strategies, Postharvest Losses

Introduction

Postharvest losses (PHLs) refer to reductions in the quantity and quality of food occurring between harvest and consumption. Quantitative losses involve reductions in the amount of food available for human consumption, while qualitative losses involve deterioration in nutritional value, physical quality, safety, and market acceptability (Alshabanat et al., 2021; Rana et al., 2021; Okori et al., 2022). In fruits and vegetables, such losses may result from mechanical damage, moisture and temperature changes, pest and disease infestation, poor handling, inadequate storage, and inefficient transportation and marketing systems (Ray & Ravi, 2005; WFLO, 2015; FAO, 2016). Postharvest losses of tropical fruits have been reported to range widely, with losses occurring throughout the supply chain from harvesting and packaging to storage, transportation and retailing (James et al., 2018).

The problem is particularly severe in developing countries, where inadequate infrastructure and logistics, poor postharvest handling practices, limited technical knowledge, and inefficient marketing systems contribute substantially to food losses (Kitinoja, 2002; Ray & Ravi, 2005; WFLO, 2015; FAO, 2016). Fruits and vegetables are especially vulnerable because of their high moisture content and physiological activity,

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making them highly susceptible to bruising, water loss, deterioration and microbial decay. Consequently, postharvest losses reduce the quantity and quality of food reaching consumers while also affecting the profitability and competitiveness of actors along the value chain (Kereth et al., 2013; FAO, 2016).

Pawpaw (*Carica papaya* L.) is an important tropical fruit in Nigeria, valued for its nutritional composition, including vitamins A, C and E, folate, dietary fibre and the proteolytic enzyme papain, which has industrial and pharmaceutical applications (Oyekunle et al., 2020). The crop is cultivated across several agro-ecological zones of Nigeria and is widely marketed in urban centres, including Kano metropolis, where fruit marketing provides an important livelihood activity for small-scale traders (NPC, 2006; Lawal et al., 2021). Banana (*Musa* spp.) is similarly an economically important fruit crop, and an affordable source of dietary carbohydrates, potassium and vitamins (FAO, 2019). In Kano State, bananas are sourced from irrigated production areas within and outside the state and distributed through major urban markets, including Yankura, Yankaba and Yan Lemo, supporting numerous wholesalers and retailers (Murthy et al., 2007; Kalule & Kyanjo, 2013).

Both pawpaw and banana are climacteric fruits, and therefore undergo rapid physiological changes during ripening; making them highly perishable (Kitinoja, 2002). Pawpaw is particularly susceptible to bruising, skin abrasion and puncturing during harvesting, transportation and handling, while banana may suffer finger detachment, blackening and microbial spoilage under unsuitable handling and transportation conditions (Ray & Ravi, 2005; Jedermann et al., 2014). These problems may be intensified in the hot environment of Kano metropolis by inappropriate packaging and storage facilities, and prolonged exposure of fruits under ambient market conditions (WFLO, 2015).

The vulnerability of these fruits makes effective postharvest management essential throughout the marketing chain. However, where modern storage, transportation and handling facilities are limited, marketers often rely on adaptive and indigenous practices to minimise losses. Such practices may include the selection of suitable transportation, use of protective packaging, storage under shade, purchase of healthy or less mature fruits, rapid delivery, training in postharvest management, advertising, persuasion of buyers and price adjustments. The effectiveness and adoption of these strategies may differ between wholesalers and retailers because of differences in their

roles, resources and exposure to specific sources of loss.

Although postharvest losses in fruits have been widely documented, location-specific evidence on the strategies employed by fruit marketers to manage these losses remains important, particularly within urban marketing systems in northern Nigeria. Existing studies have highlighted the roles of handling, transportation, storage, infrastructure and management practices in reducing postharvest losses (Bancal & Ray, 2022; Balana et al., 2022; Al-Dairi et al., 2023). However, there is limited documented evidence on how pawpaw and banana merchants in Kano metropolis respond to the specific causes of postharvest losses encountered during marketing. Understanding these responses is necessary for identifying existing coping mechanisms, gaps in postharvest management capacity, and infrastructural constraints that may require targeted intervention.

