

**POST-HARVEST LOSSES IN CASSAVA PRODUCTION AND ITS IMPACT ON FOOD
SECURITY AMONG RURAL SMALL-SCALE FARMERS IN ETSAKO EAST, EDO
STATE, NIGERIA.**

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EDO STATE**

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A PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION SERVICES, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE BACHELOR OF AGRICULTURE (B. AGRIC) (WITH OPTION OF AGRICULTURAL ECONOMICS AND EXTENSION SERVICES)

NOVEMBER, 2025.

CERTIFICATION

This is to certify that this research project titled "**Post-harvest Losses in Cassava Production and its Impact on Food Security Among Rural Small Scale Farmers in Etsako East, Edo State, Nigeria**" was carried out by Gift Omonigho ONOJORHOEVWO (MISS) with matriculation number **AGR2000041** of the Department of Agricultural Economics and Extension Services, Faculty of Agriculture, University of Benin, Benin city, Edo State.

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DEDICATION

This research work is dedicated to the Almighty God who in his infinite mercy, sustained, favoured and strengthened me all through this period.

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Last but not least, I wanna thank me I wanna thank me for believing in me.

I wanna thank me for doing all this hard work.

I wanna thank me for having no days off I wanna thank me for, for never quitting.

TABLE OF CONTENT

COVER PAGE	I
TITLE PAGE	II
CERTIFICATION	III
DEDICATION	IV
ACKNOWLEDGEMENT	V
TABLE OF CONTENT	VI
LIST OF TABLES	VIII
ABSTRACT	XI
CHAPTER ONE: INTRODUCTION	
1.1 Background of Study	1
1.2 Statement of Problem	4
1.3 Objectives of the Study	5
<i>1.4 Justification for the Study</i>	5
1.5 Hypotheses	7
CHAPTER TWO: LITERATURE REVIEW	
2.1 Nature and Magnitude of Post-Harvest Loss in Cassava Production	8
2.1.1 High Perishability and Rapid Post Physiological Deterioration (PPD)	8
2.1.2. Quantification of Post-Harvest Losses: Regional and Seasonal Variability	9
2.1.3. Critical Loss Points in the Cassava Value Chain	11
2.2. Determinants and Causes of Post-Harvest Loss Among Small-Scale Farmers	15
2.2.1 Biological and Physiological Factors Influencing PHL	15
2.2.2. Technical and Infrastructural Limitations	16
2.2.3. Socio-Economic and Institutional Constraints	18
2.3. Implications of Post-Harvest Loss for Food Security	22
2.3.1. Reduction in Physical Food Availability In Households and Community Levels	22
2.3.2. Economic Impact: Loss of Income and Constraints on Food Access	23
2.3.3. Nutritional Consequences and Food Safety Risks	23
2.3.4. Exacerbation of Food Supply Instability and Household Vulnerability	23
2.3.5. Loss of Agricultural Resources and Reduced Productivity	24

2.4. Vulnerability and Challenges Specific to Small-Scale Cassava Farmers	24
2.4.1. Financial and Resource Constraints for Loss Mitigation	25
2.4.2. Market Power Imbalance and Forced Early Sales	27
2.4.3. High Dependence on Cassava as Staple and Cash Crop	28
2.3.4. Lack of Risk Management and Coping Mechanisms	29
2.5. Emerging Trends and Future Challenges	30
2.5.1. Impact of Climate Change on Post-Harvest Loss Dynamics	30
2.5.2. Urbanization, Changing Consumer Preferences, and Pressure on Value Chains	31
CHAPTER THREE: METHODOLOGY	
3.1 Study Area and Scope	33
3.2 Sampling Technique and Sample Size	34
3.3 Data Collection	34
<i>3.4 Measurement of Variables</i>	34
3.5 Data Analysis	40
3.6 Test of Hypotheses	40
CHAPTER FOUR: RESULTS AND DISCUSSIONS	
4.1 Socio-Economic Characteristics of Cassava Farmers	42
4.1.1 Age	42
4.1.2 Gender	42
4.1.3 Marital Status	43
4.1.4 Educational Level	43
4.1.5 Household Size	44
4.1.6 Farming Experience	44
4.1.7 Farm Size	45
4.1.8 Income Source	45
4.1.9 Annual Income	46
4.1.10 Cooperative Membership	47
4.2 Factors Affecting Post-Harvest Losses in Cassava Production	50
4.2.1. Poor Storage	50

4.2.2. Delayed Processing	50
4.2.3. Lack of Transportation	51
4.2.4. Irregular Market Days	51
4.2.5. Pest and Disease Attacks	51
4.2.6. Labour Shortage	51
4.2.7. Mechanical Damage During Handling	52
4.2.8. Unfavourable Climatic Conditions	52
4.2.9. Absence of Extension Services	52
4.3 Food Insecurity Among Respondents	53
4.4 Strategies Used to Combat Food Insecurity	56
4.5 Constraints Faced by Farmers After Production	58
4.6 Determinants of Food Security Among Cassava Farmers	61
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION	
5.1 Summary	67
5.2 Conclusion	69
5.3 Recommendations	70
REFERENCES	72
APPENDIX	79

LIST OF TABLES

Table 4.1: Socio-economic characteristics of cassava farmers in Etsako East	47
Table 4.2: Factors affecting post harvest losses in cassava production.	53
Table 4.3: Food insecurity among cassava farmers in Etsako East	55
Table 4.4: Strategies and frequency of use	57
Table 4.5: Constraints faced by farmers after production	60
Table 6: Results of binary logistic regression showing determinants of frequency of use of strategies to combat food security	64

ABSTRACT

This study examined post-harvest losses in cassava production and their impact on food security among cassava farmers in Etsako East, Edo State. Primary data were collected from 100 randomly selected cassava farmers using a structured questionnaire and analyzed using descriptive statistics and binary logistic regression. The socio-economic characteristics revealed that respondents were predominantly middle-aged, married, and experienced small-scale farmers with a mean annual income of ₦505,625. Results showed that major factors influencing post-harvest losses included mechanical damage during handling, unfavourable climatic conditions, lack of transportation, irregular market days, pest and disease attacks, and poor storage facilities. Food insecurity indicators revealed that households frequently reduced meal quantity, skipped meals, or borrowed food due to shortages, indicating moderate levels of food insecurity.

