

## Awareness and Utilisation of Improved Postharvest Technologies in Nigeria

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### Abstract

*Postharvest losses substantially challenge global food security, particularly in low and middle income countries. Recognising the criticality of leveraging improved/new postharvest technology to address these losses, this study assesses the gap between available postharvest technologies and their awareness and use among farmers in Osun State. The study adopts a cross-sectional research design. With the assistance of the Agricultural Development Program officers in Osun state, a total of 126 farmers were randomly selected from the three agricultural zones in the state. The survey instrument was a structured questionnaire designed to investigate awareness, provisions, use, and challenges of postharvest technologies. The result revealed an increased awareness (34.7%) and use of improved storage technologies (mainly PICS and hermetic drums) over other technologies. Very few respondents are aware of ventilated plastic crates (5.5%), multi-crop dryer machines (4.5%), evaporating coolant systems (3.4%), and cold chain technology (3.0%). Moreover, high cost is a major hindrance, not only to adoption but also to the continuous use of some postharvest technologies. The substantial role of extension officers in providing and disseminating knowledge about new technology was evident. The study recommended strengthening extension services at all governance levels to create targeted awareness on lesser-known postharvest technologies such as ventilated plastic crates and multi-crop dryers. Additionally, private and public sector-backed subsidies, microcredit facilities, and cooperative financing models should be introduced to address high costs and ensure sustained adoption of postharvest technologies.*

### Keywords:

Food security, Postharvest innovation, Postharvest loss, Technology adoption

### Introduction

Postharvest loss (PHL) describes qualitative and quantitative wastage and damage to valuable food (Hodges et al., 2011) along the post-production chain up to the consumer's table. Globally, particularly in Africa, PHL poses a significant challenge to achieving Sustainable Development Goal 2, which aims to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture by 2030 (United Nations, 2015). The consequences of these losses are profound, contributing to global hunger, with an estimated 795 million people remaining malnourished, most of whom live in developing regions, particularly Sub-Saharan Africa (Adeyeye et al., 2023). In sub-Saharan Africa, postharvest losses are substantial, estimated at 37 percent of food between production and consumption (Kaminski & Christiaensen, 2014), amounting to about USD 4 billion for grains alone (Affognon et al., 2015).

In Nigeria, PHL is a significant contributor to ongoing poverty among farmers, who often lack adequate support. Busari et al. (2015) estimated postharvest losses of fruits and vegetables in Nigeria to around 30-50 %. About ninety percent of wastage occurs within the food value chain, including harvest, handling, processing, transportation, preservation, storage etc. (Ogundele, 2022), leading to an annual loss of about 2.7 trillion

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naira. Each year, about 1.5 million tons of grains and 700,000 tons of tomatoes go to waste (Kayode et al., 2022). Liambee & Onu's (2022) empirical study among smallholder rice farmers in Benue state revealed an average postharvest loss of approximately nineteen percent.

Previous studies have posited that there is a connection between food insecurity and postharvest losses, and that the former can be addressed by the application of new or improved technologies to reduce postharvest losses (Stathers et al., 2020; Bada et al., 2023). Thus, the evolution of improved postharvest technologies is a giant step towards curbing or minimizing PHL. These technologies are designed to reduce losses, improve the quality and safety of agricultural products, and enhance their shelf life. They are often categorized into storage, processing, preservation, and transportation technologies. Adopting these technologies is essential for the sustainable growth of the agricultural sector in any country, poverty reduction, and sustainable use of resources, among other benefits (Goletti & Wolff, 1999).

Postharvest technology (PHT) adoption has been identified as a critical intervention to reduce losses, enhance value chain efficiency, and improve farmers' incomes. In Nigeria, several research institutions and private organisations have developed technologies, including hermetic storage tanks, ventilated plastic crates, evaporative coolers, and cold-chain infrastructure to address postharvest challenges (Kaur & Watson, 2024; Mounika et al., 2025). However, evidence suggests that these technologies are neither widely disseminated nor adopted by smallholder farmers and agro-processors.

While several studies have examined postharvest losses and their impact on farmers' livelihood and the Nigerian economy (Kariyasa & Dewi, 2013; Affognon et al., 2015; Busari et al., 2015; Bada et al., 2023; Asom et al., 2024), empirical evidence on farmers' awareness, usage, and adoption of specific modern postharvest technologies at the state level is limited. There remains limited empirical evidence on farmers' awareness, usage, and adoption of modern postharvest technologies at the state level. This gap is significant because adoption patterns often vary across locations due to socioeconomic characteristics, market access, and institutional support differences. Understanding these dynamics at the subnational level is therefore crucial for designing context-specific interventions that can promote the uptake of improved postharvest

technologies and reduce losses, particularly in agrarian states such as Osun, where agriculture constitutes a significant percentage of livelihood activity.

This study aimed to address and close the existing research gap in Osun State. The specific objectives were to: assess farmers' awareness and use of improved postharvest technologies; examine the types of postharvest technologies adopted by farmers and identify the factors influencing their adoption or non-adoption; identify the key factors that can enhance postharvest technology adoption by farmers.

