



IMPACT OF POSTHARVEST LOSSES ON MARKET FORCES AMONG SMALLHOLDER CASSAVA FARMERS: EVIDENCE FROM SOUTHEASTERN NIGERIA

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Abstract

The major objective of this study was to examine the impact of postharvest losses on market forces among smallholder cassava farmers: Evidence from southeastern Nigeria. Survey research design was adopted. The population of the study was smallholder cassava farmers in Southeast, Nigeria. The source of data was primary data. Total of 385 copies of questionnaires were distributed using a convenience sampling technique, out of which 288 valid responses were retrieved and used for analysis. Data collected were analyzed using simple linear regression analysis through Statistical Package for the Social Sciences (SPSS) version 27. The results showed that poor and inadequate storage facilities on food commodity demand; poor transportation networks on food commodity demand; poor postharvest handling mechanism on food commodity demand; poor and inadequate storage facilities on food commodity supply; poor transportation networks on food commodity supply and poor postharvest handling mechanism on food commodity supply were positively significant. The researchers ultimately concluded that serious efforts need to be made to establish adequate infrastructure to reduce food price increases among consumers and reduce post-harvest losses. Based on the findings, recommendations were made such as the issue of poor and inadequate storage facilities should be addressed appropriately, the issue of poor transportation networks should be addressed, and the issue of poor post-harvest processing mechanisms should be appropriately addressed, as it was found that adequate infrastructure if provided for smallholder cassava farmers would help reduce postharvest losses to the barest minimum and in turn reduce food prices among consumers.

Keywords: *Postharvest losses, market forces, smallholder cassava farmers, southeastern, Nigeria*

1.BACKGROUNDTOTHESTUDY

Food is one of the essential and basic needs of life. It is a fundamental part of life, regardless of social class, creed, or race. Food quality and availability directly affect human life quality and well-being Zhenlin & Lawal (2021). Governments at all levels therefore have an important role to play in reducing post-harvest losses and ensuring that people have enough food for consumption. Therefore, food must be put on people's tables. Not only that, it must be affordable and accessible through resilient and reliable supply systems (Defra, 2008, cited in Aniuga, Onuigbo, and Ekwe, 2025). Post-harvest loss (PHL) is the degradation in both quantity and quality of food produced from harvest to consumption. The quality of losses includes those that affect nutrients or caloric compositions Ibrahim, Ibrahim, Adeola, & Ojoko (2022).

Reducing post-harvest losses among smallholder cassava farmers is critical to improving food security, limiting market price increases for food raw materials, improving livelihoods, and promoting sustainable agriculture. For fresh produce, post-harvest losses can reach 30-40%, severely impacting smallholder farmers' incomes and contributing to food insecurity. (2023). Yield estimates for mangoes, bananas, oranges and papayas grown by smallholder farmers and distributed by street vendors in Limpopo are as high as 50% of Du Toit (2022), mainly due to harvesting methods, storage conditions, transport practices, inadequate packaging and consumer preferences. Elik, Yanik, Stambullu, Guzelsoy & Yavuz et al (2019). These losses are mainly due to inadequate storage facilities, poor transportation networks, improper handling mechanism, and lack of access to appropriate preservation techniques.



Ensuring quality food for the population throughout the year requires special attention to the entire agri-food production chain for all stakeholders (Aniuga, Adindu, & Okolo, 2024). One of the major global challenges today is how to ensure food security for the growing world population while ensuring long-term sustainable development (Aniuga, Adindu, & Okolo, 2024).

A very large population of Nigeria lives in rural areas and agriculture is the main occupation of people over centuries and effective agricultural marketing can significantly reduce postharvest losses by improving on some challenges confronting them like warehouse, transportation, good road network, climatic and price risks, seasonality demands and surpluses of labour and capital and often live in areas that are hard to address with financial services ultimately leading to increased food security and farmers' income.

Post-harvest losses cause widespread problems in food marketing and consumption from farm to fork, with significant economic, social and environmental impacts Aniuga, et al (2025). These problems are often exacerbated in developing countries like Nigeria due to lack of technology, inadequate storage infrastructure, poor transportation systems, and poor handling practices. Decreased income for farmers: Post-harvest losses directly reduce the amount of marketable agricultural produce, both in quantity and quality, resulting in a reduction in the overall income of farmers. In developing countries like Nigeria, these losses can be particularly devastating for smallholder farmers, threatening their livelihoods and raising food prices for consumers. When large amounts of food are lost in the supply chain, the available supply decreases, leading to higher prices for consumers. This directly contributes to high food prices and food insecurity. Increased production and marketing costs: The resources invested in growing, harvesting, and transporting food eventually rot, resulting in a complete waste of resources such as seeds, water, and energy. This increases costs for the entire food system. In Nigeria, post-harvest grain losses are estimated to range from 5 to 20 percent. 20% for fish and 50-60% for tubers, fruits and vegetables (Okojie, 2021).

Thus, impact of postharvest losses on market forces among smallholder cassava farmers: Evidence from southeastern Nigeria
Specifically, the study sought to:

1. analyze the impact of poor and inadequate storage facilities on food commodity demand.
2. examine the impact of poor transportation networks on food commodity demand.
3. evaluate the impact poor postharvest handling mechanism on food commodity demand.
4. investigate the impact of poor and inadequate storage facilities on food commodity supply.
5. examine the impact of poor transportation networks on food commodity supply.
6. ascertain the impact of poor postharvest handling mechanism on food commodity supply.

The following null hypotheses were formulated to guide this study

H₀₁: there is no significant impact of poor and inadequate storage facilities on food commodity demand

H₀₂: there is no significant impact of poor transportation networks on food commodity demand

H₀₃: there is no significant impact of poor postharvest handling mechanism on food commodity demand

H₀₄: there is no significant impact of poor and inadequate storage facilities on food commodity supply

H₀₅: There is no significant impact of poor transportation networks on food commodity supply

H₀₆: there is no significant impact of poor postharvest handling mechanism on food commodity supply

2. REVIEW OF RELATED LITERATURE

The Meaning of Food

Food is any nutrient consumed or ingested by living organisms (human or animal) or absorbed by plants to maintain or support life and growth. There is no doubt in anyone's mind that food plays an important role in any society. Countries are fighting over food. The economy revolves around food. Food is traded for political influence. Religions use food in rituals. Food is used to celebrate life's moments. Build friendships by sharing food. Families are tied together by food. Food structures our day and controls our social life. We spent a lot of time buying food, eating food, thinking about food, and earning money to buy food. Food ensures our survival. Food defines who we are as individuals.