Therefore, this study assessed the strategies adopted by pawpaw and banana merchants to reduce postharvest losses in selected markets in Kano metropolis, Kano State, Nigeria. Specifically, the study sought to: (i) describe the socio-economic characteristics of pawpaw and banana merchants in the selected markets; (ii) identify the causes of postharvest losses in pawpaw and banana sales in the study area; and (iii) describe the strategies used by merchants to reduce postharvest losses at different stages of the postharvest loss chain.

Materials and Methods

Study area

The study was conducted in Kano State, situated in the northern region of Nigeria. According to the National Population Commission (NPC, 2023), Kano State has an estimated population of approximately 15,462,200. Kano State comprises 44 Local Government Areas. The specific markets selected for the research include the Yan Lemo fruit market, located in Kumbotso Local Government Area (LGA) along Na'ibawa Zaria Road; Yankaba market, situated along Hadeja Road in Nasarawa LGA; and Yankura, in Fagge LGA, bordering Sabongari market to the north and Singa market to the west. These markets were purposively selected due to their significant concentration of fruit merchants operating at both retail and wholesale levels.

Sampling procedure

A multi-stage sampling procedure was adopted for this study. This technique was chosen because it allows for the systematic selection of markets, categorisation of

marketers, and determination of sample size in a structured and transparent manner, ensuring adequate representation of both wholesalers and retailers across the selected markets.

In the first stage, three key markets where pawpaw and banana are commonly sold were purposively selected: Yankura Market, Na'ibawa Yan Lemo, and Yankaba Market. These markets were chosen due to the high concentration of pawpaw and banana sellers operating within them.

In the second stage, the marketers in each of the three markets were stratified based on their sales volume into two groups: wholesalers and retailers.

In the third stage, a census approach was adopted whereby all registered pawpaw and banana sellers in each market category (wholesale and retail) were enumerated. The sampling frame was obtained from the Nigeria Fruits Sellers Association, Kano Chapter (2024). From the frame, a total of 159 pawpaw marketers and 120 banana marketers were selected for the study. Tables 1a and 1b present the sampling frame and sample size for pawpaw and banana merchants, respectively.

Table 1a: Sample frame and sample size for pawpaw sellers

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer
Namibia ‘Yan lemo	39	110	36	86
‘yankaba	1	14	1	14
‘yankura	2	20	2	20
Total	42	144	39	120

Source: Field survey, 2024

Table 1b: Sample frame and sample size for banana marketers.

Market	Sampling Frame Whole seller	Retailer	Sample size Whole seller	Retailer
Na’ibawa ‘Yan lemo	16	90	16	76
‘yankaba	1	13	1	13
‘yankura	2	12	2	12
Total	19	115	19	101

Source: Field survey, 2024

Analytical tools

Data were analysed using descriptive statistics, including frequency counts, percentages, means, and standard deviations, to describe the socio-economic characteristics of the merchants, identify causes of postharvest losses, and analyse strategies used to reduce these losses.

Results and Discussion

Socio-economic characteristics of the pawpaw and banana marketers

The distribution of pawpaw and banana marketers according to selected socio-economic characteristics is presented in Table 2a.

Age

Table 2a shows that wholesale pawpaw marketers had a mean age of 48.50 years (SD = 9.44), while retail pawpaw marketers had a mean age of 35.88 years (SD = 9.01), with the majority (51.7%) falling within the 31–40 age bracket. Wholesale banana marketers recorded a mean age of 42.95 years (SD = 9.11), while

retail banana marketers had a mean age of 37.63 years (SD = 10.37), with 36.5% in the 31–40 age group. This suggests that the marketers are within the active working-age bracket and are physically capable of handling the demands of fruit marketing. This finding is consistent with Oyewo et al. (2023), who reported that pawpaw and banana marketers in Oyo State, Nigeria, are relatively young and within the productive age range.

