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Barriers to Impact: Examining the Effects of Postharvest Technologies and Constraints to Their Utilization in Cassava Farming in Otukpo, Nigeria

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Abstract: *Cassava postharvest losses remain a major challenge for smallholder farmers in Otukpo Local Government Area (LGA) of Benue State, Nigeria. Despite the introduction of various postharvest technologies, many farmers continue to suffer spoilage, quality deterioration, and income loss. This study investigates the relationship between technology adoption, access to information, and cassava postharvest loss reduction. Data were collected from 384 cassava farmers through structured questionnaires and key informant interviews. Findings revealed moderate adoption of mechanized pulverizers (32.6%) and vibrating sieves (29.5%), while solar dryers (7.2%) and other advanced options remain underutilized. Awareness was highest for simple storage solutions like scaled polythene bags (61.5%), but much lower for mechanized equipment. Major constraints include high equipment costs (27.7%), inadequate storage infrastructure (18.3%), and limited access to information (7.6%). Statistical analysis showed strong positive correlations between farmers' education (r = 0.916) and income levels (r = 0.907) and their capacity to manage postharvest losses. The study concludes that reducing cassava losses requires not only technology availability but also improved access to information, financial support, and infrastructure development.*

Keywords: cassava postharvest losses, technology adoption, information access, food security, rural development

INTRODUCTION

Postharvest losses remain a critical challenge to food security and agricultural sustainability in sub-Saharan Africa. According to the Food and Agriculture Organization (FAO, 2021), up to 40% of staple crops are lost postharvest due to inadequate storage, poor handling, and limited market access. Cassava (*Manihot esculenta Crantz*), a staple crop for over 800 million people globally, is especially vulnerable to these losses because of its rapid postharvest deterioration (Ayadele, Oladele, & Adeoye, 2021). In Nigeria—the world's largest cassava producer—postharvest losses reduce both food availability and farmer incomes (Otekunrin et al., 2021; FAO, 2023).

Various postharvest technologies, such as motorized graters, hydraulic presses, solar dryers, and improved packaging, have been introduced to reduce spoilage and enhance cassava processing (Munyua & Adera, 2022). In addition, digital tools are increasingly being used to provide farmers with information on best practices for storage, processing, and marketing (Okunola, Olawuyi, & Adeyemi, 2021; Nweke, Egesi, & Manyong, 2023). However, the adoption of these technologies at the community level remains low, particularly in rural areas such as Otukpo Local Government Area (LGA) in Benue State, Nigeria (Ochej et al., 2022).

This study aims to examine the role of postharvest technologies in reducing cassava losses in Otukpo while exploring the barriers that limit their adoption. Specifically, the research assessed the availability of postharvest technologies, investigated the causes of postharvest losses, evaluated farmers' mitigation strategies, and analyzed the constraints hindering technology utilization. By addressing these issues, the study seeks to provide actionable insights to policymakers, agricultural extension agencies, and rural development stakeholders, ultimately contributing to reduced cassava losses, improved farmer incomes, and enhanced food security in the region.

Cassava (*Manihot esculenta Crantz*) is a major staple in sub-Saharan Africa, but postharvest losses (PHL) remain a significant challenge due to its rapid physiological deterioration within 24–72 hours after harvest (Siritunga & Sayre, 2020; Okoye et al., 2023). These losses result in heightened food insecurity and reduced income for smallholder farmers (Adebayo et al., 2022). Available postharvest technologies—such as motorized graters, hydraulic presses, solar dryers, and improved storage systems—have been developed to mitigate spoilage, reduce labor intensity, and extend shelf life (Chukwu et al., 2022; Ogunyinka & Oguntuase, 2020). However, adoption remains low due to high costs, poor infrastructure, and limited awareness (Adejumo et al., 2020; Nwafor et al., 2023).