## **Materials and Methods**

### **Study area**

The study was conducted in Osun State, south-west Nigeria. The state's total land area is estimated to be about 9,251 km<sup>2</sup> (3,572 sq mi), and it is mainly populated by Yoruba people, primarily of the Ibolo, Ife, Igbomina, Ijesha, and Oyo population subgroups. The economy predominantly focuses on agriculture, mainly cultivating cocoa, cassava, millet, maize, potato, vegetables and yam crops<sup>1</sup>.

### **Study design**

The study adopted a cross-sectional research design. Osun State is administratively divided into three agricultural zones by the Agricultural Development Program: the Ife-Ijesa, Iwo, and Osogbo. To ensure comprehensive coverage, communities within each zone (Table 1) were purposively selected based on the presence of active ADP operations. Subsequently, within each selected community, farmers were randomly chosen from a list of individuals who had previously engaged with ADP extension officers in technology-related activities, as these farmers were considered capable of providing accurate and experience-based information on postharvest technology utilisation. This combination of purposive and random sampling was employed to ensure representativeness across the major agricultural zones and credibility of responses from knowledgeable farmers. In total, 126 farmers who consented and responded to the instrument were surveyed, and their distribution across the communities is presented in Table 1. Data collection was carried out between June and September 2022.

Primary data were collected from eligible participants using a structured questionnaire. The latter were delivered to respondents by a research team member alongside the ADP officer covering the particular location. The ADP staff clarified the questions where necessary. The collected data were analysed using a descriptive analytical framework.

**Table 1: Zones and Townships Sampled**

Agricultural zone	Townships covered	%
Ife-Ijesa zone	Ife-Ife, Modakeke, Osu	17.5
Iwo zone	Iwo, Odo-Otin	38.8
Osogbo zone	Ayedire, Ikirun, Osogbo, Igbajo, Oke-Ila, Ila-Orangun	43.7
Total		100

**Results and Discussion****Socio-demographic characteristics of the respondents**

Table 2 presents the socio-demographic characteristics of the respondents. The Result shows that most respondents are male (79%), with many belonging to the 36 - 45 age group (31%). The mean age of respondents is 45 years.

**Table 2: Socio-Demographic Profile of Respondents**

Variable	Options	Frequency	%
Sex	Male	99	78.6
	Female	27	21.4
Age (in years)	18 – 25	01	0.8
	26 – 35	29	23.0
	36 – 45	39	31.0
	46 – 55	31	24.6
	56 – 65	17	13.5
	Above 65	09	7.1
	Marital status	Single	07
Highest education	Married	115	92.0
	Widowed	03	2.4
	Postgraduate	03	2.4
	First degree	41	33.1
	Secondary	47	37.9
	Primary	26	21.0
	Vocational	04	3.2
Discipline studied	No formal	30	2.4
	Basic sciences	18	41.9
	Engineering	01	2.3
	Social sciences	14	32.6
	Education	06	14.0
	Arts	02	4.7
	Others	02	4.7
Is farming your main occupation?	Yes	55	85.9
	No	09	14.1
Any other work or business apart from farming?	Yes	65	52.4
	No	59	47.6
Years of experience in farming	5 – 10	19	15.2
	11 – 15	18	14.4
	16 – 20	25	20.0
	21 – 30	33	26.2
	31 – 40	20	16.0
	41 – 50	09	7.2
	51 – 60	01	0.8
Farmland size	Less than 5 acres	35	28.5
	5 – 10 acres	32	26.0
	Above 10 acres	56	45.5
Average annual income from farming (in naira)	Less than 1,000,000	53	42.7
	1,000,000 – 2,500,000	42	33.9
	2,600,000 – 5,000,000	21	16.9
	Above 5,000,000	08	6.5

The majority of the farmers are married (92%). About 38 percent of the respondents have secondary education, with 33 percent possessing a post-secondary education, while 21 percent have primary education. Literacy level can be said to be high among respondents, unlike Lamidi & Akande (2013), who reported a low literacy level among their respondents selected in the same state. Concerning the area of the disciplines, many farmers have their background in basic sciences (42%), social sciences (33%), and education (14%).

More than three-quarters of the respondents engage in farming as a primary occupation (86%), and about 52 percent have some other businesses apart from agriculture. Respondents with farming experience between 21 and 31 years constitute 26 percent of the total farmers surveyed. The mean value in years for experience is 22.74. Most farmers have above 10 acres of farmland (46%), with a mean value of 8.43 acres. With respect to the average annual income from farming, 42.7 percent have less than N1,000,000; about 34 percent have between N1,000,000 and N2,500,000; 17 percent have between N2,600,000 and N5,000,000, while only 7 percent have above N5,000,000. In all, the average income of respondents is N1,960,080.43. The demographic characteristics of respondents in this study have significant implications for technology adoption, productivity, and policy interventions. First, the finding that about four in five respondents are male reflects persistent gender disparities in agricultural production, where men dominate land-intensive and commercial farming activities, while women often engage in processing and marketing (Adeyonu et al., 2021; Ohagwu et al., 2021). The predominance of farmers aged 36–45 indicates an economically active demographic, which should generally be more receptive to innovation and risk-taking than older farmers (Mwangi & Kariuki, 2015). However, the low representation of younger farmers underscores the ongoing challenge of youth disengagement in agriculture, a trend that threatens the sector's sustainability and rural employment opportunities (Morgan & Fanzo, 2020).