Household size

Table 2a further shows the distribution of marketers by household size. Retail pawpaw marketers predominantly have a household size of 11–20 persons (44.2%), with a mean of 11.65, while wholesale pawpaw marketers have a larger mean household size of 18.42. Retail banana marketers mostly fall within the 11–20 household size category (47.0%), with a mean of 8.99, whereas wholesale banana marketers have a mean household size of 12.15. A large household size can provide family labour for marketing activities (Lowder et al., 2016).

Trading experience

Table 2a also presents the distribution of marketers by years of marketing experience. Wholesale pawpaw marketers have a mean experience of 21.47 years (SD = 4.88), while retail pawpaw marketers have a mean of 7.18 years (SD = 14.10). Wholesale banana marketers recorded a mean experience of 21.63 years (SD = 7.23), while retail banana marketers had a mean of 17.63 years (SD = 9.18). The relatively high marketing experience among wholesalers suggests that they have accumulated substantial knowledge of market dynamics, supply chain management, and postharvest handling practices over the years. The socio-demographic characteristics of pawpaw and banana marketers, including gender, marital status,

educational level, and membership in marketing associations, are presented in Table 2b.

Gender

Table 2b presents the distribution of marketers by gender, marital status, level of education, and membership in marketing associations. The results show that wholesale pawpaw marketers are entirely female (100%), while retail pawpaw marketers are predominantly male (95.8%). Wholesale banana marketers are mostly female (94.7%), and retail banana marketers are overwhelmingly female (98.3%). This suggests a gendered division of labour, with males dominating retail pawpaw marketing and females dominating wholesale pawpaw marketing as well as both retail and wholesale banana marketing.

Table 2a: Distribution of Pawpaw and Banana marketers according to their socio-economic variables (Qualitative)

Class Interval	PAWPAW				BANANA			
	Wholesale Freq	Perc	Retail Freq	Perc	Wholesale Freq	Perc.	Retail Freq	Perc.
Age								
18-30	-	-	32	26.7	5	26.3	34	29.6
31-40	13	32.5	62	51.7	9	47.4	42	36.5
41-50	12	30.0	19	15.8	4	21.1	30	26.1
51-60	12	30.0	7	5.8	1	5.3	8	7.0
61-70	3	7.5	-	-	-	-	1	.9
Total	120	100	120	100	19	100.0	115	100.0
Minimum	34		19		28		22	
Maximum	68		66		59		65	
Std Dvts	9.443		9.014		9.107		10.373	
Mean	48.50		35.88		42.95		37.63	
House hold size								
1-10	2	5	23	19.5	15	78.9	34	29.6
11-20	11	27.5	53	44.2	2	10.5	54	47.0
21-30	17.0	42.5	36	30.0	1	5.3	15	13.0
31-40	10	100	8	6.7	1	5.3	12	10.4
Total	40	100	120	100	19	100.0	115	100.0
Minimum	6.00		3.00		6.00		4.00	
Maximum	113.00		32.00		22.00		24.00	
Std Dvts	16.29		5.91		4.46		4.2745	
Mean	18.42		11.650		12.15		8.9913	
Trade Exp.								
1-10	1	2.5	13	10.8	5	26.3	71	61.7
11-20	9	22.5	28	23.3	3	15.8	12	10.4
21-30	11	27.5	51	42.5	8	42.1	14	12.2
31-40	19	47.5	28	23.3	3	15.8	18	15.7
Total	40	100	120	100	19	100	115	100
Minimum	12		5		11.00		6.00	
Maximum	29		60		35.00		38.00	
Std Dvts	4.883		14.10		7.23		9.1761	
Mean	21.47		7.179		21.63		17.6261	

Source: Field Survey, 2024

Table 2b: Distribution of Pawpaw and Banana marketers according to their socio-economic variables (Quantitative)