Information dissemination through extension services, mobile phones, and farmer cooperatives plays a pivotal role in promoting technology use, but rural farmers often face barriers such as digital illiteracy and unreliable internet connectivity (Eze et al., 2022; Muriithi & Matz, 2022). Furthermore, cultural preferences for traditional processing methods and inadequate market linkages further constrain adoption (Olowosegun & Akinbode, 2022). The modernization theory provides a useful framework for understanding this gap, emphasizing the need for technology

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transfer, infrastructural development, and behavior change to reduce cassava postharvest losses (Moore, 1966; Seibel, 2006).

MATERIALS AND METHODS

Study Area and Population

This study was conducted in Otukpo Local Government Area (LGA) of Benue State, Nigeria. Otukpo is located in the southern part of Benue State and serves as the administrative and commercial hub of the Idoma ethnic group. Geographically, it lies between latitude 7°13'N and longitude 8°07'E (BNARDA, 2025). The population of Otukpo LGA is estimated at over 350,000 (NPC, 2023). Agriculture is the dominant livelihood, with cassava being a major staple and cash crop. Despite favorable climatic conditions, the area experiences high postharvest losses due to poor storage, limited mechanization, and inadequate access to modern postharvest technologies (Benue ADP, 2022; PIND Foundation, 2021). Government extension services are available through BNARDA and NGOs, but coverage remains limited. Cultural factors and gender roles also shape agricultural practices, with women playing central roles in cassava processing and marketing (FAO, 2021).