Furthermore, with eighty-six percent of respondents identifying farming as their primary occupation, the sector remains a critical source of livelihood, meaning that innovations, such as postharvest technologies, can significantly impact income stability and poverty reduction (Zorya et al., 2011). Furthermore, substantial farm sizes (46% operating more than 10 acres) and considerable farming experience (26 % with 21–31 years) suggest a primarily commercially oriented

group. Such farmers should typically have better access to resources and more capable of absorbing risks, facilitating the adoption of capital-intensive technologies (Ogutu et al., 2020). Nevertheless, while experience enhances informed decision-making, it may also breed conservatism, requiring strong economic incentives, evidence of profitability, and reliable extension support to encourage technological adoption (De Caires et al., 2024).

### Crops cultivated by the farmers

Table 3 shows the distribution of crops grown. It reveals that most farmers engage in multicrop farming, combining food crops (27.9%) with vegetables (20.7%), cereals (19.0%), fruits (15.0%), and cash crops (17.4%). Such diversification decreases production risk, enhances household food security, and supports income stability while boosting resilience to climate and market shocks (De Caires et al., 2024; Isaacs et al., 2016). This finding also aligns with Danbaba et al. (2019), who observed that food crops are the main agricultural products in Nigeria.

**Table 3: Crops cultivated by farmers**

Crops	Frequency	%
Fruits	63	15.0
Vegetables	87	20.7
Cereals	80	19.0
Food crops	117	27.9
Cash crops	73	17.4

### Awareness of postharvest technologies

Awareness of the existence and significance of improved postharvest technologies is critical to their accessibility and adoption. Postharvest losses often occur during basic agricultural activities including storage, processing, preservation, and transportation (Tomlins et al., 2016). This categorisation forms the basis for the classification adopted in this study; the awareness of various technologies in each category is presented in Figure 1. The result suggests that most (34.7%) of the farmers are aware of storage technologies, while only a few percent (16.5%) are aware of transportation technologies. Transportation technologies include reusable plastic crates for safe carriage of tomatoes, fruits & other perishables. The lack of adequate transportation technologies, especially in many developing countries, is responsible for damage to food products through bruising and losses due to spillage (Popkin, 2006). The present result further suggests a paucity of knowledge about preservatives in curbing postharvest losses among

respondents. The use of certain chemical fumigants and natural insecticides, which can serve as preservatives to reduce the incidence of postharvest losses, was identified and discussed in Popkin (2006). A similar study in Nigeria attributed low awareness of improved postharvest technologies to the unavailability of the equipment in their localities (Asom et al., 2024). Thus, innovative channels are required at the community and farmer-association levels to foster promotion and awareness of technological innovations to reach end users, mostly in rural communities.

### Postharvest technologies identified by the farmers

The result from Table 4 suggests that most respondents have a poor knowledge of nearly all the technologies; however, some are familiar with cassava processing sheds and fryers (15.4%). This may be attributed to cassava being one of the major farm crops cultivated at the study location. Other postharvest technologies with a high level of awareness among the farmers include cellophane bags for storage and marketing of farm produce (13%) and Purdue Improved Crop Storage (PICS) bags (12%).