Given the great importance of food, its acquisition, preparation and consumption should never be left to chance. Below is the anatomy of the relationship between food and society and individual consumers, Ejionueme & Nebo (2014, cited in Aniuga et al, 2024).

Postharvest system

Food loss and waste occurs in post-harvest systems. Postharvest systems involve the movement of food from the time and place of harvest/production to the time and place of consumption (FAO, 2025). This system refers to a complex set of functions and operations that are logically interconnected throughout the agricultural product value and supply chain. Includes: The first stage is agricultural production, which corresponds to the pre-harvest stage. The second part concerns post-harvest processing and storage. The third part is production and processing. The fourth is distribution. The last part – consumption.

Post-harvest period

The post-harvest period is the period after the environment and food source have been separated (Harris & Lindblad, 2024). There are three critical times when food can be lost: pre-harvest, harvest, and post-harvest.

Post-harvest losses

Improper post-harvest handling, improper storage, poor logistics, and low awareness of improved conservation practices have been identified as significant factors contributing to root and tuber losses (Sugri, Abubakari, Owusu, & Bidzakin, 2021). Additionally, a lack of storage facilities forces smallholders to sell their crops quickly and at lower prices to prevent spoilage, reducing their bargaining power and income. At the same time, retailers are facing product safety issues during transportation and retail, which affects marketing profits. Furthermore, with increasing food security concerns and increasing urban demand, reducing post-harvest losses is now widely accepted as a cost-effective strategy to increase food availability and stabilize rural livelihoods (FAO, 2018; Willett, Rockstrom, Loken, 2019).

The essence of postharvest losses is to understand the multifaceted deterioration of food quantity and quality from harvest to consumption. Postharvest losses can be defined as the deterioration in the quantity and quality of food produced between harvest and consumption. Postharvest losses are measurable declines in food quality and quantity that occur after harvest, from harvest to the final consumption stage (Harris & Lindblad (2024)). Quality losses include those that affect the nutritional/caloric composition, acceptability, and edibility of the product. Postharvest losses depend in part on the technology available in a country and the degree of development of agricultural markets. Three interrelated global factors provide a common framework to characterize supply chains and future trends in developing and transitional economies. Postharvest loss refers to any change in the availability, edibility, usefulness, or quality of food that precludes human consumption. There are two types of food loss: direct and indirect. Direct losses are food losses due to food spillage or ingestion by insects, rodents, and birds. Indirect losses are such a reduction in quality that people refuse to eat it. According to Grolleaud (2004, cited in Aniuga and Nto, 2016, Aniuga et al., 2024), direct losses occur when food loss is caused by leakage (e.g. spilled bags) or ingestion by pests (insects, rodents, birds), while indirect losses occur when consumers abandon their purchases due to poor quality. Postharvest losses can be defined as the loss of quality and quantity of agricultural produce after harvest due to mishandling from the point of production to the point of consumption.

Postharvest losses (PHL) refer to measurable quantitative and qualitative losses of food in postharvest systems (de Lucia & Assennato, 1994). This system includes interrelated activities from harvesting, crop processing, marketing, and food preparation to the consumer's final decision to eat or discard the food. Globally, the monetary cost to the environment of post-harvest losses is estimated at \$882 billion annually.

Types of Post-Harvest Losses

According to FAO (2021), physical loss occurs when fresh or processed cassava products are severely damaged and therefore have to be discarded in the value chain. This can be due to poor

ripening, poor processing techniques, climate change, disease/pest infestation and poor storage, and can result in loss of weight and quality. Economic losses refer to products whose quality has deteriorated, reducing either their market price or the product's usability. Monetary losses are financial losses due to physical or economic losses, including stolen roots. Post-harvest losses are classified into three broad categories, namely quantitative losses, qualitative losses and economic or commercial losses (Suleiman & Rosentrater, 2015). Others classify them as direct and indirect losses.

Quantitative Loss: Quantitative loss indicates reduction in body weight and can be easily quantified and evaluated. For example, some grains damaged by pests or lost during transportation can be weighed and evaluated.

Qualitative Losses: Qualitative losses cover a wide range and include external characteristics, shape and size as well as odor and taste, which affect consumer acceptance and loss of nutritional value of products. These losses include cultural factors that can influence diet and eating habits, contamination from poor quality grains, leftover straw or other plant debris, soil, stones and broken glass. Other contaminants are difficult to remove and pose a greater risk of contamination than others, such as soluble pest faeces, oils, pesticides, pathogens spread by rodents, and mold toxins (mycotoxins). The presence of foreign bodies, which can distort the weight of a sold batch, also affects the quality and therefore the market value of a product. Second

Economic Losses: Economic losses occur when the monetary value of the product decreases due to a reduction in the quality and/or quantity of the food. Although these categories of losses are often measured individually, the incidence of these losses is interrelated. Significant weight loss often means a loss of both nutritional and commercial value Tefera (2012). Direct losses: Direct losses occur when the disappearance of a food product is caused by leaks (e.g. leakage from bags) or consumption by pests (insects, rodents, birds), while indirect losses occur when a reduction in quality leads to the consumer refusing to purchase. Although weight loss is easy to observe and measure, it does not necessarily mean a loss of food as it may simply result from a reduction in fluid content. The loss of moisture during drying is therefore not a loss of food. On the other hand, abnormal weight gains due to moisture absorption after rain on stocks left outdoors can cause serious damage resulting in losses.

Direct losses: Direct losses occur when the disappearance of a foodstuff is caused by leakage (for example, spillage from bags) or consumption by pests (insects, rodents, birds), whereas indirect losses occur when a reduction in quality leads to the consumer's refusal to purchase. While weight loss is easy to observe and measure, it does not necessarily mean food loss, since it can result simply from a reduction in moisture content. Moisture loss during drying is therefore not a food loss. On the other hand, an abnormal increase in weight through moisture absorption following rainfall on stocks left in the open can cause serious damage resulting in loss.