Variable	PAWPAW				BANANA			
	Wholesale		Retailer		Wholesale		Retailer	
	frequency	%	Frequency	%	frequency	%	frequency	%.
Gender								
Female	40	100.0	5	4.2	18	94.7	113	98.3
Male	-	-	115	95.8	1	5.3	2	1.7
Total	40	100	120	100.0	19	100.0	115	100.0
MStatus								
Married	1	2.5	126	96.7	15	79	77	67.0
Single	39	97.5	4	3.3	4	21	38	33.0
Total	40	100.0	120	100.0	19	100.0	115	100.0
Education								
Quaranic	16	40.0	52	43.3	1	5.3	20	17.4
Primary	20	50.0	56	46.7	4	21.1	10	8.7
Secondary	4	10.0	12	10.0	7	36.9	73	63.5
Tertiary	-	-	-	-	7	36.8	12	10.4
Total	40	100.0	120	100.0	19	100.0	115	100.0
CMembership								
Yes	39	97.5	111	92.5	10	52.6	76	66.1
No	1	2.5	9	7.5	9	47.4	39	33.9
Total	40	100.0	120	100.0	19	100.0	115	100.0

Source: Field Survey, 2024

This finding is consistent with Kwamboka (2018), who reported gender specialisation along the banana value chain in Kenya.

Marital status

Regarding marital status, wholesale pawpaw marketers are predominantly single (97.5%), while the majority of retail pawpaw marketers are married (96.7%). Wholesale banana marketers are mostly married (79%), and retail banana marketers are also largely married (67.0%). Married individuals may have greater stability and resources for retail marketing, while single individuals may find wholesale marketing more accommodating to their circumstances (Schindler, 2010).

Level of education

With respect to education, retail pawpaw marketers are almost evenly split between Quranic (43.3%) and primary education (46.7%), while wholesale pawpaw marketers have Quranic (40%) and primary (50%) education. In contrast, banana marketers generally have higher levels of formal education, with retail banana marketers having predominantly secondary education (62.6%) and wholesale banana marketers distributed across secondary (36.9%) and tertiary (36.8%) levels. Higher education levels among banana marketers may influence their adoption of improved

marketing strategies and access to market information (Flarian et al., 2018).

Marketing association membership

The majority of pawpaw marketers belong to a marketing association, with 97.5% of wholesalers and 92.5% of retailers being members. Banana marketers show lower membership rates, with 52.6% of wholesalers and 66.1% of retailers belonging to an association. Membership in marketing associations provides access to resources, market information, and collective bargaining power (Ma et al., 2023).

Strategies used by the wholesalers to reduced postharvest losses during marketing of Pawpaw

The strategies employed by wholesalers to minimize postharvest losses (PHLs) during pawpaw marketing are presented in Table 3a. The causes of postharvest losses (PHLs) in pawpaw and the measures adopted by wholesalers to mitigate them are presented in Table 3a. Poor market patronage was identified as a major contributor to PHLs, with wholesalers employing various strategies to address the problem. These included advertising (28.6%), attractive packaging (21.4%), persuading buyers (31%), and reducing prices (19%). Such measures are intended to improve the marketability of pawpaw and stimulate consumer demand, thereby facilitating faster sales and minimizing losses resulting from unsold

produce (Suh et al., 2020). Inadequate transportation facilities contribute to losses where strategies employed include choice of good trucks (36.8%) and use of a good J5 bus (39.5%) and use of pickups (23.7%). The emphasis on advertising and attractive packaging indicates a proactive approach by wholesalers to enhance visibility and appeal in a competitive market. A study in Kenya reported that 30-50% of bananas are lost at postharvest stages due to inadequate handling and poor infrastructure (Bancal & Ray, 2022). This aligns with the findings regarding pawpaw, where transportation and storage issues are prevalent. One of the notable strategies is the emphasis on improving transportation facilities, particularly the use of trucks (50% frequency) and J5 buses (36.4% frequency), which are critical for ensuring fast and reliable deliveries. This aligns with findings from a study that highlight the importance of efficient transportation in mitigating spoilage and maintaining produce quality (Jansen & van der Lans, 2018). To address the challenge of obsolete storage facilities, wholesalers adopted several strategies to minimise spoilage risks, including spreading fruits under shade (40%), using jute bags (28%), and spreading produce in the open (32%). These low-cost storage methods, though rudimentary, help reduce direct exposure to heat and physical damage during the sales period.