Strategies used to combat food insecurity included reliance on cooperatives, selling farm produce, seeking assistance from relatives or NGOs, and engaging in off-farm jobs. The binary logistic regression revealed that age, sex, education, household size, farming experience, farm size, cooperative membership, annual income, and access to extension services significantly influenced food security status ($p < 0.05$). The study concludes that post-harvest losses significantly undermine both income and food availability, thereby contributing to household food insecurity in the area. It recommends investment in improved storage facilities, timely processing technologies, better road and market infrastructure, and strengthened extension services to reduce losses and enhance food security among cassava farmers.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Global food insecurity has increased substantially in developing regions, particularly in Africa, where the situation is deteriorating rapidly (Delgado & Tschunkert & Smith. 2023). According to FAO (2021), severe food insecurity rose from 8.3 % (\approx 605 million) in 2014 to 11.9 % (\approx 928 million) by 2020 (FAO et al., 2021).

The Merriam-Webster dictionary defines “food insecurity” as “the fact or an instance of being unable to consistently access or afford adequate food” (Merriam-Webster Dictionary 2021), therefore food security is the state of having reliable access to a sufficient quantity of affordable, healthy food. The concept of food security has since expanded from the initial four pillars which are availability, access, utilization, and stability to include agency and sustainability. These six dimensions of food security are reinforced in conceptual and legal understandings of the right to food (Clapp et al., 2022). Food insecurity as measured by the Food Insecurity Experience Scale survey module (FIES-SM) refers to limited access to food, at the level of individuals or households, due to lack of money or other resources (FAO et al., 2021)

The effectiveness of agricultural production, along with post-harvest losses and food waste, significantly affects how well the system converts biomass into nutritional value for human consumption (Nwankwo & Chiekiezie, 2023). 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 composition (Ibrahim.et.al. 2022).

Post harvest loss largely arises from inadequate handling, processing, storage, and marketing infrastructure. For instance, cassava, a highly perishable root crop, experiences rapid deterioration within days of harvest if not promptly processed. Olagunju et al. (2020) demonstrated that processing cassava into instant fufu powder among rural women in Oyo State, Nigeria, can effectively reduce losses by extending shelf life and creating market opportunities.

It is disheartening to note that while many resources are devoted to planting and crop management, little is done to minimize post-harvest loss, thereby wasting productive inputs (Adepoju, 2014, as cited in Ibrahim, Adeola, & Ojoko, 2022). Crop production undergoes a series of operations such as harvesting, drying, transportation, storage, whole selling, and retailing before reaching the consumer, and there are sizable losses in crop output at all these stages. In developing countries, crop losses occur in the production chain and hit small farmers the hardest. A considerable percentage of total production is lost before it reaches the market due to problems ranging from improper use of inputs to lack of proper post-harvest storage, processing, or transport (Chiekiezie.et.al.2023).

Given the multidimensional nature of food security, it is imperative to examine how sustainable agricultural practices and targeted interventions can empower smallholder farmers to effectively contribute to, and benefit from, a resilient and equitable food system, this could be achieved by the cultivation of cassava to combat food insecurity and post harvest losses in cassava production. Cassava (*Manihot esculenta* Crantz) is a vital staple crop in Nigeria, providing a major source of calories (FAO, 2004, as cited in Chiekezie et al., 2023) and income for millions of rural small-scale farmers (Anyanwu, Ibeto, Ezeoha, & Ogbuagu, 2015, as cited in Olajide et al., 2021). This

crop is a drought-tolerant perennial woody shrub, and is extensively cultivated across Africa, particularly in Nigeria (Olajide et al., 2021, as cited in Ganiyu & Oyebamiji, 2025).

Given its resistance to drought and depleted soils and the possibility of planting and harvesting it almost throughout the year, cassava is crucial to food security, especially in areas prone to drought and poor soils (Adebayo, 2023). The low average yield of cassava can be ascribed to inadequate knowledge of the crop's inherent benefits, poor on-farm management (such as tilling, spacing, and weeding), and low soil fertility (Akinwumiju et al., 2020).

Nigeria's position as the largest global producer of cassava has consistently increased over the last five decades with an average output of 60,001,531 million tons and 7,737,846 ha of area harvested in 2020 (FAOSTAT, 2022, as cited in Anyaegbu et al., 2023). Despite being the world's largest cassava producer, Nigeria faces low yield per hectare due to limited mechanization, Smallholder farmers largely manage current cassava production with outdated farming practices, and poor access to modern inputs. These challenges hinder cassava's full potential to enhance food security (Omoluabi et al., 2024).

Within hours of harvest, cassava roots begin to spoil due to post-harvest physiological deterioration (PPD), rendering them unusable if not processed quickly (Adeleye et al., 2021).

The uses of cassava are very versatile and can be locally processed in Nigeria in the form of food, which includes the production of Gari (eba), fufu (akpu), cassava flour, among others. Industrially it's application is used in ethanol production, adhesives and textile with examples like glue, paper, and fabric sizing, pharmaceuticals production due to the cyanogenic properties of cassava. Cassava peels and byproducts are used to feed livestock. It can be processed to dried chips or pellets which are fed to poultry, swine or cattle feed formulations. These and several

other reasons make cassava an important staple crop of food security in Nigeria (Udebuanie et al., 2024)

Cassava is a crop that is considered as a poor man's saviour crop which helps them to sustain their livelihood in times of natural disturbances (Immanuel et al., 2024)

1.2 Statement of Problem

Despite being the world's largest cassava producer, Nigeria faces low yield per hectare due to limited mechanization, Smallholder farmers largely manage current cassava production with outdated farming practices, and poor access to modern inputs. These challenges hinder cassava's full potential to enhance food security (Omoluabi et al., 2024).