The extent and type of post-harvest losses vary from country to country, depending on their stage of economic development. In high- and middle-income countries, significant losses occur early in food supply chains and at the consumer level (United Nations, 2011). While food losses in low-income countries mainly occur at the early and middle stages of food supply chains, the quantities wasted at the consumer level are relatively less. Food losses in low-income countries are the result of "unintentional losses" due to the "poor" state of their supply chains.

Causes of Post-Harvest Losses in Nigeria

All crops are subject to spoilage or spoilage at different stages and times immediately after harvest. As soon as a crop is harvested from the ground or separated from its parent stock, rot begins (Campus, 2021).

The following are some of the factors that fuel or contribute to post-harvest losses in South-Eastern Nigeria.

Poor and Inadequate Storage Facilities: This is probably one of the biggest agricultural and food security problems in Nigeria. Due to heavy reliance on rain-fed agriculture, farmers harvest almost simultaneously, resulting in oversaturation and waste. As a result, a significant percentage of these agricultural products surplus during the harvest season, which should have been processed or stored for off-season use, are lost due to the unavailability of modern storage and processing facilities.



Maintenance is another problem plaguing public infrastructure in Nigeria; some good storage facilities built years ago are currently out of service due to lack of maintenance (Bolarin & Bosa, 2015).

Poor Transportation Networks: In Nigeria, there are not enough proper vehicles to transport produce from farms to markets. Furthermore, the roads are inadequate and very bad, with the result that old vehicles will only be used to access connecting roads. Most communities use donkeys and bicycles, while others use wheelbarrows and canoes. In other countries, people travel long distances to move agricultural products from one place to another. These transportation methods are usually very slow and cumbersome, making agricultural marketing more expensive and difficult. Poor road conditions between farmers and markets increase costs or even prevent the delivery of bulk supplies to markets. According to CBN (2003), the poor state of Nigeria's transportation system has a negative impact on production costs and is a major cause of cost inflation in the country. Furthermore, the rural areas where most agricultural activities take place in Nigeria are characterized by the lack of infrastructure such as access and connection roads necessary for the regular transport of agricultural products. The access roads to farms and those connecting rural communities to towns and cities are in poor condition; this situation has contributed greatly to the loss of agricultural products as transportation requires additional costs, time and effort. Due to poor road conditions, vehicles transporting agricultural products to markets for sale break down or even get involved in terrible accidents leading to waste of some of these products before they reach end users in several cities across the nation (Abbas et al., 2018)

Poor Post-Harvest Mechanism: The importance of having the right information and skills required in post-harvest management cannot be stressed enough. Good knowledge and skills on best harvesting, storage, packing and transportation practices among smallholder farmers will go a long way in reducing losses incurred.

Market forces

Market forces are the economic factors and interactions; primarily supply and demand that determine the price and availability of goods and services in a market. These forces, often referred to as the "invisible hand," drive the allocation of resources and create a balance known as market equilibrium. Also, Market forces are primarily the dynamics of supply, demand, price volatility, and market infrastructure are dominant drivers of postharvest losses (PHL), accounting for significant economic and physical waste, particularly in developing regions. These forces influence decision-making along the postharvest supply chain, often forcing farmers and traders to prioritize immediate sales over proper handling, leading to quality degradation and, ultimately, waste.

Factors for Market Forces

1. Fundamental Drivers

Demand: The quantity of a good or service consumers are willing and able to purchase at various prices, driven by consumer preferences, income levels, and purchasing behavior.

Supply: The quantity of a good or service producers are willing and able to sell, influenced by production costs, technology, and availability of resources. **Price Signal:** The resulting price, which acts as a signal to both consumers and producers to adjust their behaviors.

2. Competitive Forces (Porter's Five Forces)

Market forces are heavily influenced by the competitive structure of an industry, often analyzed using Porter's Five Forces:

Internal Rivalry: The intensity of competition among existing firms, leading to price wars or innovation. **Threat of New Entrants:** The ease or difficulty for new firms to enter the market, affecting profit margins. **Bargaining Power of Suppliers:** The ability of suppliers to dictate prices, which affects production costs.

Bargaining Power of Customers: The capacity of customers to demand lower prices or higher quality, especially in markets with few buyers or many alternatives.

Threat of Substitutes: The availability of alternative products that can fulfill the same consumer need.

3. External Influences

Government Policies & Regulation: Actions such as taxes, subsidies, and regulations that directly influence supply and demand and can disrupt market equilibrium.

Economic Conditions: Macroeconomic factors like interest rates, inflation, and GDP growth that affect overall spending and production capacity. **Technological Advancements:** Innovations that can create new markets, change production methods, or alter demand for existing products.

Social & Cultural Trends: Changes in consumer attitudes, demographic shifts, and societal trends that impact consumption. **Investor Sentiment:** Psychological factors that drive buying or selling behaviors in financial markets, influencing asset valuation.

Geopolitical Events: Factors like trade barriers or international conflicts that disrupt supply chains (Retrieved online, Fri, Apr 3, 2026).

The high prevalence of post-harvest losses in cassava cultivation

Cassava has high growth forecasts despite post-harvest losses. PHL occurs at different stages, such as cleaning, drying, packaging, transportation and storage (Anyoha, Udemba, Ogbonnaya & Okoroma 2023 cited in Kitinoja, Saran, Roy & Kader (2011). Kitinoja and Kader (2003) argue that there are two types of PHL: qualitative and quantitative. The former refers to changes in taste, texture, appearance, and nutritional content, while the latter refers to the amount or percentage of food lost (Hidayati, Garnevaska, & Childerhouse, 2021). PHLs can make food unsafe and unappetizing and reduce the economic return on invested resources (Kumar and Kalita 2017). The extent of the PHL can vary significantly depending on inputs and weather conditions (Danilola, Babatunde, & Animashaun 2019).

Impacts of Post-Harvest losses on Market Forces:

Supply Reduction and Price Volatility:

Significant losses, estimated at 30–50% in Sub-Saharan Africa, effectively reduce the market supply, resulting in shortages even when overall production may meet demand. This creates an artificial scarcity that drives up food prices for consumers.

Forced Sales and Low Producer Prices:

Due to inadequate storage facilities, smallholder farmers are frequently compelled to sell their harvests immediately after collection to prevent spoilage. This sudden influx of supply during harvest season results in an oversupply, which subsequently decreases farm-gate prices and diminishes farmers' income, despite consumer prices remaining elevated later in the season.