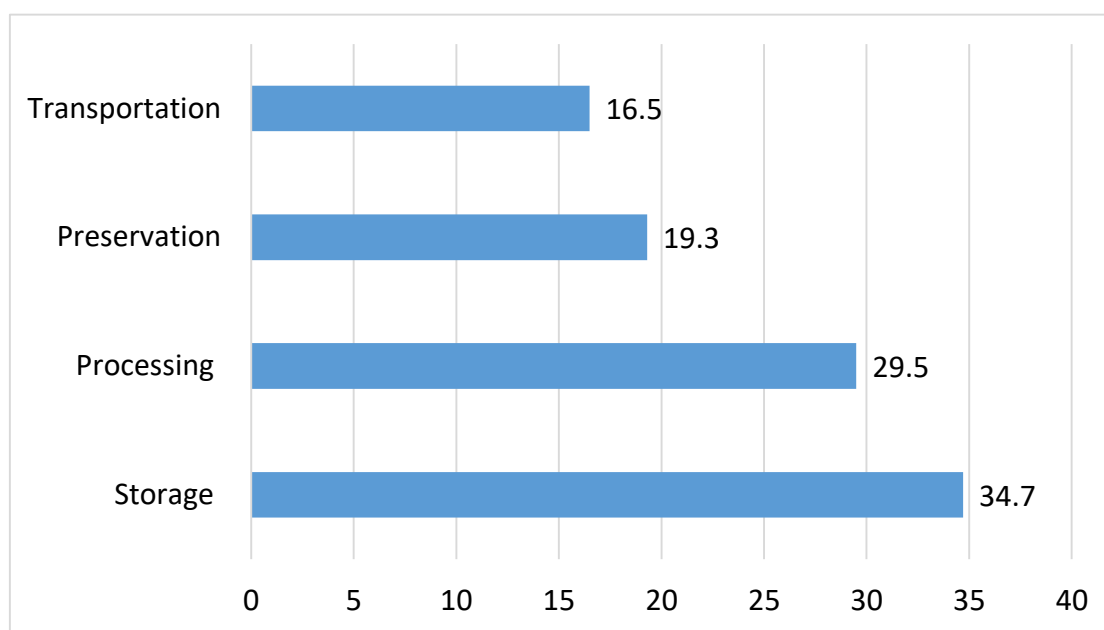


Figure 1: Awareness of Categories of Improved Postharvest Technologies

**Table 4: Improved Postharvest Technologies Identified by the Farmers**

S/N	Postharvest technologies	Frequency	%
A	Processing shed and fryer for cassava processing	76	15.4
B	Cellophane bags for the storage and marketing of farm produce	64	13.0
C	Purdue Improved Crop Storage (PICS) Bags	59	12.0
D	Silo	50	10.1
E	Hermetic container/drum	43	8.7
F	Improved warehouse for storage	38	7.7
G	Dryers for tomatoes and peppers	35	7.1
H	Solar dryer	29	5.9
I	Ventilated plastic crates	27	5.5
J	Multi-crop dryer machine	22	4.5
K	Evaporating coolant systems	17	3.4
L	Cold chain technology	15	3.0
M	Basket	7	1.4
N	Crib	6	1.2
O	Cassava peeling machine	1	0.2
P	Kernel breaker	1	0.2
Q	Maize dryer	1	0.2
R	Chemical for maize preservation	1	0.2

The result here can only suggest the predominance of rudimentary or traditional technologies among sampled farmers. Improved technologies for drying (solar & multi-dryer), peeling, cooling, and carriage are rarely used among respondents.

### Source of knowledge of the postharvest technologies among the farmers

Table 5 reveals that many respondents became aware of these technologies through agricultural extension workers (46.7%). This highlights the importance of agricultural extension workers (ADPs) and their crucial role in raising awareness about new postharvest technologies among farmers in the country. Moreover, approximately fifteen percent learned about postharvest technologies through other extension workers, who may not necessarily be ADP staff, and ten percent through their various farmer associations. Previous studies, such as Sinyolo et al. (2014) and

Asom et al. (2024), highlighted that farmers' contact with extension agents significantly impacted their adoption of improved postharvest and storage technologies.

### Provision of the postharvest technologies among the farmers

Regarding the agent or body that supplied technologies to the farmers (Table 6), a higher proportion of respondents claimed the technologies were provided by the ADPs (44.8%). Twenty-five percent of the respondents self-funded the postharvest technologies. Other bodies which funded the acquisition of the postharvest technologies include government agencies (6.9%), farmer associations (6.9%), other extension workers (5.7%), regional or international organisations (3.4%), non-governmental organisations (NGOs) (2.3%), and government officials (2.3%).

**Table 5: Source of Knowledge of the Postharvest Technologies among the Farmers**

S/N	Source of knowing about the Postharvest Technologies	Frequency*	%
a.	The ADPs	64	46.7
b.	Other extension workers	20	14.6
c.	Government representatives/politicians	6	4.4
d.	Farmer associations	14	10.2
e.	Radio/television/SMS	8	5.8
f.	Other farmers neighbours	6	4.4
g.	Cooperative groups	3	2.2
h.	Social media platform(s)	6	4.4
i.	Research institute (CRIN)	5	3.6
j.	Research institute (IITA)	1	0.7
k.	Research institute (NSPRI)	1	0.7
l.	Lecture room	1	0.7
m.	Research	1	0.7
n.	Self	1	0.7

\* NSPRI – Nigerian Stored Products Research Institute, \* CRIN – Cocoa Research Institute of Nigeria, \*IITA – International Institute of Tropical Agriculture

**Table 6: Sources of Acquisition of Improved Postharvest Technologies by Farmers**

S/N	Sources	Frequency	%
a.	The ADPs	39	44.8
b.	Self-funded	22	25.2
c.	Farmer associations	6	6.9
d.	Government agency	6	6.9
e.	Other extension workers	5	5.7
f.	Regional/international organizations	3	3.4
g.	Government officials/politicians	2	2.3
h.	NGOs	2	2.3
i.	Town	1	1.1
j.	NSPRI	1	1.1

There is a possibility that farmers may be unaware of the sources of some technologies but readily attribute them to the ADP officials, who are mostly the channel through which they got them. Some technologies from governments and a few NGOs are also deposited with the ADPs for user distribution. These may account for the increased percentage accrued to the ADPs. Notably, a quarter of respondents obtain technologies via out-of-pocket means. This can deter the adoption of technologies with high initial capital, such as improved crop dryers. It is therefore not surprising that cellophane and PICS bags emerged as the most widely adopted technologies in this study (Table 4), apart from cassava processing sheds and fryers, which are predominantly utilised collectively at the community level. The high acquisition cost remains a significant barrier to adopting improved postharvest technologies.

**Usage of postharvest technologies among the farmers**

Notably, the respondents' adoption level of postharvest technologies is relatively high. The present result shows that more than half of the sampled farmers employ one or more improved postharvest technologies (63.7%), while approximately 36 percent do not (Figure 2). This is expected to mitigate food losses, as enhanced technologies for curbing postharvest losses have drastically increased agricultural production in many developed countries (Stathers et al., 2020).