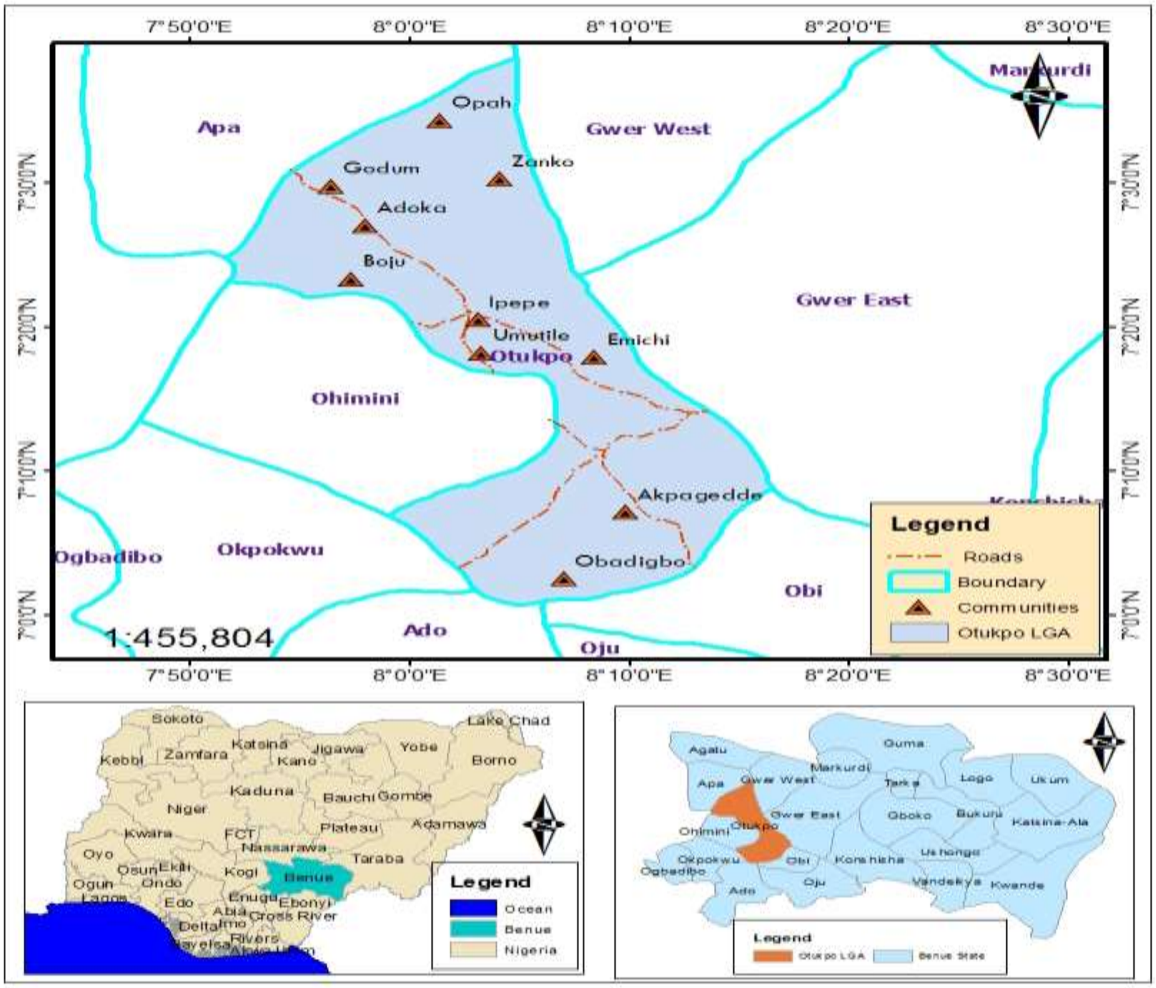

Figure:1. The Study Area
Source: GIS and Remote Sensing Software, ABU, Zaria

The study population comprised all cassava farmers in Otukpo LGA, including men, women, and youths involved in cassava cultivation, processing, and marketing. Given the large and undefined number of cassava farmers in the area, Smith's (2013) formula for large and unknown populations was applied to determine the sample size. Using a 95% confidence level and a 5% margin of error, a sample size of 384 respondents was obtained. Otukpo was stratified into three major cassava-producing clusters: Otukpo Town, Adoka Area, and Ogobia/Upu Area. The snowball sampling technique was employed, beginning with known cassava farmers who then referred other farmers until the sample size was achieved.

Method of Data Collection

Data collection drew on both primary and secondary sources. Primary data were obtained through structured and semi-structured questionnaires as well as interviews. A total of 400 questionnaires were administered, covering sections on socio-demographic characteristics, availability of postharvest technologies, causes of postharvest losses, strategies for minimizing losses, and the effects of technology use. In addition, twelve (12) key informant interviews were conducted with local leaders, agricultural officers, and experienced farmers, providing in-depth perspectives on constraints affecting technology adoption. Twelve trained research assistants were recruited to support questionnaire administration and interviews, ensuring cultural sensitivity and broad coverage of the study area.

Data Analysis

Quantitative data were analyzed using descriptive statistics (percentages and frequencies) and inferential statistics (Chi-square tests) with SPSS Version 21. These facilitated hypothesis testing, including the relationships between cassava farmers' income, education levels, and postharvest losses. Qualitative data from interviews were transcribed and analyzed thematically to complement the quantitative findings and provide context to farmers' experiences and perceptions regarding technology use and postharvest losses.

Results and Discussion

A total of 384 cassava farmers in Otukpo, Benue State, participated in this study, representing a 96% response rate. Respondents were predominantly male (61.9%) and aged 35 years and above (51.2%). Nearly half (48.3%) had only primary education, while 58.2% earned below ₦10,000 monthly, reflecting economic limitations that may constrain technology adoption. In contrast, key informants were younger, more gender-balanced, and better educated, with 41.7% holding tertiary education.

Analysis of postharvest technologies showed that mechanized pulverisers (32.6%) and vibrating sieves (29.5%) were the most commonly used cassava-processing tools. Hydraulic presses were adopted by 22.2%, while motorized graters and peelers accounted for 8.4%. The least utilized were solar dryers and kiln dryers (7.2%). Awareness of technologies also varied, with scaled polythene bags for storage having the highest awareness level (61.5%), while awareness of mechanized chopping and drying technologies remained below 40%.