Decreased Quality and Market Value:

Post-harvest losses entail a decline in quality (due to spoilage, bruising, damage), consequently reducing the market value of the food. Produce of lower quality commands lesser prices, impacting the profit margins for traders and profitability for farmers.

Rising Transaction Costs:

Inadequate infrastructure and poor transportation systems that contribute to physical losses also escalate logistics expenses. These increased costs are ultimately transferred to consumers, further raising prices.

Market Inefficiency and Information Gaps:

Insufficient information regarding market demand and supply contributes to overproduction in some areas while others face shortages, exacerbating waste and destabilizing prices.

Structural Implications:

The lack of storage facilities hinders farmers from practicing temporal arbitrage—selling their goods when prices are favorable. This situation perpetuates a cycle of poverty for farmers and deters investment in expanding production, as the perceived risk of loss is deemed excessively high. Additionally, in numerous regions like Southeast Nigeria, the high costs associated with managing post-harvest losses lead farmers to view these losses as a regular "cost of doing business," instead of a manageable issue (Retrieved online, Thu, Mar 26, 2026 at 9:10 PM).

Thus, the following hypothesis as shown in Fig 1 are developed to test the impact of each PHL dimensions on market forces.

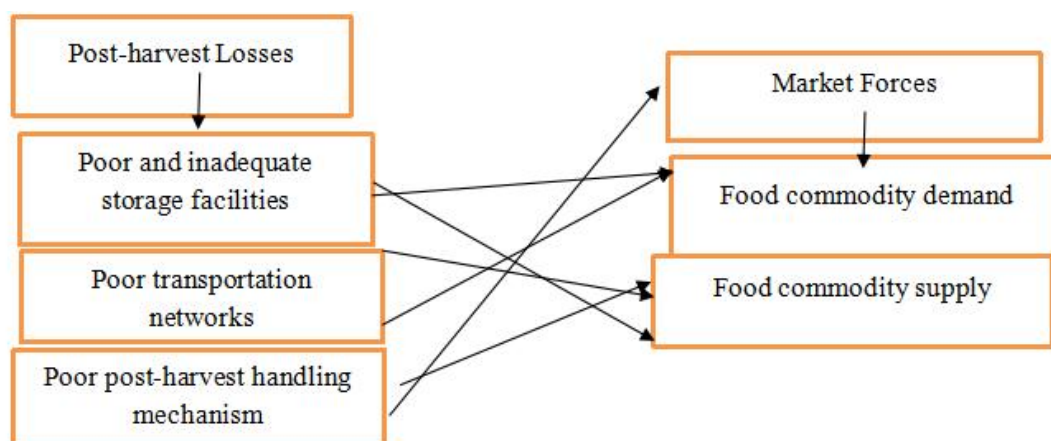


Fig.1 Research Framework

3.THEORETICAL FRAMEWORK

This study anchored on resource-based view (RBV) theory and Von Thunen's Location Theory of Agricultural location. Resource-based theory (RBV) provides strategic insights into the relationship between rural post-harvest losses and marketing for food security: implications for economic sustainability in South-Eastern Nigeria, particularly in South-Eastern Nigeria (Abia, Anambra and Enugu States). According to this theory, farmers can achieve sustainable competitive advantage by effectively using their internal resources and capabilities (Barney, 1991, cited in Bappah & Adejoh, 2024). RBV Resource-based theory (RBV) assumes that firms have unique resources and capabilities that vary in type, quantity and quality (Wernerfelt, 1984, cited in Bappah & Adejoh, 2024). In South-Eastern Nigeria, farmers who engaged in agriculture may not have various resources such as infrastructure, technology, human capital and financial resources that can be used to address post-harvest losses and improve food security. The theory also assumes that resources are not perfectly mobile across farmers, leading to different competitive outcomes (Bappah & Adejoh, 2024). This means that farmers in South-Eastern Nigeria may not have access to certain resources and skills such as: traditional agricultural practices, local networks or geographic advantages that can help mitigate post-harvest losses and ensure food security. RBV also emphasizes the importance of identifying valuable, rare, inimitable and non-substitutable resources (Barney, 1991). In southeastern Nigeria, farmers must prioritize resources and skills that meet these criteria to effectively manage post-harvest losses and ensure food security.

Von Thunen's theory is a model of agricultural land use that involves concentricity. The analysis of land use patterns has long been one of the basic concepts of geography. At first glance, it might seem that agricultural land use is hardly influenced by relative location.

Basic assumptions of the Von Thunen model

The isolated state consists of a market area and an agricultural hinterland.

The market only receives goods from the hinterland and the hinterland only sells goods to the market.

The hinterland does not ship its surplus to any market other than that of the city.

There is a homogeneous physical environment, comprising a unified plain around the city. Farmers who want to maximize profits settle inland.

There is only one means of transport: a horse-drawn cart is used.

Transportation costs are directly proportional to the distance. The greater the distance, the higher the transportation costs.

Von Thunen's model examines the location of different crops in relation to the market. According to him, the location of crops is determined by:

1. Market prices
2. Shipping costs,
3. The yield per hectare

The model compares the relationships between production costs, market price and transportation costs of an agricultural product and is expressed as follows:

$$R = Y(p-c) - Yfm$$

R = Rent per unit of land.

Y = Revenue per unit of land. p = market price per unit of income.

c = Average production costs per unit of income.

m = distance from market (in kilometers or miles).

f = freight rate per unit of output and unit of distance.

These theories are directly applicable within the context of this study since market forces among smallholder cassava farmers can be significantly minimized if resources are mobile to curb the causes of post-harvest losses are effectively addressed.

4. Empirical Review

Ibrahim, Diayi, Adeyemo, & Chidolue (2025) analyzed the perceptions of smallholder farmers in south-west Nigeria regarding biotech interventions for postharvest loss reduction. The effectiveness of biotechnology solutions in reducing postharvest losses among smallholder farmers in Southwest Nigeria was the subject of this cost-benefit analysis. Descriptive statistics, cost-benefit ratios (CBR), paired sample t tests, linear regression, and ANOVA at a 0.05 significance level were used to analyze 400 valid responses from 500 farmers who were selected through proportional stratified random sampling for the survey. These results show that adopting biotechnology increases profitability, decreases spoilage, and improves the economic resiliency of households.