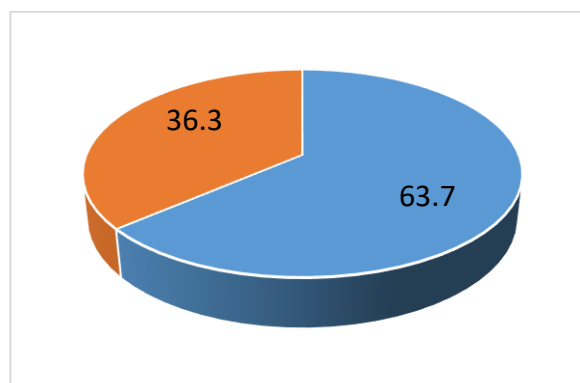


Figure 2: Usage of postharvest technologies among the farmers

**Reasons for non-usage of postharvest technologies**

The reasons for not using any of the improved PHTs, as reported by non-adopters, are presented in Table 7. The significant reasons reported include non-transparency in selecting beneficiaries of PHTs (19.3%). This mainly concerns technologies that were freely distributed to users in a community, either at the trial phase or as an act of benevolence from donors. Other reasons include the high cost of the technologies (16.9%), politicking/lobbying in technologies distribution (16.9%), and the inadequacy of the available technologies in terms of quantity (13.3%). These reasons have implications for technologies that were distributed to farmers. The result suggests a need to ensure fairness and transparency in selecting beneficiaries of any intervention to distribute resources to recipients effectively.

**Table 7: Reasons for non-usage of postharvest technologies**

S/N	Reasons for not using any of the postharvest technologies	Frequency	%
a.	I was/am not interested in the technology	3	3.6
b.	I was not selected	8	9.6
c.	The selection was not open/transparent	16	19.3
d.	I got to know late	5	6.0
e.	It didn't go around	11	13.3
j.	The technology is too expensive for me	14	16.9
k.	The technology is/was not in my own area of farming activity	3	3.6
l.	It was politicized	14	16.9
m.	Not aware/seen any postharvest technologies	7	8.4

**Specific postharvest technologies utilised by the farmers**

Table 8 presents the specific postharvest technologies utilised by respondents. Key specific PHTs used by respondents include PICS bags (23.1%), hermetic drums (22.1%), cellophane bags for storage and marketing (17.3%), cassava processing shed and fryer (13.5%). The high prevalence of these technologies'

usage could be partly attributed to easy accessibility and low acquisition cost.

**Level of adoption of the postharvest technologies among the farmers**

The farmers were asked to rate their level of adoption (continuous use after the initial time) of the postharvest technologies (Figure 3). Results show that the majority

of the farmers (47.4%) adopted the use of postharvest technologies, while 17 percent have an average level of adoption. However, only about 3 percent of the farmers have a low level of adoption, while only 2 percent never adopted any postharvest technologies.

**Table 8: Major postharvest technologies utilised by the respondents**

S/N	Technologies	Frequency	%
a.	PICS bags	24	23.1
b.	Hermetic containers/drums	23	22.1
c.	Cellophane bags for storage and marketing	18	17.3
d.	Cassava processing shed and fryer	14	13.5
e.	Cribs	8	7.7
f.	Silo	4	3.8
g.	Others	3	2.9
h.	Plant nut shelling machine	2	1.9
i.	Harvester machine	2	1.9
j.	Threshing machine	2	1.9
k.	Spraying machine	2	1.9
l.	Automated <i>garri</i> processing machine	1	1.0
m.	Flash dryer	1	1.0

This reveals a positive attitude towards the utilisation of the technologies. Consequently, many farmers will respond positively to postharvest technologies if made available and affordable. Responses such as this are bound to aid the transition of the agricultural sector from subsistence farming to a highly productive agro-industrial economy (McMichael, 2009).

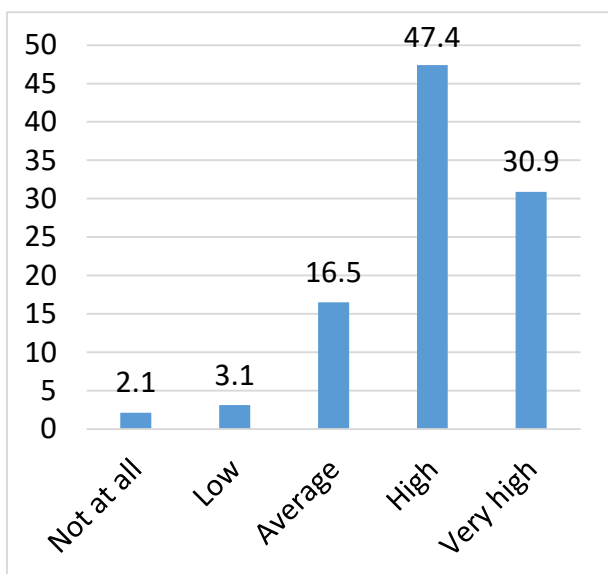


Figure 3: Level of adoption of postharvest technologies by the respondents

**Effectiveness of the technologies in reducing postharvest losses**

Improved technologies are very pivotal in the advancement of agriculture. Table 9 indicates the effectiveness of the postharvest technologies in minimising losses. Results indicate that almost all the surveyed farmers reveal that the improved postharvest technologies they have used effectively reduce wastage. This implies that the importance of technology in enhancing food security cannot be overlooked. This is consistent with the report of Kariyasa & Dewi (2013), which states that adopting new agricultural technologies, such as postharvest technologies, enhances food productivity. Additionally, Calicioglu et al. (2019) reported that the lack of technology adoption and poor postharvest practices were part of Nigeria's leading causes of food losses and waste. This suggests that postharvest losses can be drastically reduced if farmers and other concerned stakeholders adequately deploy technologies.