Noncedo Vutula (2024) reiterated that post-harvest loss leads to reduced food availability, increased food prices, and negative nutritional outcomes, ultimately undermining food security at multiple levels. The study identifies several factors contributing to post-harvest losses (PHL) in cassava, primarily linked to the inherent perishability of cassava roots. These roots begin to deteriorate rapidly—within 24 to 48 hours after harvest—due to physiological deterioration (PDD) (Vutula, 2024).

Also poor handling practices damage during harvesting, transportation, and processing contributes significantly to losses (Qange et al., 2024). Furthermore, lack of proper storage facilities at the farm level leads to spoilage (Nwankwo & Chiekezie, 2024). Bad roads and delays in transportation, traditional and rudimentary processing methods, Inefficient Processing, Insufficient financial resources limit farmers' ability to invest in better harvesting, handling, and processing technologies, limited access to information, market access issues, all of these are factors that can influence post harvest losses.

Therefore in view of the foregoing, this study aims at assessing the post harvest losses and food security problems in the study area, and to provide answers to the following research questions:

1. What are the socio-economic characteristics of cassava farmers in the study area?
2. What are the factors affecting post harvest losses in cassava production in the study area?
3. What is the degree of food insecurity level among respondents in the study area
4. What are the strategies used by respondents to combat food insecurity
5. What are the constraints faced by respondents with post harvest activities in the study area?

1.3 Objectives of the Study

The broad objective is to assess the post harvest losses in cassava production and their implications on food security in Etsako east L.G.A. of Edo state, Nigeria. The specific objectives are:

1. Describe the socio economic characteristics of respondents in the study area.
2. Determine the factors affecting post-harvest losses in cassava production in the study area.
3. Analyze the degree of food insecurity level among respondents in the study area
4. Determine the strategies used by respondents to combat food insecurity in the study area
and
5. Identify the constraints faced by cassava farmers after production in the study area

1.4 Justification for the Study

Recent studies estimate that up to 35% of cassava is lost along Nigeria's value chain, significantly reducing food supply, raising market prices, and worsening food insecurity. These losses are largely driven by rapid physiological deterioration, insufficient processing

infrastructure, and various socioeconomic challenges (Teferra, 2022, as cited in Chiekezie et al., 2024).

The traditional methods of cassava processing are labor-intensive, and the resulting products are often contaminated with undesirable foreign materials, making them unhygienic and reducing their market value (Taiwo & Fasoyiro, 2015, as cited in Adeleye et al., 2021).

The study aims to identify key loss points by identifying where and why losses occur—such as at harvesting (the stage with the highest loss, up to 55% (Femi Ogundele (2022), processing, and distribution, cannot be over emphasized, the study aims to provide actionable insights for targeted interventions. Reducing post-harvest losses increases the efficiency of cassava production, conserves resources, and helps stabilize food prices. It is essential for transforming cassava from a subsistence crop to a reliable cash crop, supporting broader rural development goals.

Also several works have been done post harvest losses of cassava production in Nigeria but little or no work has been on post harvest losses in cassava production and the implications on food security among rural small-scale farmers in Nigeria for example in 2022, Femi Ogundele conducted a research on Post Harvest Losses and Food Security in Nigeria and found out that high post harvest losses occur across staple crops like yam, cassava and rice suffering the highest losses during harvesting. Cassava farmers recorded an average loss of about 22.6% at the farm level especially during harvesting, processing losses averaged around 1.8%, and marketing losses about 5.1% (Ogundele, 2022).

This research would show the major causes of losses at the farm level include traditional harvesting methods, with about 95% of farmers using hand tools such as hoes, cutlasses, and sickles, which contribute to mechanical damage.

This study will examine post harvest losses in cassava production and its implications to food security in Etsako east L.G.A. Edo state. It is expected that information from this research will be beneficial to government agencies in policy formulation, extension agencies and agents in determining how to go about disseminating information, research institutions, entrepreneurs who would like to get into cassava production and the general public that seeks information on post harvest losses in Etsako east Edo state Nigeria.

The research is significant because it will not only quantify the scale and drivers of cassava post-harvest losses but also connect these losses to broader issues of food security, small scale rural farmer welfare, and sustainable development in Nigeria.

1.5 Hypotheses

1. **H0₁**: There is no significant relationship between the socioeconomic characteristics of respondents and their food insecurity level in the study area.
2. **H0₂**: There is no significant relationship between respondents socioeconomic characteristics and the strategies used by respondents to combat food insecurity in the study area
3. **H0₃**: There is no significant relationship between the socioeconomic characteristic of the respondent and the constraint faced by cassava farmers after production in the study area.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nature and Magnitude of Post-Harvest Loss in Cassava Production

2.1.1 High Perishability and Rapid Post Physiological Deterioration (PPD)

Cassava is a staple crop widely cultivated by small-scale farmers, especially in Nigeria. A key challenge with cassava post-harvest management is its high perishability, predominantly driven by Post-Harvest Physiological Deterioration (PPD) that begins within 24 to 72 hours after harvest (Nwankwo & Chiekezie, 2024)

The physiological deterioration process leads to discoloration, accompanied by increased tissue softening, off-odors and flavors, a decline in starch content, and microbial susceptibility, which makes the roots unmarketable and inedible typically within 7 to 10 days under ambient tropical conditions (Zainuddin et al., 2023; Mbinda et al., 2022). The initiation of PPD is fundamentally linked to mechanical damage sustained during harvesting or handling, which triggers cellular injury and activates a cascade of metabolic responses aimed at defense and healing but which paradoxically accelerates deterioration (Wahengbam et al., 2023).

At the cellular level, PPD is closely associated with the overproduction of reactive oxygen species (ROS). These molecules, including hydrogen peroxide and superoxide anions, accumulate rapidly in response to tissue injury and cause oxidative stress that damages membranes, proteins, and other critical cellular components. The accumulation of ROS leads to lipid peroxidation and the oxidation of phenolic compounds, which contribute to the characteristic discoloration and textural spoilage of the roots (Li et al., 2022).