The main causes of postharvest losses included improper handling during harvest (33%), transportation difficulties due to poor infrastructure (29%), and lack of immediate market access (22%). Microbial spoilage (9%) and physiological deterioration (7%) were also reported.
Farmers adopted several strategies to minimize losses. The most common was processing cassava into durable byproducts such as chips, garri, and starch (48.3%). Others emphasized the need for improved market access (27.2%), better storage facilities (10%), feeder road construction (7.5%), and establishment of local processing industries (6.5%).

Available technologies contributed to reducing postharvest losses by expanding marketing networks (22.2%), extending product shelf life (21.9%), and promoting better processing practices (20.4%). However, farmers still faced significant constraints, including high costs of equipment

and facilities (27.7%), inadequate storage (18.3%), poor transportation infrastructure (17.5%), and limited access to processing technologies (17%).
Statistical analysis revealed strong positive relationships between education ($r = 0.916, p < 0.001$), income ($r = 0.907, p < 0.001$), and farmers' capacity to manage postharvest losses.

Table 1: Utilization of Available Postharvest Technologies by Cassava Farmers in Otukpo

Postharvest Technology	Frequency (N=384)	%	Rank
Mechanized/Improved Pulveriser for Chopping Cassava	125	32.6	1st
Vibrating Sieve for Sieving Products	113	29.5	2nd
Hydraulic Press/Screw Jack for Dewatering Cassava	85	22.2	3rd
Motorized Grater/Mechanical Peeler	33	8.4	4th
Upgraded Roaster/Solar Dryer/Kiln or Oven Dryer	28	7.2	5th

Source: Field Survey, 2025

Table 1 findings indicate that the mechanized pulveriser is the most utilized postharvest technology among cassava farmers in Otukpo (32.6%). This suggests a preference for technologies that simplify the initial stages of cassava processing, particularly chopping, which is traditionally labour-intensive and time-consuming. By reducing drudgery and improving efficiency, pulverisers directly address one of the most critical constraints faced by smallholder farmers (Abdoulaye et al., 2014). The vibrating sieve, with 29.5% usage, also highlights farmers' focus on enhancing product quality and consistency through better separation of cassava fractions. This aligns with Scott et al. (2015), who emphasized that quality improvement technologies are increasingly valued in cassava processing due to rising consumer expectations. However, the adoption of other technologies such as hydraulic presses (22.2%), motorized graters (8.4%), and solar dryers (7.2%) remains low. Several reasons may account for this trend.

Financial barriers remain a major limitation, as most respondents earn less than ₦10,000 monthly, making investment in advanced technologies difficult (Churi et al., 2012). Technical knowledge gaps and inadequate extension support also hinder adoption, with many farmers lacking exposure to or training in modern equipment handling (Adegbola & Bamishaiye, 2010). The limited availability of these technologies within local markets further restricts accessibility.

The low usage of solar dryers and kilns is particularly concerning since drying is critical to extending shelf life and reducing microbial spoilage in cassava (FAO, 2020). This finding underscores a paradox: although farmers are aware of postharvest losses caused by poor drying, they still rely heavily on traditional sun drying, which is weather-dependent and often inefficient. As noted by Onumah et al. (2019), the limited adoption of drying technologies across sub-Saharan Africa is not only a function of cost but also of cultural preference for traditional methods, which are often perceived as sufficient despite their inefficiencies.

Additionally, socio-cultural and gender dynamics may influence technology adoption. Women, who dominate cassava processing in Otukpo, often have limited financial autonomy to purchase equipment, even when they are the primary users (FAO, 2021). This gendered access constraint reinforces reliance on rudimentary tools and traditional practices, thereby perpetuating higher postharvest losses.

The findings also reflect broader structural issues, such as inadequate rural infrastructure. Poor transportation networks discourage investment in advanced processing technologies since farmers still struggle to get products to markets before spoilage occurs (Nweke, 2013). Similarly, the absence of organized cooperative systems limits collective investment in shared facilities, which could otherwise make modern technologies more affordable and accessible.