Belemu & Oluwatayo (2025). Conducted a study on postharvest losses among smallholder fruit crop farmers in South Africa: insights from the Vhembe district of the Limpopo province. They argued that postharvest losses pose a significant threat to the economic and food security of smallholder fruit crop farmers in the rural areas of South Africa (PHLS). A structured questionnaire was used to collect data from a random sample of 224 smallholder FCFS, and descriptive statistical analysis tools were used to analyze the data. The study came to the conclusion that effective postharvest management practices, improved information dissemination, and improved access to storage facilities, packhouses, credit, and markets are crucial for reducing postharvest losses and enhancing smallholder farmers' livelihoods.

Akinyemi, Omisore, & Kupolusi (2025) carried out volatility has on analysis of food price indices and inflation rate in Nigeria. The significant impact that food price volatility has on inflation and economic stability is highlighted in this study, which investigates the connection between food price indices and inflation in Nigeria. The findings were analyzed using descriptive analytical tools, multiple linear regression, and time series models. The negative skewness of their price indices and the significant difference between their results and those of the regression showed that, beginning in 2021, there was a significant decrease in consumption of meat and dairy.

Aniuga, Onuigbo, & Ekwe (2025) examined the connection between marketing for food security and post-harvest losses in rural areas. The study specifically investigated the connection between food utilization, standardization/grading, transportation accessibility, storage availability, and food stability, as well as marketing intelligence and food stability. The survey method of research was used in the study. The results showed that marketing for food security has a positive and significant relationship with post-harvest losses in rural areas, standardization/grading has a positive and significant relationship with food utilization, storage has a positive and significant relationship with food availability, and marketing intelligence has a positive and significant relationship with food stability.

Ojo, Dawodu, Ezekiel, & Bamidele (2025) looked at how losses after harvest affected the food security of cowpea farming families in Oyo state, Nigeria. The study's samples were selected using the multistage sampling method. A well-organized questionnaire and interview schedule were used to collect data from the farmers for the study. The collected data were analyzed using descriptive statistics. The results indicate that, post-harvest losses, the planting of local cowpea varieties, and household size had a negative and significant impact on food security, whereas variables like access to credit, years of formal education, and farm size had a positive and significant impact on food security.



Muwereza's (2025) conducted a research on analysis of the predictors of the post-harvest losses among smallholder maize farmers: a case study of eight districts from Uganda. According to him, post-harvest losses, (PHL), are one of the most significant obstacles that smallholder farmers, particularly those in developing nations, must overcome. The finding suggests that the government of Uganda and its development partners should focus on increasing maize production among smallholder farmers, as they are particularly vulnerable to post-harvest losses.

Onyenekwe, Anyichie, Amaechina, Ayogu & Egwue, (2025) investigated the effects of post-harvest losses on the farm income and marketing margins of cocoyam farmers and marketers in the Nsukka local government area of Enugu state, Nigeria. A multi-stage sampling method was used to select 80 respondents, 40 of whom were marketers and 40 of whom were farmers. Structured questionnaires were used to collect data, which were then analyzed with descriptive statistics, multiple regression analysis, and likert scale mean scores. The study came to the conclusion that although post-harvest losses are common, they have little direct impact on income and margins and are more influenced by socioeconomic factors. To increase cocoyam value retention and enhance rural livelihoods, the study recommends targeted financial interventions, investment in storage infrastructure, farmer education on post-harvest handling, and cooperative support.

Gehlot & Singh (2024). Conducted a study on agricultural marketing trends and challenges in India. They held the opinion that a significant portion of the population survives on agriculture, which is the backbone of the Indian economy. The India state database, the Indian government's ministry of statistics and program implementation, and the Indian government's ministry of agriculture and farmers' welfare provided secondary data for this study. The agricultural market in India is changing quickly, and different points of view are emerging at the state and national levels. The most important things are making it easier for farmers to make a living, using sustainable methods, and accepting new technological developments.

Bappah & Adejoh (2024) looked at factors mitigating post-harvest losses to ensure food security in north-west Nigeria. They argued that post-harvest losses pose a significant threat to food security in the agriculturally dependent north-west of Nigeria. The paper suggests investing in robust post-harvest infrastructure, such as upgraded storage facilities with adequate cooling and pest control, improved transportation networks, and enhanced market access, to address this issue. To improve the region's food security, farmer education programs on advanced post-harvest practices and value addition are also recommended.

According to Aroyehun, Ugwuja, & Onoja (2024), the climate change poses a significant threat to melon production because of the frequent shifts in agricultural practices. As a result, the purpose of this study was to investigate the factors that influence the adaptation strategies that melon farmers in southern and southern Nigeria use to deal with the risks posed by climate change. The data were analyzed with the partial eta squared test and the multivariate probit (MVP) model. Access to information on climate change (0.353) was significant at the 0.01 level and determined the adoption of off-farm job opportunities. Age (0.010), farm size (0.085), and crop insurance (0.26) were also significant at the 0.05 level. Climate-smart agricultural practices, public-private partnerships, and the availability of credit are among the suggestions made in the study.

Nwankwo & Chiekezie (2024) carried out a study on agricultural productivity and postharvest loss among cassava farmers in Nigeria's Anambra state. They asserted that reducing postharvest loss is a crucial route to food security and one of the greatest obstacles to agricultural productivity. The data were analyzed using descriptive statistics, the logit model, mean threshold from five points likert scale, and inferential statistics. The study came to the conclusion that cassava farmers in the state of Anambra experience significant postharvest losses—32.0%. Improved storage facilities and financial incentives for farmers to increase agricultural productivity and reduce postharvest losses are recommended by the study.

Oteh, Osabohien, & Hefferon (2023) investigated Nigerian bio-fortified cassava producers' marketing capabilities, market orientation, and food security. A structured questionnaire was used to collect the information. The hypotheses were tested using the structured equation model (SEM). The findings lend credence to the idea that capabilities in marketing have spillover effects that enhance market orientation and food security. It reinforces the significance of farmers marketing farm produce in a market-oriented manner.