The extent and speed of PPD are influenced by several internal and external factors. Internal factors include varietal differences in biochemical composition, antioxidant enzyme activities,

and the concentrations of metabolites such as ascorbic acid and glutathione, which mitigate oxidative damage. Externally, temperature, humidity, and handling practices significantly modulate PPD progression. For instance, elevated temperatures and improper storage conditions exacerbate ROS generation and phenolic oxidation, accelerating deterioration (Zhao et al., 2023). PPD poses serious challenges for the cassava value chain, from farmers to consumers, by reducing the availability of fresh roots for consumption or processing. The rapid perishability drives the need for immediate processing or utilization, constraining market access and increasing postharvest losses, which in turn negatively impact livelihoods and food security in cassava-dependent regions. The economic impact of cassava perishability is immense, particularly in sub-Saharan Africa, where cassava is a major food source. Postharvest losses not only reduce the quantity and quality of the crop available for consumption but also translate into significant income losses for farmers. For example, improper storage alone accounts for about 25% of total unrealized income from cassava, with disease, poor handling, transportation, and marketing challenges further compounding losses (Jimoh et al., 2025).

Mitigating PPD requires a multidisciplinary approach, including breeding for resistant varieties, improving postharvest handling to minimize mechanical damage, and employing storage technologies that reduce oxidative stress. For example, the use of edible coatings, controlled atmosphere storage, and antioxidant treatments show promise in extending shelf life by slowing PPD (Akitoye et al., 2024)

2.1.2. Quantification of Post-Harvest Losses: Regional and Seasonal Variability

Cassava farmers face various forms of losses, consistent with FAO (2021) classifications which classifies postharvest losses into physical, economic, and monetary categories. Physical losses occur when cassava is damaged and must be discarded at any stage of the value chain. Economic

losses involve quality deterioration that reduces market value or limits intended use, though products may still be repurposed. Monetary losses refer to financial setbacks resulting from physical or economic losses, including theft. Globally, estimates of cassava postharvest losses range between 15% and 60%, with African smallholder farmers typically losing 30% to 50% of their harvests (FAO, 2021). These losses vary seasonally and regionally depending on environmental conditions, storage methods, and farmer practices. Such quantitative losses translate into lower farmer incomes and reduced cassava availability in rural households, exacerbating food insecurity.

(FAO, 2019; Abass et al., 2018; Affognon et al., 2020). For instance, a study showed average postharvest loss reaching 32%, with variations based on farmer demographics, processing methods, and infrastructure (Chinedum et al., 2024).

Loss estimations are typically based on farmer surveys, direct physical assessment, or combined approaches where losses are reported or measured at different stages including harvesting, sorting, packaging, transport, storage, and marketing.

A recent study combined cassava farmers' reports with multiple linear regression analysis to quantify losses by stage and estimate the financial impact on farmers. It found that improper storage accounted for the largest share of losses at about 25%, followed by pest and disease infestations (~22%), poor handling (~17%), and inadequate harvesting techniques (~14%). The study also estimated an average loss of 2,062 kg of cassava per farmer, resulting in an unrealized income of ₦25,506, highlighting the significant financial impact of these postharvest losses. (Jimoh et al., 2025).

Regional variability in losses is often tied to differences in infrastructure, storage facilities, and climate. Studies from African cassava-growing areas show that loss distribution varies widely

across localities. For example, a study from Otukpo, Benue State, Nigeria, highlights that improper handling during harvest is the main cause of cassava postharvest losses. Farmers adopt strategies like harvesting at the right maturity, processing cassava into by-products, using breathable packaging, and collaborating with extension workers to reduce losses. Poor infrastructure and market access contribute to losses during transport and storage, confirming regional variability in loss distribution due to infrastructure and climate conditions (Moses et al., 2025).

Farm-level surveys and estimations suggest that the financial losses from postharvest degradation are considerable, with potential income losses running into thousands of local currency units per farmer annually. The economic impact is compounded by the fact that cassava is a staple food crop essential for food security and livelihoods, especially in rural areas. Such losses contribute to food scarcity, price increases, and diminished farmer incomes.

2.1.3. Critical Loss Points in the Cassava Value Chain

Losses occur throughout the cassava value chain, with key hotspots identified as follows:

1. Harvesting: Post-harvest losses often begin at the farm during harvesting of crop. Cassava is usually harvested manually using hoes or cutlasses, and this frequently causes physical damage such as bruising or breakage of the tubers. These injuries expose the crop to microbial invasion and speed up physiological deterioration and oxidative stress that trigger rapid spoilage. (FAO, 2021). Additionally, delayed harvesting or leaving cassava in the ground for too long causes the tubers to become woody and fibrous, making them less marketable (Nzola et al., 2022). In rural Nigeria, lack of trained labor and basic harvesting tools further worsens the situation. Inappropriate harvesting time was identified as the cause of post-harvest losses because this could affect the weight and quality of cassava root (Anyoha et al., 2023). Injury to cassava

storage roots through cuts and abrasions also triggers a complex metabolic machinery that responds rapidly by producing proteins and secondary metabolites to ensure physiological modifications for survival and protection of the injured tissue (Mbinda and Mukami et al., 2022).

2. Handling & Transportation: Losses are further compounded during handling and transportation. Poor road infrastructure in rural areas leads to delays, while rough loading practices, use of inappropriate containers, and exposure to sunlight or rain accelerate deterioration. Delays during transport extend the window of vulnerability, accelerating quality decline, especially given cassava's short shelf life. (Lateef et al., 2021; FAO, 2021). Karim et al. (2020) noted that cassava transported in woven sacks or without cushioning materials often suffers increased bruising. A recent study from Otukpo Local Government Area in Benue State, Nigeria, identified improper handling during harvesting as a major cause of postharvest losses, and highlights the importance of proper processing, such as converting cassava into flour, chips, garri, pellets, bread, and starch, as part of loss reduction strategies. Farmers also adapt by harvesting at the right maturity, using breathable packaging to maintain airflow, and collaborating with extension workers for improved postharvest handling and storage monitoring (Moses et al., 2025). Additionally, poor road networks and a lack of reliable transportation delay the movement of cassava from farms to processing centers or markets, leading to spoilage during transit.