**Table 9: Effectiveness of the technologies in reducing postharvest losses**

Minimising postharvest losses	Frequency	%
Yes	90	97.8
No	1	1.1
Not really/unsure	1	1.1

**Reasons for discontinuing the use of improved postharvest technologies**

The study went further to assess why some initial adopters discontinued using such technologies (Table 10). Approximately 43 percent posit that the technologies are too expensive, while 19 percent maintain that they are unavailable in their areas. Meanwhile, 14 percent report that they are not freely provided. This finding agrees with a previous study, which reported that ignorance of technology existence, non-availability, and high cost were among the reasons for low adoption of improved postharvest technologies among farmers in Northern Nigeria (Debelo et al., 2020). Other reasons adduced by some of the respondents who have stopped using the postharvest technologies include maintenance issues (9.5%), non-durability of the technology (4.8%), absence of infrastructure to operate the technology (4.8%), and non-availability of workers to utilize the technology (4.8%).

**Table 10: Reasons for discontinuing the use of postharvest technologies**

S/N	Reasons	%
a.	It is too expensive to acquire	42.9
b.	It is not available for purchase in my area	19.0
c.	It is not freely provided	14.3
d.	Maintenance issues	9.5
e.	It was not durable	4.8
f.	No infrastructure to operate the technology	4.8
g.	No worker	4.8

**Motivation for the use of postharvest technologies**

Respondents highlighted several factors that can motivate farmers to use postharvest technologies. These include availability of the technology (16.8%), training (14.4%), durability (13.2%), and availability of spare parts (13.2%), which are critical factors. This is consistent with the result presented in Table 10. However, the primary motivation for stimulating the use of postharvest technologies among farmers is to make them widely available for purchase (Table 11).

**Table 11: Essential motivation to enhance the use of postharvest technologies**

S/N	What should be done to encourage farmers	Frequency	%
a	Technology should be widely available for purchase	102	16.8
b	There should be training on the usage	87	14.4
c	Providers should make spare parts available	80	13.2
d	The technology should be durable and strong	80	13.2
e	They should provide an adequate number of technologies in the community	79	13.0
f	They should be available to repair it when it has faults	72	11.9
g	Technology providers should provide the infrastructure to operate it	57	9.4
h	They should change/modify the parts to suit local climatic conditions	48	7.9
i	To produce at a lower price	1	0.2

**Improvement in the use of postharvest technologies among the farmers**

The results indicate that farmers recognise financial incentives and support mechanisms as key motivators for adopting postharvest technologies. Access to government grants (12.1%) and subsidisation of equipment (10.9%) were identified as the most influential factors, highlighting the importance of reducing upfront costs associated with improved technologies. Similarly, access to loans—particularly low-interest credit (10.6%), and the free distribution of storage bags (10.1%) were cited as critical enablers, reflecting the persistent challenge of liquidity constraints in smallholder farming systems (Table 12). These findings align with studies showing that cost and affordability are primary determinants of technology uptake, and that financial support, whether through subsidies, grants, or credit, significantly enhances adoption (Thiele et al., 2011; De Caires et al., 2024). In addition, access to loans has been recognised as one of the economic factors determining the adoption of agricultural technologies, including PHT (Mwangi & Kariuki, 2015). Interventions to improve farmers' access to credit, provide input subsidies, and distribute low-cost technologies can accelerate the adoption of postharvest innovations and reduce losses along the value chain.

**Table 12: Strategies for improving adoption of postharvest technologies**

S/N	Strategies	Frequency	%
a.	Access to government grants	100	12.1
b.	Subsidisation of farm equipment and its spare parts	90	10.9
c.	Access to loans	88	10.6
d.	Access to low-interest loans	88	10.6
e.	Free distribution of storage bags	84	10.1
f.	Free training and maintenance services for the technology	75	9.0
g.	Provision of mechanisation services at highly subsidised rates	71	8.6
h.	Provision of storage silos	68	8.2
i.	On-farm demonstrations of technologies	60	7.2
j.	Provision of storage trays	58	7.0
k.	Provision of subsidised cold chain	44	5.3
l.	Training	3	0.4

## Conclusion

Tackling postharvest losses is crucial to improving food security, especially in developing countries where the technologies to reduce losses are limited or unavailable. This study contributes to knowledge by providing comprehensive insights into the awareness, utilisation, and effectiveness of postharvest technologies among farmers. Findings reveal that affordable and accessible technologies, such as PICS bags, hermetic drums, and cellophane bags, dominate usage in Osun state due to their low acquisition cost and ease of availability. Most farmers reported continuous adoption, indicating a positive attitude toward postharvest innovations, which can significantly reduce losses and enhance food security when widely deployed.