In summary, while mechanized pulverisers and vibrating sieves are relatively well adopted in Otukpo, the low uptake of drying and pressing technologies reveals critical gaps in the cassava value chain. Addressing financial, infrastructural, and gender-related barriers is essential to promote wider adoption of postharvest technologies that can substantially reduce losses and improve food security in the area.

Table 2: Level of Farmers' Awareness of Postharvest Technologies

Technology	**Aware (N)**	**% Aware**	**Not Aware (N)**	**% Not Aware**
Mechanized Pulveriser for Chopping Cassava	149	38.9%	235	61.1%
Hydraulic Press/Screw Jack for Dewatering	215	56.1%	169	43.9%
Vibrating Sieve for Sieving Products	161	42.0%	223	58.0%
Upgraded Roaster/Solar Dryer/Kiln/Oven Dryer	149	38.9%	235	61.1%
Motorized Grater/Mechanical Peeler	205	55.5%	179	46.5%
Scaled Polythene Bags for Storage	255	61.5%	129	38.5%

Source: Field Survey, 2025

Awareness levels vary significantly across technologies. Scaled polythene bags for storage recorded the highest awareness (61.5%), likely due to their affordability, accessibility, and widespread use beyond cassava processing. Farmers often repurpose polythene bags from other household activities, making them familiar and easy to adopt. This indicates that cost-effective and easily available technologies tend to diffuse more rapidly among rural communities (Adeoti, 2009).

In contrast, awareness of mechanized pulverisers (38.9%), solar dryers (38.9%), and vibrating sieves (42.0%) remains limited. This gap reflects the restricted visibility of these technologies within rural areas, as they are often confined to pilot projects or small-scale demonstrations that do not reach a wider audience. Similar findings were reported by Mhlanga and Gatsi (2014), who noted that awareness of modern processing tools in sub-Saharan Africa is typically highest in urban or semi-urban zones but relatively low in rural farming communities.

The relatively higher awareness of hydraulic presses (56.1%) and motorized graters (55.5%) may be attributed to their visible roles in community-level cassava processing hubs, where groups of farmers come together to process large volumes of tubers. These technologies are often promoted through cooperative societies, donor-funded agricultural projects, and extension agents, which makes them more recognizable to rural farmers (Voh, 2014; Daudu et al., 2013). This suggests that clustering technologies around shared facilities is an effective strategy for raising awareness and encouraging gradual adoption.

The findings also highlight that lack of awareness is a key barrier to technology adoption. Without knowledge of the existence, benefits, and operational requirements of these technologies, farmers are unlikely to consider them, regardless of affordability or availability. This supports the need for targeted extension services, farmer field schools, and practical demonstrations to bridge the awareness gap (Ezeh, Anyanwu, & Madukwe, 2016). Information dissemination through farmer cooperatives, local radio programmes, and mobile phone platforms could also enhance exposure to available technologies.

Moreover, awareness alone does not always translate into adoption. As noted by Adebayo et al. (2022), farmers may be aware of a technology but fail to adopt it due to financial, infrastructural, or cultural barriers. Therefore, awareness campaigns must be integrated with strategies that address affordability (through subsidies or credit schemes), accessibility (through rural infrastructure development), and acceptability (through gender-sensitive and culturally relevant training).

In conclusion, while awareness of simple, low-cost technologies like polythene bags is relatively high, more advanced but critical postharvest technologies such as pulverisers, solar dryers, and vibrating sieves remain poorly known among cassava farmers in Otukpo. Strengthening extension systems, promoting cooperative-based processing centers, and integrating local media in awareness campaigns are vital steps toward bridging this gap and ensuring broader adoption of technologies that can significantly reduce postharvest losses.