3. Short-term Storage: Cassava's swift post-harvest deterioration limits its storability to a few days. Besides direct loss, post-harvest deterioration results in a decline in root quality, which results in price markdowns and adds to financial losses (Anyoha et al., 2023). According to Fondong and Ray (2018), as cited by Anyoha (2023), many rural farmers continue to produce cassava without adequate knowledge of proper storage techniques or modern processing methods.

Cassava is highly perishable due to its high moisture content and lack of natural protective covering. A recent article by the Guardian Editorial Board (2025) reported that, in most smallholder farming communities, appropriate storage infrastructure, such as cooling facilities or modified atmosphere storage is lacking. As a result, farmers often leave cassava unharvested until needed, a practice that increases the risk of loss due to pest attacks or poor weather conditions. Cassava roots are notoriously difficult to store fresh beyond 2–3 days without advanced interventions. Physiological post-harvest deterioration (PPD) is known to involve enzymatic stress responses to wounds and changes in gene expression. PPD can be accompanied by moisture and starch loss. Attempts to extend the shelf life of fresh cassava have explored curing, varietal differences, chemical treatments, storage containers, and minimizing physical damage during harvest and handling. Curing—wound healing at 80–85% humidity and 25–35 °C—has proven effective in reducing storage losses. Previous studies report storage durations ranging from 11 days to two months, though mostly under small-scale laboratory conditions with limited practical application. Larger trials in Colombia (300 kg) and Tanzania (500 kg) showed potential but lacked replication. Given cassava’s low market value, the challenge remains to develop an affordable large-scale storage solution (Tomlins et al., 2021). Traditional storage systems often fail to extend shelf life sufficiently, resulting in losses estimated around 25% of the total postharvest loss in some assessments (Olufemi & Lebot, 2021). Traditional storage practices used for other tubers such as yam are largely ineffective for cassava, contributing to rapid losses. Research has shown that ventilated crates, waxing, and storage under modified atmospheres can extend shelf-life marginally (Wheatley & Gomez, 2020), but such technologies are rarely accessible to smallholder farmers.

4. Processing: The cassava processing industry in Nigeria faces major constraints such as the lack of appropriate machines, tools, equipment, and affordable processing technologies. Many of the available machines are locally fabricated without adequate input from engineering research, making them less effective and unsuitable for efficient processing (Abiodun et al., 2024). Rapid processing is essential to preserve cassava after harvest, but small-scale farmers often lack access to adequate processing equipment such as motorized graters, mechanical presses, and solar dryers. Many rely on manual or traditional methods that are slow and labor-intensive. This delay results in significant quality deterioration before the produce can be turned into shelf-stable products like gari or flour (Food Business Africa, 2023). The absence of decentralized processing centers in farming communities creates a bottleneck, particularly during peak harvest seasons. Processing is both a preservation strategy and a critical loss point.

5. Marketing: Losses at this stage are related to poor storage by vendors, extended holding periods, and rejection of produce based on quality criteria such as size, appearance, and spoilage symptoms. Markets may lack cold storage or appropriate facilities, exposing products to further deterioration. The short marketability window restricts sales volume, driving economic losses for traders and farmers alike (Westby, 2020). Furthermore, consumer preferences for fresh and undamaged roots mean that even slightly blemished cassava may be unsold (Ndukwu et al., 2019). Processed cassava products such as gari and fufu also face losses due to inadequate packaging, moisture absorption, and microbial contamination (Akinyele & Akinyele, 2020).

2.2. Determinants and Causes of Post-Harvest Loss Among Small-Scale Farmers

2.2.1 Biological and Physiological Factors Influencing PHL

Physiological factors such as the effect of environmental stressors, especially heat and drought, further aggravate PHL. Higher losses during the dry season (61.4%) compared to the rainy season (38.6%) correlate with increased physiological stress on cassava roots, which accelerates PPD and enhances vulnerability to fungal invasion. (Owusu et al., 2023).

Soil fertility also plays a significant role. While cassava adapts to a range of soil types, poor soil fertility limits root development and vigor, indirectly affecting post-harvest quality and increasing susceptibility to deterioration. During an interview a 29 year old male farmer pointed out that soil fertility was another challenge to consider in cassava farming (Oyekola et al., 2021).

A study in Oyo State reflects these dynamics: higher losses in the dry season (61.4%) compared to the rainy season (38.6%) may be attributed to increased physiological stress on cassava roots under hot, dry conditions, which accelerates PPD and makes tubers more vulnerable to fungal invasion. Furthermore, since 78.8% of households processed their cassava and nearly all of them (78.6%) still reported losses during processing, it highlights that cassava's biological vulnerability extends beyond storage—poor processing methods, contamination, and microbial growth during fermentation or drying also exacerbate losses (Bamikole et al., 2022).

These findings show that cassava's inherent physiology (perishability and rapid PPD) combined with biological agents (molds and pests) create a dual challenge, making post-harvest loss both inevitable and severe unless low-cost storage, improved processing, and microbial control measures are adopted.