5.METHODOLOGY

The research design was survey research design. Survey research design was adopted because it allows the researchers to elucidate the characteristics of a large population which no other research method can offer this broad capability which ensures a more accurate sample to gather targeted results in which to draw conclusions and make important decisions (Kendra, 2020, Ponto, 2015, and Adindu, Aniuga, and Adindu, 2024), it also allows us to investigate, describe, and record information in their natural setting. Simple linear regression model was employed to analysis the importance postharvest losses on rising food commodity price among smallholder cassava farmers: Evidence from southeastern Nigeria, Nigeria. This study was limited in southeast (Abia, Anambra and Enugu) Nigeria. Southeast Nigeria is a geopolitical zone of Nigeria, comprising the five states of Abia, Anambra, Ebonyi, Enugu and Imo. South East was studied because they are known for farming. The population for study was made up of farmers in southeast (Abia, Anambra and Enugu States) Nigeria and are unknown because there is no record. Sample size was approximately 385. A total of 385 questionnaires were distributed using a convenience sampling technique, out of which 288 valid responses were retrieved and used for analysis. Convenience sampling technique was used because of it speed, low cost, and ease of data collection by selecting readily available respondents. Primary data were collected from smallholder cassava farmers through a structured questionnaire. The instrument was designed using a five-point Likert scale to capture respondents on impact postharvest losses on rising food commodity price among smallholder cassava farmers in southeastern Nigeria. Data were obtained from smallholder cassava farmers in Abia, Anambra and Enugu States. Simple linear regression model was used to analyse the formulated hypotheses through the use of Statistical Package for Social Science (SPSS) version 27.

Sample Size Determination

To scientifically generate a sample size, the formula for sample size determination for an infinite population suggested by Cochran (1963) was utilized. The formula is based on a z-score and presented as follows: $n = \frac{z^2 pq}{d^2}$

Where:

N = sample size

Z = the standard normal deviation at 95% confidence level =1.96

P = the proportion in the target population estimated to have a certain characteristic.

Since there is no estimate, 50 percent (0.5) has been adopted in the study as the maximum variability as recommended by Keller and Warrack (1997), and Mugenda and Mugenda (2003).

Q = 1 – p

D = margin of error of 5%

$$N = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2} = 385.$$

questionnaire to enhance its validity.

3.9 Reliability of the Instrument

Test-retest method using Cronbach alpha coefficient was used to find out the instrument reliability. To give credence to this study, a pilot verification was conducted using cross section of the population under study. The outcome of the pilot test was subjected to serious modifications where there are flaws. The Cronbach alpha (α) was computed to ensure that test show reliability before the questionnaire was eventually administered to the various components of the sample size.

Poor and inadequate storage facilities	.772
Poor transportation networks	.728
poor postharvest handling mechanism	.760
Food commodity Demand	.897
Food commodity supply	.856

The reliability coefficients result range from 0.72 to 0.89 which is considered sufficient for the study.

6.RESULTS AND DISCUSSION

The following null hypotheses are formulated to guide the study

Hypotheses Tests Results

Test of hypothesis 1

Table 1: Number of questionnaire administered

States	Number of questionnaire Administered	Percentage of questionnaire Administered	Number validly returned	Percentage of number validly returned	Number not returned	Percentage of number not returned
Enugu	127	33.0	88	30.5	39	40.2
Abia	129	33.5	115	40	14	14.4
Anambra	129	33.5	85	29.5	44	45.4
Total	385	100	288	100	97	100

Table 1: Distribution of questionnaire according to three selected states. Out of 385 copies of questionnaire, a total of 127 (33.%) were distributed to Enugu State and 88 (30.5%) copies of questionnaire were validly returned and 39 (40.2) did not return. 129 (33.5%) copies of questionnaire were distributed Abia State, 115 (40%) were validly returned and 14 (14.4%) did not return while 129 copies of questionnaire were distributed Anambra State, 85 (29.5%) were validly returned and 44 (45.4%) did not return. Therefore, out of this 385 copies of questionnaire administered, 288 (74.8%) were validly returned and were used for the analysis while 97 (25.2%) did not return.

Test of hypothesis i

Test i is based on hypothesis 1 projected in null form thus:

H₀₁: There is no significant impact of poor and inadequate storage facilities on food commodity demand.

Table 2: Simple linear regression analysis result on impact of poor and inadequate storage facilities on food commodity demand

Variable	Parameters	Coefficient	Std error	Tcal-value
Constant	β^0	1.790	0.016	29.135
Poor and inadequate storage facilities (X1)	β^1	0.652	0.18	36.488
R-Square R ²		0.823		
Adjusted Square	R	.0.822		
F- Statistics		1331.395		
F- probability		0.000		

Decision Rule: If $F_{tcal} > F_{tab}$ accept the alternate hypothesis and reject null hypothesis. Otherwise accept null hypothesis (***=1% , (**=5%) and *=10%) denotes significance of coefficient level respectively. T-value = 1.966, $df=288$, dependent variable: food commodity demand (Y) Predictors: (Constant), poor and inadequate storage facilities (X)

The findings revealed that poor and inadequate storage facilities had a statistically significant and positive effect on food commodity demand at the 1% significance level. The coefficient value of 0.652 indicates that a one-unit increase in poor storage facilities, holding other factors constant, leads to a 0.652-unit increase in food commodity demand (cassava prices). The calculated t-value of 36.488 exceeded the critical value of 1.966 at the 5% significance level, confirming statistical significance. The coefficient of determination (R^2) was 0.823, implying that 82.3% of the variation in food commodity demand is explained by poor storage facilities, while 17.7% is attributable to other factors. The F-statistic (1331.395) and probability value ($0.001 < 0.05$) further confirmed the overall significance of the model. Consequently, the alternative hypothesis was accepted, indicating a significant relationship between inadequate storage and food commodity demand. This finding aligns with Adepoju (2014), who identified inadequate storage as a major cause of post-harvest losses in tomato production in Ogbomosho.

Test of hypothesis ii

Test ii is based on hypothesis 2 projected in null form thus:

H₀₂: there is no significant impact of poor transportation networks on food commodity demand

Simple linear regression analysis result on impact of poor transportation networks on food commodity demand.

Test of hypothesis 2

H₀₂: there is no significant impact of poor transportation networks on food commodity demand

Table 3. Simple linear regression analysis result on impact of poor transportation networks on food commodity demand

Variable	Parameters	Coefficient	Std error	Tcal-value
Constant	β^0	3.427	.159	21.578***
Poor transportation networks (X1)	β^1	.134	.046	2.914***
R-Square R^2	.029			
Adjusted Square	R .025			
F- Statistics	8.489			
F- probability	0.004			

Decision Rule: If $F_{tcal} > F_{tab}$ accept the alternate hypothesis and reject null hypothesis. Otherwise accept null hypothesis (***=1% , (**=5%) and *=10%) denotes significance of coefficient level respectively. T-value = 1.966, $df=288$, dependent variable: food commodity demand (Y) Predictors: (Constant), poor transportation networks (X).