One of the notable strategies is the emphasis on improving transportation facilities, particularly the use

Table3a: Strategies used by the wholesalers to reduced postharvest losses during marketing of Pawpaw

Actors	Causes of PHLS	Strategies to reduce PHLS	Freq.	Perc.
Pawpaw Wholesalers	Poor market patronage	Advertisement of the produce	12	28.6
		Attractive packaging	9	21.4
		Persuasion of buyers	13	31
		Price reduction	8	19
	Bad mode of transportation facility	Choice of good trucks	14	36.8
		Use of good J5 bus	15	39.5
		Use of pickup	9	23.7
	Bad road	Night travel	6	13.6
		Use of good J5 bus to deliver fast	16	36.4
		Use of good truck for fast deliver	22	50
	Outdated storage facility	Spreading under shade	20	40
		Use of jut bags	14	28
		Spreading in the open	16	32
	Longer distances	Use of good J5 bus for fast deliver	17	37
		Use of good truck for fast deliver	14	30.4
		Purchase of unripe fruit	15	32.6
	Inadequate postharvest management skill	Training on new management skill	20	50
		Adopting new management skill	20	50
	Pest attack and Disease Infestation	Purchase of healthy fruit.	18	66.7
		Discriminate use of rat poison	9	33.3
	Time of sales	Persuasion of buyers	15	31.25
		Purchase of healthy fruit	18	37.5
		Attractive packaging	15	31.25
	Weather condition	Use of jut bags	17	51.5
		Spreading under shade	16	48.5

Source: field survey 2024.

It was also revealed from the result that longer transport distances exacerbate losses. Strategies include using good J5 buses for fast delivery (37%), using good trucks for fast delivery (30.4%) and purchasing unripe fruit to reduce spoilage during transit (32.6%). The focus on using better vehicles highlights the importance of reliable logistics in reducing damage during transit. Inadequate postharvest management skills where lack of skills in postharvest management leads to higher losses. Strategies used to mitigate PHLs include training on new postharvest management skills (50%), adopting new postharvest management techniques (50%).

The emphasis on purchasing healthy fruit (66.7%) as a pre-emptive strategy against pest attacks and disease infestation demonstrates an understanding that quality at the point of purchase can mitigate losses later in the supply chain. This aligns well with agricultural best practices that advocate for the selection of high-quality produce to minimize risks (FAO, 2019).

The timing of sales can impact fruit quality, with strategies including persuasion of buyers (31.25%), purchasing healthy fruit (37.5%), and attractive packaging (31.25%). The adoption of training programs signifies an acknowledgment of the need for improved skills in postharvest management, which is crucial for minimizing losses. Research has shown that training farmers on postharvest management techniques can significantly reduce losses. This is reflected in the strategies used by pawpaw wholesalers who prioritize skill development.

Adverse weather can affect fruit quality, leading to strategies like using jute bags for protection during transport (51.5%) and spreading under shade to prevent spoilage (48.5%). The strategies addressing weather conditions reflect an understanding of the external factors affecting fruit quality, suggesting that wholesalers are adapting their practices accordingly.

PHLs in the banana supply chain can be substantial, occurring at various stages of the value chain. Banana is a climacteric perishable fruit and therefore, its postharvest losses are relatively high and occur mainly during handling and transportation in the supply chain. Addressing those issues is essential for minimizing losses and enhancing the profitability and food security.

The strategies adopted by wholesalers to reduce PHLs during the sales of bananas, as outlined in Table 3b, reveal a multifaceted approach to addressing various challenges. The highest frequency strategy is the use of jut bags (39.5%), which highlights the importance of proper packaging in preserving fruit quality during

storage and transport. Additionally, the need for good transportation facilities is underscored by the high percentages for choosing suitable trucks (60%) and using J5 buses (40%). These findings align with existing literature that emphasizes the significance of robust transport and storage solutions in mitigating postharvest losses (FAO, 2019; Oluoch et al., 2020).

The prominent strategies addressing poor market patronage, such as advertising (32.5%) and attractive packaging (17.5%), suggest an understanding among wholesalers of the need to enhance consumer interest and perceptions about the product. These tactics are supported by research showing that effective marketing strategies can significantly influence consumer behavior and reduce unsold inventory (Kumar et al., 2021).