2.2.2. Technical and Infrastructural Limitations

Small-scale farmers often lack access to technologies that reduce PHL, including:

1. Lack of Appropriate Storage: Cassava roots are rarely stored fresh because of the lack of affordable, effective short-term storage facilities. Many farmers do not have access to low-cost solutions like ventilated storage structures or hermetic packaging, which are essential for slowing physiological deterioration. Without proper storage, farmers are often forced to sell immediately after harvest at low prices, resulting in economic losses and discouraging production. During storage, cassava lose moisture through transpiration, which lowers acidity, reduces cooking quality, and diminishes market value. In rural areas, this problem is reduced because roots are usually harvested and processed immediately for home consumption. However, where immediate processing is not possible, the absence of adequate storage significantly contributes to postharvest losses, reducing both food availability and household income. Cold storage can extend shelf life but is often too expensive or technically demanding for most farmers. Cassava roots are also sensitive to chilling injury; when stored below 5–8 °C, they suffer internal breakdown, water loss, and decay, and their eating quality declines. Although storage at around 3 °C offers the best results, deterioration accelerates once roots are brought back to room temperature. In-ground storage is the simplest and most common traditional practice, as cassava's flexible harvest time allows roots to remain in the soil until needed. However, prolonged storage can cause lignification, reduce quality, and make roots vulnerable to pests and pathogens. Other traditional techniques, like burying in soil, piling with watering, or coating with loamy soil, extend shelf life for only a few days and are unreliable. Over time, cassava roots lose cyanide, moisture, and starch, while ash, sugar, fiber, and acidity levels increase, further reducing quality (Uchechukwu et al., 2015). A recent study in Mubi revealed that 20% of

respondents identified lack of access to adequate warehousing facilities as a major challenge. This constraint often forces farmers to sell their produce at low prices, leading to dissatisfaction and discouragement, ultimately affecting both the quality and quantity of production (Moses et al., 2021).

2. Processing: Processing is a vital pathway for preserving cassava, yet traditional methods such as manual grating, fermentation, and sun-drying remain labor-intensive, weather-dependent, and often inefficient. These limitations cause delays between harvest and processing, leading to increased spoilage and physical losses during manual handling. Limited access to affordable mechanical equipment further worsens post-harvest losses. Mechanization offers a solution by enhancing efficiency and reducing reliance on human labor. Technologies such as powered graters, cassava washing machines, peelers, and chippers have been identified as essential tools for modern cassava processing (Food and Agriculture Organization of the United Nations, 2008, as cited in Agbaeze et al., 2020). The Federal Government of Nigeria (FGN) introduced several initiatives to accelerate mechanization and enhance food production through improved processing. Nevertheless, these efforts have yielded limited progress in cassava processing, largely due to the high costs associated with mechanization. For instance, the prices of powered graters and cassava peelers increased by about 35% between 2012 and 2016 (Ozumba, 2017, as cited in Agbaeze et al.).

3. Transportation: In transportation, the use of unsuitable vehicles and inadequate packaging combined with long transport distances over poor roads leads to physical damage such as bruising and cuts, which accelerate spoilage in transit. The fragile nature of cassava roots demands careful handling to reduce breakage, a condition unmet in many rural areas with poor infrastructure. Efficient transportation networks are essential for moving agricultural products

from farms to markets in a timely manner, reducing spoilage, lowering costs, and improving food affordability. In contrast, poor transportation systems cause delays, increase expenses, and limit the distribution of goods, thereby worsening food insecurity. In Nigeria, one of the major challenges is the deteriorating state of infrastructure, particularly in rural areas where farming is the main source of livelihood. For example, in Ogo-Oluwa Local Government Area (LGA) of Ogbomoso, Oyo State, poorly maintained roads frequently delay the movement of produce to markets, leading to higher costs. Inadequate transport infrastructure not only reduces food availability but also restricts farmers' access to critical inputs such as seeds, fertilizers, and extension services needed to boost productivity. Moreover, inefficient rural transport systems prevent farmers from reaching larger, more profitable markets, thereby limiting their income opportunities and undermining the overall economic vitality of farming communities. Research in Oyo State shows a clear link between road quality, transport costs, and food prices. Paved roads keep costs lowest (₦5,000/ton) with only a 5% rise in food prices. Partially paved roads raise costs moderately, reducing affordability. Poor gravel roads increase costs to ₦12,000/ton and food prices by 20%, while eroded roads are the most costly (₦18,000/ton), causing a 35% price hike due to delays, spoilage, and frequent breakdowns (Adeniran et al., 2025).

2.2.3. Socio-Economic and Institutional Constraints

Several socio-economic factors exacerbate PHL for smallholder cassava farmers:

1. Market Inefficiencies: Market inefficiencies, including weak market linkages, price fluctuations, and lack of market information, significantly contribute to post-harvest losses by limiting farmers' ability to sell cassava promptly and at optimal prices. These inefficiencies force farmers to make decisions that prioritize immediate sales over quality preservation, exacerbating spoilage and economic losses. Weak market systems and poor linkages between farmers and

buyers significantly exacerbate cassava losses. Many small-scale farmers lack access to reliable market information, leading to uncertainties in pricing and demand (Abass et al., 2020). This often compels them to sell immediately after harvest, even at low prices, to avoid spoilage. Furthermore, inadequate rural infrastructure and limited aggregation centers restrict timely sales, while volatile market prices discourage investment in improved post-harvest practices (Ndukwu et al., 2019). Consequently, market inefficiencies create a cycle of low returns and high losses for cassava producers.

2. Limited Finance/Credit: Limited access to finance or credit restricts smallholder farmers' ability to invest in technologies and practices that mitigate post-harvest losses, such as improved processing equipment, storage facilities, or transport solutions. This financial constraint perpetuates reliance on inefficient methods, exacerbating losses and limiting income potential. Access to capital is fundamental to boosting cassava processing and strengthening food production for national development. Improved financing enables farmers and processors to invest in value addition, thereby enhancing food supply and reducing poverty. To address this, the Federal Government of Nigeria (FGN) introduced several schemes to support cassava processing. For example, in 2009, it allocated ₦200 billion under the Commercial Agricultural Credit Scheme (CACS), which provided loans at a maximum interest rate of 9% to promote agricultural ventures, including cassava processing. By 2016, ₦336 billion had been accessed due to the revolving nature of the facility. These funds encouraged participation in cassava processing, contributed to food production, generated employment, and marginally reduced poverty. However, access to capital has remained relatively low, especially among cassava processors, largely because of stringent loan conditions. Between 2012 and 2015, both small- and large-scale cassava processors accessed less than 50% of the total available credit. Evidence

from a 2019 survey reinforces this constraint: 74.71% of respondents agreed that access to capital strongly affects cassava processing in Nigeria, while 16.71% disagreed and 8.58% were indifferent, who argued that capital is essential to advancing cassava processing and food production in Nigeria. Taken together, these findings demonstrate that access to capital remains a critical factor influencing cassava processing and its role in food production, with far-reaching implications for socioeconomic transformation and national development (Agbaeze et al. 2020).