Table 3: Causes of Postharvest Losses of Cassava in Otukpo

Cause of Loss	Frequency (N=384)	%
Improper Handling during Harvest	125	33.0
Transportation Challenges	113	29.0
Lack of Market for Cassava	85	22.0
Microbial Spoilage	33	9.0
Physiological Deterioration (PPD)	28	7.0

Source: Field Survey, 2025

The primary causes of postharvest losses in cassava in Otukpo were identified as improper handling during harvest (33%) and transportation challenges (29%). Both factors contribute significantly to mechanical damage, bruising, and accelerated physiological deterioration of cassava roots, which typically begin to spoil within 24–72 hours after harvest. These findings are consistent with Okwulehie et al. (2014), who emphasized that inadequate rural infrastructure, such as poor feeder roads and lack of proper harvesting tools, increases vulnerability to postharvest losses. Similarly, Abass et al. (2014) highlighted that cassava roots are particularly prone to spoilage when subjected to rough handling and long-distance transportation without cushioning or protective packaging.

Market unavailability (22%) was also a major cause, suggesting that farmers often struggle to dispose of cassava quickly. Since fresh cassava has a short shelf life, any delays in marketing result in deterioration and financial losses. This aligns with the observations of Forsythe et al. (2016), who found that weak market linkages and lack of timely buyers often compel farmers either to sell at low prices or to abandon part of their harvest. In Otukpo, where market facilities are limited and price fluctuations are common, farmers face an increased risk of postharvest losses.

Microbial spoilage (9%) and physiological deterioration (7%) were reported as secondary causes. These outcomes, though less frequent, further exacerbate cassava wastage. Microbial spoilage often arises from contamination during peeling, grating, or storage, particularly when hygiene practices are poor (Oyeyinka et al., 2019). Physiological deterioration, on the other hand, is an inherent biological challenge of cassava tubers that can be slowed but not entirely eliminated. Technologies such as waxing, high relative humidity storage, and cassava varieties with delayed postharvest physiological deterioration (PPD) have shown promise in mitigating these losses (Sayre et al., 2011; Tumuhimbise et al., 2014).

Overall, the results underscore that cassava postharvest losses in Otukpo are driven largely by mechanical and infrastructural challenges rather than biological causes. Addressing these issues requires a multi-pronged approach: promoting improved harvesting tools and techniques, investing in rural road infrastructure, and strengthening market linkages to reduce delays between harvest and sale. Farmer cooperatives and aggregation centers could also play a vital role by pooling produce, coordinating transport, and attracting bulk buyers, thereby minimizing the risks of spoilage.

Table 4: Strategies Adopted by Farmers to Reduce Postharvest Losses

Strategies	Frequency (N-384)	%
Provision of Integrated Markets	104	27.2
Processing into Chips, Garri, Starch, etc.	185	48.3
Provision of Modern Storage Facilities	40	10.0
Construction of Good Feeder Roads	30	7.5
Establishment of Local Processing Industries	25	6.5

Source: Field Survey, 2025

Farmers' dominant strategy for mitigating postharvest losses is processing cassava into byproducts (48.3%), particularly garri, chips, flour, and starch. This strategy is effective because it transforms highly perishable cassava roots, which begin deteriorating within 24–72 hours after harvest, into shelf-stable products that can be stored, transported, and marketed over longer periods. This aligns with FAO (2020), which identifies value addition as one of the most practical strategies for reducing food losses in root and tuber crops. Similarly, Abass et al. (2018) emphasize that processing not only reduces wastage but also enhances household income and food security by creating multiple streams of marketable products.

The creation of integrated markets (27.2%) and provision of modern storage facilities (10%) also emerged as significant strategies. Integrated markets, by bringing together producers, traders, and consumers, can reduce the time lag between harvest and sale, thereby lowering spoilage. Studies in Nigeria by Okoye et al. (2016) highlight that structured market systems with better price information and aggregation centers significantly reduce farmers' reliance on informal, fragmented outlets. Modern storage facilities, though less frequently mentioned, offer critical support for short-term preservation. Improved storage techniques such as high relative humidity chambers, polyethylene packaging, and cold storage have been tested with success in extending cassava shelf life (Tumuhimbise et al., 2014). However, their adoption remains low due to cost and lack of technical expertise.