Wholesalers also recognize the impact of environmental factors, as indicated by their strategies to address weather conditions (51.72%, spreading under shade) and time management in marketing (34.29%, persuasion of buyers). This awareness aligns with studies indicating that environmental challenges, like extreme weather, can significantly affect agricultural outputs and market access (Morris et al., 2018). Moreover, the dimensions of training and skill development (55.17% for training on new postharvest management skill are vital, suggesting that enhancing the capabilities of wholesalers can contribute significantly to the reduction of PHLs. This finding resonates with other research results advocating for capacity building as a mechanism to improve postharvest management practices (Kehinde et al., 2022).

The findings from this study are consistent with previous research indicating that effective postharvest management strategies can significantly reduce losses. For instance, a study by Al-Dairi et al. (2023) found that investments in better storage facilities and training for farmers could mitigate 25% to 50% of postharvest losses in various crops, including bananas. Furthermore, the integration of technology, such as temperature-controlled storage and transport solutions, has been identified as a game-changer in minimizing losses and enhancing market access (World Bank, 2021).

The implications of these findings suggest that to effectively reduce postharvest losses, stakeholders within the banana supply chain must invest in both physical and human capital. This may include ensuring that merchants are equipped with the right vehicles and training to optimize handling practices while simultaneously focusing on sales strategies that

Table 3b: Strategies used by the wholesaler to reduced postharvest losses during Banana sales

Actor	Causes of PHLs	Strategies to reduce PHLs	Freq.	Perc.
Banana Wholesalers	Poor market patronage	Advertisement of the produce	13	32.5
		Attractive packaging	7	17.5
		Persuasion of buyers	9	22.5
		Price reduction	11	27.5
	Bad mode transportation facility			
		Choice of good trucks	15	60.0
		Use of good J5 bus	10	40.0
	Bad road			
		Night travel	11	33.3
		Use of good J5 bus to deliver fast	12	36.4
		Use of good truck for fast deliver	10	30.3
	Outdated storage facility			
		Spreading under shade	16	37.2
		Use of jut bags	17	39.5
		Spreading in the open	10	23.3
	Larger distance			
		Use of good J5 bus for fast deliver	11	27.5
		Use of good truck for fast deliver	14	35.0
		Purchase of unripe fruit	15	37.5
	Inadequate postharvest management skill			
		Training on new management skill	16	55.17
		Adopting new management skill	13	44.83
	Pest attack and disease Infestation			
		Purchase of healthy fruit.	13	65.0
		Discriminate use of rat poison	7	35.0
	Time of marketing			
		Persuasion of buyers	12	34.29
		Fruit Purchase of healthy	15	42.86
		Attractive packaging	8	22.85
	Weather condition			
		Use of jut bags	14	48.28
		Spreading under shade	15	51.72

Source: field survey 2024.

enhance consumer engagement. Additionally, collaborative efforts among merchants, market leaders, and relevant agricultural development agencies are essential to address infrastructural gaps and improve overall supply chain efficiency in the study area.

The strategies used by retailers to reduce PHLs during the sales of pawpaw, as shown in Table 3c indicate a comprehensive approach to overcoming the challenges faced in maintaining fruit quality and enhancing consumer appeal. Notably, the use of jut bags (36.84%) and the practice of spreading in the open (33%) stand out as paramount strategies, which signifies an emphasis on effective storage and handling in preserving fruit quality during transportation and storage. These findings correspond with existing

studies that underscore the importance of appropriate packaging and environmentally controlled storage in minimizing postharvest losses (FAO, 2019; Alonso et al., 2020).

Retailers also recognize the criticality of improving market visibility and consumer engagement. Strategies such as attractive packaging (31.98%) and promotional activities (27.92%) for advertisement of the produce underscore the need for retailers to invest in sales promoting initiatives that enhance the perceived value of pawpaw. Research supports that effective sales promoting initiatives can significantly influence consumer purchasing decisions and help reduce inventories of unsold products (Simpson et al., 2021).

Table3c: strategies used by the retailers to reduced postharvest losses during sales period of pawpaw.