3. Knowledge and Training Gaps: Insufficient awareness and access to training on best practices for harvesting, handling, and storage significantly contribute to post-harvest losses. Many smallholder farmers lack knowledge of modern techniques to minimize mechanical damage, manage PPD, or process cassava efficiently, leading to preventable losses across the value chain. Inadequate knowledge and limited access to extension services hinder the adoption of improved post-harvest practices. Many farmers are unaware of simple, low-cost techniques such as improved harvesting tools, proper handling methods, or basic storage innovations (Teeken et al., 2020). The scarcity of agricultural extension officers and the low coverage of farmer training programs in rural areas further widen these knowledge gaps (Chinedum et al., 2024). Without adequate training, farmers continue to use traditional practices that contribute to inefficiency and loss.

4. Labor Constraints and Gender Dynamics: The high labor demand for timely harvesting and processing of cassava often conflicts with other agricultural or household activities, leading to delays that exacerbate post-harvest losses. Labor shortages or inefficiencies prevent farmers from harvesting at the optimal time or processing cassava quickly, allowing PPD to degrade quality. Gender dynamics significantly influence post-harvest losses, as women, who are often the primary processors of cassava in regions like Nigeria, face unique constraints that limit their

ability to adopt loss-reducing practices. These constraints include limited access to resources, time burdens, and social barriers, which exacerbate inefficiencies in the value chain. Cassava post-harvest management in sub-Saharan Africa is deeply influenced by gender dynamics and labor availability, with women playing a dominant role in processing activities. Women are primarily responsible for labor-intensive tasks such as peeling, washing, fermenting, and drying—critical steps in reducing postharvest loss and ensuring product quality. However, these women often face "time poverty" due to the dual burden of agricultural work and extensive domestic responsibilities, which limits the time they can devote to timely and efficient postharvest management. The disproportionate workload on women reduces their capacity to manage postharvest loss effectively, contributing to higher losses and decreased income which affects household food security. Additionally, women's limited access to resources such as credit, labor-saving technologies, extension services, and market information restricts their ability to adopt improved storage and processing methods. Research indicates that men typically own the assets and control decision-making related to production and processing, even though women carry out a significant share of postharvest work, which further limits women's agency and investment in postharvest loss reduction. Moreover, socio-cultural norms often reinforce gender roles that confine women to low-value, labor-intensive parts of the cassava value chain and limit their participation in higher-value activities and leadership. These constraints create structural barriers to improving efficiency and reducing losses within the value chain (Masamha et al., 2025). Addressing these gender-specific challenges requires targeted interventions, such as promoting labor-saving technologies accessible to women, strengthening women's cooperatives, and improving their access to finance and extension services. Incorporating gender considerations into cassava breeding programs, extension, and value chain development

initiatives leads to better adoption of innovations that meet both men's and women's needs (FAO, 2011). Gender inequalities in access to land, finance, and extension services further adds to the constraints of post-harvest losses (Umar et al., 2021).

2.3. Implications of Post-Harvest Loss for Food Security

2.3.1. Reduction in Physical Food Availability In Households and Community Levels

Cassava is a staple crop for millions in sub-Saharan Africa, providing calories and dietary energy for rural and urban households alike. However, its high perishability and susceptibility to physiological post-harvest deterioration (PPD) reduce the volume of edible cassava available for consumption (Hillocks, 2021). This immediate reduction in food supply is particularly critical in rural households that rely heavily on cassava for daily subsistence. Abass et al. (2020) observed that PHL diminishes food availability at both household and national levels, undermining food security even when production volumes appear sufficient at harvest. According to the Food and Agriculture Organization (FAO), food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy life (FAO, 2021). The concept is built on four interrelated pillars:

- Availability refers to the physical presence of food through domestic production, imports, or aid
- Accessibility relates to economic and physical access to food, can people afford and reach it?
- Utilization addresses how the body uses food, influenced by dietary diversity, nutrition, and sanitation.

- Stability ensures that the first three pillars are sustained over time, even during economic or climate shocks (FAO, 2021).

2.3.2. Economic Impact: Loss of Income and Constraints on Food Access

PHL leads to diminished quantities available for market sale, reducing farmers' cash income. Further, deteriorated roots sell at lower prices or may be unsellable, severely limiting economic access to other food types and household necessities (Nweke et al., 2020; FAO, 2021).

Post-harvest losses reduce the marketable yield for farmers, diminishing their earnings and ability to invest in improved agricultural practices and technologies (Vutula, 2024).

2.3.3. Nutritional Consequences and Food Safety Risks

Losses reduce not only calories but also the nutritional quality of households' food supply. Delays in processing can increase cyanogenic compounds in some cassava cultivars, posing safety risks (Bradbury & Holloway, 2021). Loss of roots intended for value-added products (e.g., gari and flour) further reduces dietary diversity and nutrient intake, impacting the **utilization** dimension of food security. PHL leads to degradation of essential nutrients in cassava, increasing risks of malnutrition, especially among vulnerable groups like children and pregnant women (Bahn et al., 2022).

2.3.4. Exacerbation of Food Supply Instability and Household Vulnerability

PHL increases seasonal variability in supply, creating periods of scarcity and vulnerability during lean seasons, undermining the **stability** of food access and incomes (FEWS NET reports, 2022).

Reduced food reserves from postharvest losses heighten susceptibility to shocks such as climate variability, pest outbreaks, and economic disruptions

2.3.5. Loss of Agricultural Resources and Reduced Productivity

PHL represents wasted land, water, labor, and agricultural inputs, reducing overall farm productivity and efficiency, thereby further compromising food security (Kummu et al., 2021).

Losses waste inputs such as land, water, labor, and fertilizers, resulting in inefficient resource use and increased environmental impact (Vutula, 2024).