The study also highlights key barriers, including high cost, unavailability, maintenance issues, and lack of infrastructure or skilled operators, corroborating earlier reports. Furthermore, farmers identified financial support mechanisms—such as grants, subsidies, affordable credit, and free input distribution—as strong motivators for adoption, consistent with recent literature emphasising affordability and access as critical determinants. Additionally, low awareness of specific technologies, particularly for transportation and preservation, underscores the need for improved extension services and innovative dissemination strategies.

Overall, these findings reinforce the pivotal role of postharvest technologies in reducing food losses and supporting the transition to a more productive and resilient agro-industrial economy.

## Recommendations

### 1. Enhance accessibility and affordability of postharvest technologies

Government and development partners should prioritise subsidisation of postharvest equipment and provide financial support mechanisms such as grants, low-interest credit, and input financing to reduce the cost barriers that currently limit adoption among smallholder farmers.

### 2. Strengthen awareness and capacity building programs

Extension services and farmer associations should implement targeted training and awareness campaigns on the benefits and proper use of diverse postharvest technologies, especially those for preservation and transportation, where awareness remains low.

### 3. Improve infrastructure and local availability of technologies

Policies should focus on creating rural-based distribution networks, promoting community-level processing and storage facilities, and ensuring the availability of spare parts and skilled operators to address the challenges of non-availability and maintenance.

Implementing these recommendations can significantly mitigate postharvest losses, improve farmers' livelihoods, achieve food security, and boost sustainable agricultural practices in Nigeria, particularly in Osun State.

## Limitation

This study served as a pilot survey for a larger national project and was primarily constrained by limited funding, which restricted the scope of sampling and prevented broader representation within the state.

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## References

- Adeyeye, S. A. O., Ashaolu, T. J., Bolaji, O. T., Abegunde, T. A., & Omoyajowo, A. O. (2023). Africa and the Nexus of poverty, malnutrition and diseases. *Critical Reviews in Food Science and Nutrition*, 63(5), 641-656.
- Adeyonu, A. G., Okunola, A., Alao, M. E., Oyawoye, E. O., & Okonkwo, C. E. (2021). An assessment of broiler value chain in Nigeria. *Open Agriculture*, 6(1), 296-307.
- Affognon, H., Mutungi, C., Sanginga, & P., Borgemeister, C. (2015). Unpacking postharvest Losses in Sub-Saharan Africa: A Meta-Analysis. *World Development*, 66, 49-68.
- Asom, T. S., Tingir J. I., & Ijirshar, V. U. (2024). Technology and Postharvest Losses of Tomatoes in Benue State. In book: *Policy and Development Issues in Nigeria: Festschrift in Honor of Professor Simeon Oko Ajegi* Available online: [https://bsum.edu.ng/journals/jesr/ProfOko/file\\_s/4.pdf](https://bsum.edu.ng/journals/jesr/ProfOko/file_s/4.pdf). Accessed on 25 July 2025.
- Bada, M. M., Mohammed, S. T., Shettima, B. G., Sambo, A. S., Abdulaziz, K., & Ghide, A. A. (2023). Effects of postharvest losses on poverty status of vegetable farming households in Kano State, Nigeria. *Journal of Agricultural*