Actors	Causes of PHLS	Strategies to reduce PHLS	Freq.	Perc.
Pawpaw Retailers	Patronage	Advertisement of the produce	55	27.92
		Attractive packaging	63	31.98
		Persuasion of buyers	39	19.80
		Price reduction	40	20.30
	Bad transportation facility	Choice of good tricycle for transport	34	24.82
		Use of good wheel barrow	68	49.63
		Use of taxi	35	25.55
	Obsolete storage facility	Spreading under shade	92	30.26
		Use of jut bags	112	36.84
		Spreading in open	100	33.00
	Inadequate postharvest management skill	Training on new management skill	68	57.14
		Adopting new management skill	51	42.86
	Pest attack and Disease Infestation	Purchase of healthy fruit	87	81.31
		Discriminate use of rat poison	20	18.69
	Time of marketing	Persuasion of buyers	66	34.74
		Purchase of healthy fruit	76	40.0
		Attractive packaging	48	25.26
	Weather condition	Use of jut bags	110	52.38
		Spreading under shade	100	47.62

Source: field survey 2024.

Additionally, the focus on training to improve postharvest management skills (57.14%) emphasizes the importance of equipping retailers with the knowledge needed to use modern practices for managing pawpaw effectively. This aligns with similar findings that advocate for capacity-building initiatives within the agricultural sector to help mitigate postharvest losses (Kehinde et al., 2022). Retailers' strategies also reflect addressing transportation challenges, with the use of good wheelbarrows (49.63%) as a prominent tactic, emphasizing the need for suitable transport means to minimize mechanical damage and losses. This insight is supported by existing literature that asserts the significance of proper transportation facilities in maintaining produce quality during supply chain operations (Jansen & van der Lans, 2018).

Table 3d presents the strategies adopted by retailers to reduce PHLS during banana sales. The results reveal that retailers employ a multifaceted approach to address various causes of postharvest losses, including

poor market patronage, inadequate transportation, obsolete storage facilities, pest and disease infestation, and adverse weather conditions.

This result demonstrates a broad understanding of the challenges associated with maintaining banana quality throughout the sales process. The findings reveal that Purchase of healthy fruits (43.50%) and the use of good wheelbarrows (38.28%) are among the most frequently used strategies to prevent PHLS. This indicates a strong correlation between effective presentation and physical handling of the product in reducing losses. These results align with research showing that appealing packaging not only enhances consumer interest but also minimizes mechanical damage during transportation and display (Wang et al., 2021). Additionally, these findings imply that retailers should prioritize investments in both logistics and training to enhance their capacity. This could lead to a more efficient supply chain that not only lowers losses but also improves profit margins and consumer satisfaction.

Table 3d: strategies adopted by the retailers to reduced post- harvest losses during marketing Banana.

Actors	Causes of PHLS	Strategies to reduce PHLS	Freq.	Perc.
Banana Retailers	Poor market patronage	Advertisement of the produce	68	23.69
		Attractive packaging	80	28.88
		Persuasion of buyers	94	32.75
		Price reduction	45	15.68
	Bad transportation facility			
		Choice of good tricycle or transport	76	29.69
		Use of good wheel barrow	98	38.28
		Use of taxi	82	32.03
	Outdated storage facility			
		Spreading under shade	95	35.85
		Use of jut bags	90	33.96
		Spreading in open	80	30.19
	Inadequate postharvest management skill			
		Training on new management skill	85	48.57
		Adopting new management skill	90	51.43
	Pest attack and Disease Infestation			
		Purchase of healthy fruit.	97	43.50
		Discriminate use of rat poison	46	20.63
		Covering	80	35.87
	Time of marketing			
		Persuasion of buyers	85	34.27
		Purchase of healthy	68	27.42
		Attractive packaging	95	38.31
	Weather condition			
		Use of jut bags	90	50.0
		Spreading under shade	90	50.0

Source: field survey 2024.