Interestingly, road construction (7.5%) and local processing industries (6.5%) are less frequently mentioned by farmers, despite their critical importance to long-term postharvest loss reduction. Poor rural road networks in Otukpo limit farmers' access to markets and increase transport-related losses. Investing in road infrastructure has been shown to significantly reduce agricultural losses and transaction costs, as noted by Dorosh et al. (2012). Similarly, establishing local processing industries would decentralize cassava processing, reduce transport burdens, and create rural employment opportunities (Adebayo et al., 2022). The low prioritization of these infrastructural solutions by farmers may reflect their limited capacity to directly influence such interventions, which typically fall under government and institutional responsibility.

Overall, the findings suggest that while farmers in Otukpo are proactive in adopting immediate, household-level strategies like processing, broader structural solutions such as storage infrastructure, market integration, and road networks remain underemphasized. This indicates a gap between what farmers can control individually and what requires collective or government-driven investment. Bridging this gap through public-private partnerships, farmer cooperatives, and policy support will be essential for sustainable postharvest loss reduction.

Table 5: Effect of Postharvest Technologies on Cassava Loss Reduction

Effect of Technologies	Frequency (N=384)	%
Increased Marketing Network	85	22.2
Extended Shelf Life and Microbial Stability	85	21.9
Increased Adoption of Processing and Storage Techniques	78	20.4
Improved Hygiene and Modern Packaging Practices	61	15.9
Increased Industrial Production of High-Quality Cassava Flour	45	11.7
Increased Production of Convenient Cassava Food Forms	30	7.8

Source: Field Survey, 2025

Respondents identified multiple positive effects of using postharvest technologies. The most reported benefits include increased marketing networks (22.2%) and extended shelf life of cassava products (21.9%), both of which are critical for reducing spoilage and enhancing farmer income. Improved market access suggests that postharvest technologies enable farmers to move beyond subsistence-level production and participate in wider value chains. This is consistent with Abass et al. (2018), who argue that adoption of postharvest innovations creates linkages between smallholder farmers and emerging agribusiness markets.

Adoption of improved processing methods (20.4%) and hygiene practices (15.9%) further reflect growing awareness of quality standards in cassava processing. These outcomes are particularly important given the increasing demand for safe, standardized food products in both domestic and export markets (Okoye et al., 2016). The integration of hygiene practices reduces contamination risks, enhances consumer confidence, and aligns with global food safety regulations.

However, only 11.7% reported increased industrial production of high-quality cassava flour (HQCF), underscoring that commercial-scale cassava processing is still limited in Otukpo. This resonates with Nweke (2019), who observed that the HQCF sector in Nigeria has faced challenges related to inadequate investment in large-scale processing facilities, inconsistent quality supply, and weak policy enforcement on industrial cassava utilization. The relatively low industrial uptake highlights a structural gap: while farmers benefit at a local scale from technologies, broader industrial transformation remains constrained by infrastructure, financing, and technical capacity (Msuya et al., 2020).

These findings suggest that while available technologies are making measurable contributions to improving cassava handling, processing, and marketing, their potential remains underutilized. Enhancing farmer training, promoting farmer–processor linkages, and expanding credit access for technology adoption could strengthen these benefits. Moreover, government and private sector collaboration in establishing industrial-scale processing hubs would accelerate the transition from localized improvements to sustainable, large-scale transformation of the cassava value chain.

Table 6: Constraints to the Utilization of Postharvest Technologies

Constraint	Frequency (N=384)	%
High Cost of Facilities	106	27.7
Poor Storage Facilities	70	18.3
Poor Transportation Infrastructure	67	17.5
Lack of Processing Technologies	65	17.0
High Cost of Power/Electricity	29	7.6
Non-Availability of Technologies	30	7.6
Inadequate Marketing Channels	17	4.4

Source: Field Survey, 2025

The primary constraint to postharvest technology utilization is the high cost of facilities (27.7%), reflecting the financial limitations commonly faced by smallholder farmers. As noted by Voh (2014), most rural farmers operate at subsistence levels and lack the capital required to invest in mechanized or modern postharvest equipment. Without affordable credit facilities or cooperative financing systems, these farmers remain dependent on rudimentary and labour-intensive methods. Other significant barriers include poor storage facilities (18.3%), transportation problems (17.5%), and lack of processing technologies (17.0%). These challenges are interconnected: poor storage increases spoilage, while inefficient transportation systems exacerbate postharvest losses by delaying market delivery. Chikoye et al. (2016) also emphasize that limited rural infrastructure contributes to high transaction costs, discouraging farmers from adopting technologies even when they are aware of their benefits.