Decision Rule: If $F_{tcal} > F_{tab}$ accept the alternate hypothesis and reject null hypothesis. Otherwise accept null hypothesis (denotes significance of coefficient level respectively. T-value, dependent variable: food commodity demand (Y) Predictors: (Constant), poor transportation networks (X). Similarly, poor transportation networks were found to have a positive and statistically significant relationship with food commodity demand at the 1% level. The coefficient of 0.134 suggests that a unit increase in poor transportation leads to a 0.134-unit rise in food commodity demand. The t-value of .914 exceeded 1.966, confirming significance at the 5% level. However, the R^2 value of 0.029 indicates that only 2.9 % of the variation in demand is explained by transportation challenges, with 97.1% influenced by other variables. The F-statistic (8.489) and probability value ($0.004 < 0.05$) show that the regression model is statistically significant. These findings are consistent with Hlatshwayo et al.

(2023), who emphasized the importance of market access in improving household food security in South Africa, and Adepoju (2014), who also identified transportation as a contributor to post-harvest losses

Test of hypothesis iii

Test iii is based on hypothesis 3 projected in null form thus:

H_{03} : there is no significant impact of poor postharvest handling mechanism on food commodity demand.

Table 4 Simple linear regression analysis result on impact poor postharvest handling mechanism on food commodity demand.

Variable	Parameters	Coefficient	Std error	Tcal-v alue
Constant	β^0	2.920	.139	20.993
Poor harvest handling mechanism (X1)	β^1	.292	.040	7.279
R-Square R^2	.156			
Adjusted Square	R .153			
F- Statistics	52.983			
F- probability	0.000			

Decision Rule: If $F_{tcal} > F_{tab}$ accept the alternate hypothesis and reject hull hypothesis. Otherwise accept hull hypothesis (**=1% , (**=5%) and *=10%) donates significance of coefficient level respectively. T-value = 1.966, $df=288$, dependent variable: food commodity demand (Y) Predictors: (Constant), poor postharvest handling mechanism (X)

Poor post-harvest handling mechanisms also showed a positive and statistically significant relationship with food commodity demand at the 1% level. The coefficient of .292 indicates that a unit increase in poor handling practices leads to a .292-unit increase in demand. The calculated t-value of 7.279 exceeded the critical value of 1.966, confirming statistical significance. The R^2 value of 0.153 suggests that 15.3 1% of the variation in food commodity demand is explained by poor handling practices, while 84.7 is due to other factors. The F-statistic (52.983) and probability value ($0.000 < 0.05$) further confirm the model's significance. This finding supports Anyoha, Aja, Udemba, & Okoroma (2023), who reported widespread physical post-harvest losses among cassava farmers in Imo State, Nigeria.

Test of hypothesis iv

Test iv is based on hypothesis 4 projected in null form thus:

H_{04} : there is no significant impact of poor and inadequate storage facilities on food commodity supply.

Table 5 Simple linear regression analysis result on impact of poor and inadequate storage facilities on food commodity supply

Variable	Parameters	Coefficient	Std error	Tcal-value
Constant	β^0	3.199	.141	22.668
Poor and inadequate storage facilities (X1)	β^1	.198	.041	4.815
R-Square R^2	0.75			
Adjusted Square	R 0.72			
F- Statistics	23.182			
F- probability	0.000			

Decision Rule: If $F_{tcal} > F_{tab}$ accept the alternate hypothesis and reject hull hypothesis. Otherwise accept hull hypothesis (**=1% , (**=5%) and *=10%) donates significance of coefficient level

respectively. T-value =1.966, $df=288$, dependent variable: food commodity supply. (Y) Predictors: (Constant), poor and inadequate storage facilities (X)

Regarding food commodity supply, poor and inadequate storage facilities also demonstrated a statistically significant and positive relationship at the 1% level. The coefficient of 0.198 indicates that a unit increase in poor storage facilities results in a 0.198-unit increase in food commodity supply. The t-value of 4.815 exceeded 1.966, confirming statistical significance. The R^2 value of 0.75. implies that 75% of the variation in supply is explained by storage facilities, while 25% is influenced by other factors. The F-statistic (23.182) and probability value ($0.000 < 0.05$) confirm the model's overall significance. This aligns with Bekele et al. (2019), who found that improved storage technologies significantly enhance food availability among smallholder farmers in Tanzania.

Test of hypothesis v

Test v is based on hypothesis 5 projected in null form thus:

H₀₅: There is no significant impact of poor transportation networks on food commodity supply.

Table 6 Simple linear regression analysis result on impact of poor transportation networks on food commodity supply.

Variable	Parameters	Coefficient	Std error	Tcal-value
Constant	β^0	3.367	.159	21.114
Poor transportation networks (X1)	β^1	.142	.046	3.076
R-Square R^2		.032		
Adjusted Square	R	.029		
F- Statistics		9.464		
F- probability		0.002		

Decision Rule: If $F_{cal} > F_{tab}$ accept the alternate hypothesis and reject hull hypothesis. Otherwise accept hull hypothesis ($***=1\%$, $**=5\%$) and $*=10\%$) donates significance of coefficient level respectively. T-value =1.966, $df=288$ dependent variable: food commodity supply. (Y) Predictors: (Constant), poor transportation networks (X) In addition, poor transportation networks had a positive and statistically significant effect on food commodity supply at the 1% level. The coefficient of .142 indicates that a unit increase in poor transportation leads to a 0.142-unit increase in supply. The t-value of 3.076 exceeded 1.966, confirming significance. The R^2 value of 0.032 shows that 3.2 percent changes in dependent variable can be explained by changes in the independent variable while 96.8 percent can be explained by the stochastic term in model. The F-statistic (1339.464) and probability value ($0.002 < 0.05$) indicate that the model is statistically significant. The finding is consistent with Usman & Haile (2022), who emphasized the importance of market access and rural infrastructure in enhancing food security and dietary diversity in Eastern Africa.