- Economics, Environment and Social Sciences*, 9(2), 103- 118.
- Busari, A. O., Idris-Adeniyi, K.M., & Lawal A.O. (2015). Food Security and Postharvest Losses in Fruit Marketing In Lagos Metropolis, Nigeria. *Discourse Journal of Agriculture and Food Sciences*, 3(3), 52-58.
- Calicioglu, O., Flammini, A., Bracco, S., Bellù, L., & Sims, R. (2019). The future challenges of food and agriculture: An integrated analysis of trends and solutions. *Sustainability*, 11(1), 222.
- Chaaban, J., Chalak, A., Ismail, T., & Khedr, S. (2018). Agriculture, Water and Rural Development in Egypt: A Bottom-Up Approach in Evaluating European Trade and Assistance Policies. MEDRESET Working Papers No. 21.
- Danbaba, N., Idakwo, P. Y., Kassum, A. L., Bristone, C., Bakare, S. O., Aliyu, U., Kolo, I. N., Abo, M. E., Mohammed, A., Abdulkadir, A. N., Nkama, I., Badau, M. H., Kabaraini, M. A., Shehu, H., Abosede, A. O., & Danbaba, M. K. (2019). Rice postharvest Technology in Nigeria: An Overview of Current Status, Constraints and Potentials for Sustainable Development. *Open Access Library Journal*, 06(08), 1–23. <https://doi.org/10.4236/oalib.1105509>.
- De Caires, S., Smith, B. A., Atwell, M. A., & Wuddivira, M. N. (2024). Technological adoption framework for mitigating food insecurity in Caribbean Small Island Developing States: A bibliometric approach. *Tropical Agriculture*, 101(3), 340-368.
- Debelo, W. B., Minale, M., Fisha, H., Tedla, A., Eshetu, R., Jafar, M., & Wakgari, G. (2020). Review on roles and challenges of agricultural extension system on growth of agricultural production in Ethiopia. *Journal of Plant Sciences*, 8(6), 189-200
- Goletti F., and Wolff, C. (1999). The impact of postharvest research. MTID Discussion Paper No. 29. International Food Policy Research Institute (IFPRI). Available online: <https://cgspace.cgiar.org/server/api/core/bitstreams/74a917c8-d87f-4bdd-a6c4f19e3f3b4e0b/content>. Accessed 10-08-2025.
- Hodges, R.J., Buzby, J.C., & Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: Opportunities to improve resource use. *The Journal of Agricultural Science*, 149, 37-45. 10.1017/S0021859610000936.
- Isaacs, K. B., Snapp, S. S., Chung, K., & Waldman, K. B. (2016). Assessing the value of diverse cropping systems under a new agricultural policy environment in Rwanda. *Food Security*, 8(3), 491-506.
- Kaminski, J., & Christiaensen, L. (2014). Postharvest loss in sub-Saharan Africa—what do farmers say? *Global Food Security*, 3(3-4), 149-158.
- Kariyasa, K., & Dewi, Y. A. (2013). Analysis of factors affecting adoption of integrated crop management farmer field school (icm-ffs) in swampy areas. *International Journal of Food and Agricultural Economics*, 1(2), 29-38.
- Kaur, R., & Watson, J. A. (2024). A scoping review of postharvest losses, supply chain management, and technology: implications for produce quality in developing countries. *Journal of the ASABE*, 67(5), 1103-1131
- Kayode, E., Yusuf, A., Bello, I., & Ajayi, F. (2022). Postharvest Losses-The Bane of An Agripreneuership: An Overview. Proceedings of the 64th Annual Conference of Association of Deans of Agriculture in Nigeria Universities (ADAN), Keffi 2021. [https://www.researchgate.net/profile/Ayodeji-Kayode4/publication/366463491\\_P64\\_2\\_1/links/63a28b2f51f6c723c6b6bcdf/P64-2-1.pdf](https://www.researchgate.net/profile/Ayodeji-Kayode4/publication/366463491_P64_2_1/links/63a28b2f51f6c723c6b6bcdf/P64-2-1.pdf)
- Lamidi, W.A & Akande, L.O. (2013). A Study of Status, Challenges and Prospects of Agricultural Mechanization in Osun State, Nigeria. *Journal of Education, Arts and Humanity*, 1,1-8.
- Liambee, D. H., & Onu, J. I. (2022). Estimates of postharvest Losses among Smallholder Rice Farmers in Benue State, Nigeria. *Indiana Journal of Agriculture and Life Sciences*, 2(3), 13-17.
- McMichael, P. (2009). Banking on agriculture: a review of the World Development Report 2008. *Journal of agrarian change*, 9(2), 235-246.
- Morgan, A. E., & Fanzo, J. (2020). Nutrition transition and climate risks in Nigeria: moving towards food systems policy coherence. *Current Environmental Health Reports*, 7(4), 392-403.
- Mounika, K., Reddy, P. P., Singh, R. P., Pandey, A., Bharty, S. K., Kumar, A., ... & Jain, S. (2025). Postharvest technologies and cold chain management: A review. *Plant Archives*, 25(1), 3275- 3283.

- Mwangi M & Kariuki S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. *Journal of Economics and Sustainable Development* 6(5), 208-216.
- Ogundele, F. (2022), Postharvest losses and food security in Nigeria: an empirical review. *African Journal of Agriculture and Food Science* 5(3), 77-89. [10.52589/AJAFSC0442Z7J](https://doi.org/10.52589/AJAFSC0442Z7J).
- Ohagwu, V. A., Onwubuya, E. A., & Nwobodo, C. E. (2021). Enterprise training needs of poultry farmers during covid-19 pandemic in Enugu State, Nigeria. *Journal of Agricultural Extension*, 26(1), 129-137.
- Popkin, B. M. (2006). Technology, transport, globalization and the nutrition transition food policy. *Food policy*, 31(6), 554-569.
- Sinyolo, S., Mudhara, M., and Wale, E. (2014). The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA*, 40(1), 145–156.
- Stathers, T., Holcroft, D., Kitinoja, L., Mvumi, B. M., English, A., Omotilewa, O., ... & Torero, M. (2020). A scoping review of interventions for crop postharvest loss reduction in sub-Saharan Africa and South Asia. *Nature Sustainability*, 3(10),821-835.<https://doi.org/10.1038/s41893-020-00622-1>
- Thiele, G., Devaux, A., Reinoso, I., Pico, H., Montesdeoca, F., Pumisacho, M., ... & Horton, D. (2011). Multi-stakeholder platforms for linking small farmers to value chains: evidence from the Andes. *International Journal of Agricultural Sustainability*, 9(3), 423-433.
- Tomlins, K., Bennett, B., Stathers, T., Linton, J., Onumah, G., Coote, H., ... & Bechoff, A. (2016). Reducing postharvest losses in the OIC member countries. *COMCEC Agricultural Working Group*, 1-194.<http://gala.gre.ac.uk/id/eprint/16153>.
- United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development (A/RES/70/1). General Assembly. <https://docs.un.org/en/A/res/70/1>
- Zorya, S., Morgan, N., Diaz Rios, L., Hodges, R., Bennett, B., Stathers, T., ... & Lamb, J. (2011). Missing food: the case of postharvest grain losses in sub-Saharan Africa. <http://gala.gre.ac.uk/id/eprint/10385>.