Infrastructure-related constraints such as high electricity costs (7.6%) and poor marketing channels (4.4%) further limit technology utilization. Reliable energy supply is critical for running motorized graters, dryers, and presses, yet electricity access in rural Nigeria remains irregular and expensive (Nwankwo et al., 2019). Similarly, poor market linkages restrict incentives for adoption, since farmers often lack assured outlets for their processed products.

These findings indicate that even where awareness exists, socio-economic and infrastructural challenges prevent full adoption and utilization of postharvest innovations (Churi et al., 2012; FAO, 2020). Addressing these barriers requires a multi-pronged strategy that includes the provision of affordable financing mechanisms, investment in rural infrastructure (roads, energy, and storage facilities), and the creation of stronger farmer–market linkages. Extension services should also play a key role in demonstrating the economic returns of postharvest technologies, thereby motivating adoption despite initial cost barriers.

CONCLUSION

This study, titled *"Barriers to Impact: Examining the Effect of Postharvest Technologies and Constraints to Their Utilization in Cassava Farming in Otukpo, Nigeria"*, has provided critical insights into the interplay between technology awareness, availability, and utilization in cassava postharvest management.

Findings reveal a mismatch between awareness and practical adoption. While farmers are familiar with simpler technologies like scaled polythene bags, more advanced options—such as mechanized pulverisers, vibrating sieves, and solar dryers—remain underutilized due to cost, infrastructural challenges, and limited extension support. Improper handling during harvest, poor transportation infrastructure, and market bottlenecks emerged as the leading drivers of postharvest losses, compounded by cassava's rapid physiological deterioration and microbial spoilage.

Farmers have proactively adopted coping strategies, especially processing cassava into more durable byproducts such as garri, starch, and chips. However, their efforts are constrained by inadequate processing capacity, lack of local industries, and insufficient rural infrastructure. Importantly, hypothesis testing confirmed that education and income levels significantly influence the ability of farmers to adopt postharvest innovations and mitigate losses, pointing to strong socio-economic determinants of technology use.

Overall, while postharvest technologies have improved aspects of cassava preservation and marketing, the sector remains limited by financial, infrastructural, and educational barriers. Sustainable solutions will require coordinated interventions in education, financing, infrastructure development, and policy reforms to enhance farmer resilience, reduce losses, and strengthen cassava's role in food security and rural livelihoods.

Recommendations

1. Improve Farmers' Access to Postharvest Technologies: Introduce subsidized credit schemes, low-interest loans, and grants to reduce the financial burden of acquiring equipment. Support local fabricators to produce low-cost, farmer-friendly postharvest equipment.
2. Strengthen Farmer Education and Extension Services: Revitalize agricultural extension programmes with a stronger emphasis on postharvest handling, storage, and value addition.
3. Upgrade Infrastructure for Cassava Value Chains: Rehabilitate rural roads to reduce transportation delays and minimize mechanical damage during haulage. Provide affordable, decentralized storage solutions such as hermetic bags, low-cost dryers, and community warehouses.
4. Expand Market Linkages and Supportive Policies: Strengthen public–private partnerships (PPPs) to mobilize investment into rural agro-industrial development and postharvest infrastructure.
5. Address Socio-Economic Barriers: Implement inclusive programs that target low-income and less-educated farmers to ensure equitable technology adoption. Encourage community-based savings and cooperative groups as vehicles for pooling resources for technology acquisition.

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