Test of hypothesis vi

Test vi is based on hypothesis 6 projected in null form thus:

H₀₆: there is no significant impact of poor postharvest handling mechanism on food commodity supply

Table 8 Simple linear regression analysis result on impact of poor postharvest handling mechanism on food commodity supply

Variable	Parameters	Coefficient	Std error	Tcal-value
Constant	β^0	3.444	0.150	22.916
Poor harvest handling mechanism (X1)	β^1	0.119	0.43	2.740
R-Square R^2		.025		
Adjusted Square	R	.022		
F- Statistics		7.509		
F- probability		0.007		

Decision Rule: If $F_{\text{cal}} > F_{\text{tab}}$ accept the alternate hypothesis and reject null hypothesis. Otherwise accept null hypothesis ($***=1\%$, $**=5\%$) and $*=10\%$) denotes significance of coefficient level respectively. T-value = 1.966, $df=288$, dependent variable: food commodity supply. (Y) Predictors: (Constant), poor postharvest handling mechanism (X) Finally, poor post-harvest handling mechanisms were found to have a statistically significant and positive relationship with food commodity supply. The coefficient of 0.119 suggests that a unit increase in poor handling leads to a 0.119-unit increase in supply. The t-value of 2.740 exceeded 1.966, confirming significance at the 5% level. The R^2 value of 0.025 indicates that 2.5% of the variation in supply is explained by poor handling practices while 97.5 percent can be explained by the stochastic term in model The F-statistic (7.509) and probability value ($0.007 < 0.05$) confirm the overall significance of the model. This finding is in line with Akinyemi, Omisore, & Kupolusi (2025), who highlighted the influence of food price volatility on inflation and economic stability in Nigeria. Overall, the study establishes that poor storage facilities, weak transportation networks, and inadequate post-harvest handling significantly contribute to changes in both food commodity demand and supply, thereby influencing market forces in Southeast Nigeria.

7. CONCLUSION AND RECOMMENDATIONS

Impact of postharvest losses on market forces among smallholder cassava farmers can be significantly minimized if post-harvest losses are effectively addressed. This requires practical policy implementation and strong commitment from relevant stakeholders. The study implies that a nation achieves food security when the majority of its population consistently has access to sufficient and quality food at all times. Therefore, deliberate efforts must be made to reduce post-harvest losses through the provision of adequate infrastructure such as efficient storage facilities, reliable transportation networks, and improved post-harvest handling mechanisms. By doing so, the persistent increase in food commodity prices particularly among smallholder cassava farmers in Southeast Nigeria can be curtailed.

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

1. The problem of poor and inadequate storage facilities should be urgently addressed, as evidence shows that improved storage systems can help stabilize supply and demand, thereby reducing food and price increases.
2. That good transportation networks should be provided. Efficient transport systems facilitate timely distribution of produce, minimize waste, and help prevent artificial scarcity that leads to rising prices.
3. That poor post-harvest handling mechanism should be improved by providing good equipment and skilled personnel. Proper handling mechanisms reduce spoilage and losses, which in turn help moderate excessive demand pressures that drive up prices.
4. Adequate storage facilities should also be prioritized because they enhance food supply capacity, contributing directly to price stability in the market.
5. Investment in improved transportation infrastructure is essential, as it increases the availability of food commodities in markets and helps control price fluctuations.
6. Strengthening post-harvest management systems will further boost food supply and reduce unnecessary losses, ultimately lowering food commodity prices for consumers.

Theoretical and Practical Implications

Supply Shift and Equilibrium Distortions: Theoretically, postharvest losses represent a backward shift in the supply curve. Because a significant percentage of produced goods never reach the market, the available supply is lower than potential supply, leading to a higher market equilibrium price.

Reduced Price Elasticity of Supply: In regions with high perishability and limited infrastructure, farmers cannot store goods to wait for better prices. This makes the supply inelastic in the short term, as producers must sell immediately to avoid total loss, often forcing them to accept low prices despite high demand later.

Diminished Marketed Surplus: PHL reduces the "marketed surplus"—the difference between total production and farm-level consumption. Lower marketed surpluses reduce the income of farmers and weaken their bargaining power in the supply chain.

Quality Grading and Price Differentiation: Postharvest losses often lead to "commercial loss," where the product is edible but not marketable, or "quality loss," reducing the grade and therefore the price it can command.

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Practical Implications on Market Forces

Seasonal Price Fluctuations (Glut and Scarcity): A typical, practical scenario is a peak season glut where prices collapse due to excessive supply, followed shortly by scarcity because much of that supply rots before reaching urban centers. This cycle leads to high prices for consumers even when the overall harvest was good.

Inflated Transaction Costs: When traders lose a portion of their goods during transportation and storage, they adjust their pricing to compensate. The cost of spoilage is added to the cost of the remaining, good quality produce, resulting in higher final consumer prices.

Reduced Farmer Income and Profit Margins: High postharvest losses directly reduce the marketable volume, leading to lower profitability. Smallholder farmers often bear the brunt of these losses, experiencing up to 15% lower income, or even more in perishable root/tuber crops.

Weakened Supply Chain Efficiency: Poor logistics, lack of cold chains, and inadequate storage facilities at the farm level mean that the quality of products (nutritional, cosmetic) decreases significantly before reaching the retailer, limiting access to high-value markets.

Reduced Food Availability: PHL disrupts food security, as the volume lost could often feed millions of people. It makes nutritious foods (fruits, vegetables, fish) more expensive and less available, forcing consumers toward cheaper, less nutritious alternatives.

For smallholder cassava farmers to achieve their objective, deliberate efforts must be made to reduce post-harvest losses through the provision of adequate infrastructure such as good and efficient storage facilities, reliable transportation networks, and improved post-harvest handling mechanisms. By doing so, the persistent increase in food commodity prices, particularly smallholder cassava farmers in Southeast Nigeria can be curtailed.

Contributions to Knowledge

This study makes several important contributions to knowledge. First, it emphasizes that reducing post-harvest losses is critical for improving food security, stabilizing food price, enhancing farmers' incomes, and promoting sustainable agricultural development.

Second, the findings provide useful guidance for smallholder cassava farmers with strategies on how to produce and harvest without much losses.

Third, the study adds to the limited body of empirical research in Southeast Nigeria that examines the impact postharvest losses on market forces among smallholder cassava farmers.

Finally, the research serves as a valuable reference material for scholars and students conducting further studies on post-harvest losses and their impact on market forces.

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