The high frequency of strategies emphasizing persuasion of buyers (32.75%) and advertisement of the produce (23.69%) highlights the importance of sales enhancing efforts in facilitating consumer engagement. This aligns with studies that reveal how promotional activities can enhance market demand and reduce unsold inventory (Suh et al., 2020). Moreover, the strategies employed by retailers reinforced the position of comprehensive supply chain management as a critical factor in reducing losses. According to the International Fund for Agricultural Development (IFAD, 2020), successful postharvest loss mitigation combines effective storage, improved logistics, and robust sales enhancing strategies.

In addition, a significant focus on improving transportation methods is evident, with options such as choosing good transportation means (29.69%) and using taxis (32.03%) being adopted. This emphasis on transportation strategies indicates that retailers recognize the detrimental effects of poor transport on banana quality (Jansen & van der Lans, 2018). Ultimately, stakeholders across the supply chain from producers to retailers must collaborate to develop comprehensive strategies that encompass sales

enhancing strategy, transportation, and storage solutions. Collaborative efforts can lead to improved techniques, infrastructure, and practices that ensure the preservation of banana quality and affordability in the marketplace.

The results also reflect a commitment to improving storage conditions, as indicated by the widespread use of shades for storage (50%) and jut bags (50%). These strategies are crucial to maintaining fruit quality and reducing deterioration rates, consistent with literature highlighting proper storage conditions as essential for minimizing postharvest losses (Alonso et al., 2020). These findings is similar with a previous study that emphasizes the multi-dimensional approach required to reduce postharvest losses effectively. For instance, studies by Kader (2005) have shown that combining proper handling techniques, optimal packaging, and sales enhancing strategy can significantly decrease losses in various fruit crops, including bananas.

The emphasis on training and using new management skills (48.57% and 51.43 %, respectively) demonstrates the recognition of the importance of human capital in managing postharvest processes effectively. This corresponds with findings from

Kehinde et al. (2022), which advocate for training programs to enhance retailer skills in postharvest management.

Conclusion

This study was designed to assess the strategies adopted by pawpaw and banana marketers to mitigate postharvest losses (PHLs) in Kano Metropolis, Nigeria. The findings reveal that PHLs in the marketing of these highly perishable, climacteric fruits are substantial and are primarily driven by poor market patronage, inadequate transportation, outdated storage facilities, pest infestations, and adverse weather conditions. To cope with these challenges, marketers have adopted various indigenous and adaptive strategies, such as the use of jute bags, spreading fruits under shade, selective purchasing of healthy produce, and persuasive marketing techniques. However, the effectiveness of these strategies is often constrained by a lack of modern postharvest management skills and poor logistical infrastructure. The study contributes to the existing literature by highlighting the critical intersection of human capital (handling skills) and physical capital (packaging and transport) in the horticultural supply chains of northern Nigeria. Ultimately, reducing PHLs in the pawpaw and banana value chains requires a shift from mere coping mechanisms to the adoption of sustainable, modern postharvest management systems.

Recommendations

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

1. **Capacity Building and Training:** Government agencies, NGOs, and agricultural extension services should provide regular practical training for wholesalers and retailers on improved postharvest handling, packaging, storage, transportation, inventory management, and loss-reduction techniques.
2. **Improved Transportation and Logistics:** Relevant authorities should facilitate access to affordable, suitable, and well-maintained transportation facilities to reduce mechanical damage and spoilage during the movement of pawpaw from production areas to markets.
3. **Affordable Market Storage Facilities:** Market authorities and local governments should provide and maintain affordable, hygienic, and well-ventilated storage facilities in major fruit markets, including Yan Lemo, Yankaba, and

Yankura, to minimise deterioration caused by adverse environmental conditions.

4. **Strengthening Cooperatives, Financial Access, and Marketing:** Government and financial institutions should promote cooperative membership and provide accessible financial support to marketers to improve their bargaining power, access to market information, packaging materials, and transportation. Marketers should also be encouraged to adopt effective promotional strategies, attractive packaging, buyer engagement, and appropriate pricing to improve market patronage and reduce losses from unsold produce.
5. **Directions for Future Research:** Further research should quantify the economic value of PHLs in pawpaw and banana value chains and assess the cost-effectiveness of alternative loss-reduction strategies to provide evidence for policy and investment decisions.

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