2.4. Vulnerability and Challenges Specific to Small-Scale Cassava Farmers

Resource scarcity profoundly limits smallholder farmers' capacity to address post-harvest losses (PHL) in the cassava value chain, particularly in sub-Saharan Africa, with Nigeria as a critical case due to its status as the world's largest cassava producer. Smallholders typically operate on small landholdings, often less than 2 hectares, and have minimal capital, restricting their ability to invest in modern technologies such as drying racks, ventilated storage facilities, or processing equipment like motorized graters and mechanical presses, which are essential for reducing losses caused by cassava's high perishability (Liverpool-Tasie et al., 2017). The lack of financial resources forces reliance on traditional methods, such as manual harvesting with hoes or cutlasses, which frequently cause mechanical damage like bruising or cuts, triggering post-harvest physiological deterioration (PPD) within 24–72 hours through oxidative stress and reactive oxygen species (ROS) accumulation (Li et al., 2022; Nwankwo & Chiekezie, 2024).

Similarly, traditional storage practices, such as piling cassava roots in heaps or leaving them unharvested in the ground, are ineffective at preventing spoilage, as they fail to control environmental factors like high humidity and temperature, leading to losses of 20–30% of harvested roots (Affognon et al., 2015; Olufemi & Lebot, 2021). In Nigeria, where cassava is a staple for over 70% of the population, resource scarcity is exacerbated by limited access to formal financial systems, with many farmers relying on high-interest informal loans that further

constrain their investment capacity (FAO/IFAD, 2019). This scarcity results in significant physical losses, with an average of 2,062 kg of cassava lost per farmer, translating to an economic loss of ₦25,506, which severely restricts household income and the ability to purchase diverse foods or non-food essentials like healthcare and education (Jimoh et al., 2025). These losses reduce food availability for both household consumption and market supply, exacerbating food insecurity and perpetuating poverty in rural areas like Otukpo, Benue State, where infrastructure limitations amplify the problem (Moses et al., 2025).

The inefficiency caused by resource scarcity also limits land and labor availability for other crops, straining overall agricultural productivity and contributing to a cycle of low output and economic vulnerability (Kummu et al., 2012; FAO, 2019). To mitigate these challenges, microfinance programs tailored to smallholders can provide affordable credit to invest in technologies like solar dryers or ventilated crates, which extend cassava's shelf life by maintaining airflow and reducing PPD (Akitoye et al., 2024). Farmer cooperatives can pool resources to access shared processing facilities, as demonstrated in some Nigerian communities, while government subsidies for affordable equipment can alleviate financial barriers (Abiodun et al., 2024). Extension services, such as those implemented in Otukpo, can train farmers on optimal harvesting and storage techniques, such as harvesting at the right maturity to minimize damage, thereby enhancing resource efficiency and supporting food security and livelihoods in cassava-dependent regions (Moses et al., 2025; FAO, 2021).

2.4.1. Financial and Resource Constraints for Loss Mitigation

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2.4.2. Market Power Imbalance and Forced Early Sales

Market power imbalances place smallholder cassava farmers in a precarious position, as they are price-takers in markets dominated by intermediaries who exploit their limited storage and transport options, particularly in Nigeria, where poor infrastructure exacerbates these challenges. Cassava's high perishability, with PPD setting in within 24–72 hours, forces farmers to sell quickly during harvest gluts to avoid spoilage, often at significantly reduced prices due to oversupply (Tittonell et al., 2010; Nwankwo & Chiekezie, 2024). Inadequate road networks and lack of cold storage facilities delay transport to markets, increasing spoilage risks and leading to rejection of deteriorated cassava showing symptoms like discoloration or off-odors, contributing to 30–50% PHL (Lateef et al., 2021; FAO, 2021; Ndukwu et al., 2019).

The absence of real-time market information further weakens farmers' bargaining power, as they cannot identify better markets or optimal selling times, leaving them vulnerable to middlemen who dictate prices (Abass et al., 2018). This dynamic results in substantial economic

losses, with an estimated ₦25,506 in unrealized income per farmer, limiting economic access to diverse foods and non-food essentials like healthcare, and perpetuating poverty in rural Nigeria, particularly in regions like Benue State (Jimoh et al., 2025; Moses et al., 2025). These imbalances also discourage investment in loss-reduction strategies, as low returns diminish farmers' financial capacity, further entrenching economic vulnerability and reducing market supply, which exacerbates food insecurity (FAO, 2019).

Mitigation strategies include strengthening farmer cooperatives to enhance collective bargaining power, as seen in some Nigerian initiatives, allowing farmers to negotiate better prices and reduce reliance on intermediaries (Abass et al., 2018). Mobile-based market information systems or community radio can provide real-time data on prices and demand, empowering farmers to make informed decisions, while investments in rural infrastructure, such as paved roads and market facilities with cold storage, can reduce transport delays and spoilage, enabling access to urban markets with higher prices (FAO, 2019; Moses et al., 2025). These interventions can improve income, stabilize market supply, and support food security by ensuring more cassava reaches consumers in better condition, aligning with broader economic development goals.

2.4.3. High Dependence on Cassava as Staple and Cash Crop

The heavy reliance on cassava as both a staple food and primary income source among smallholder farmers in sub-Saharan Africa, particularly Nigeria, makes PHL particularly devastating, as it directly undermines household food security and financial stability with few alternative options. Cassava's short shelf life and susceptibility to PPD, triggered by mechanical damage during harvesting or handling, result in 20–30% losses, with an average of 2,062 kg lost per farmer, equating to ₦25,506 in unrealized income, severely impacting households that

depend on cassava for both consumption and cash (Liverpool-Tasie et al., 2017; Affognon et al., 2015; Jimoh et al., 2025).

In Nigeria, where cassava is a dietary staple for over 70% of the population, these losses reduce household food availability, forcing over-reliance on cassava's carbohydrate-heavy, low-nutrient profile, which limits dietary diversity and increases malnutrition risks, particularly among children and pregnant women (FAO, 2011; Hodges et al., 2011). The lack of diversified crops or income sources leaves households with few fallback options, exacerbating poverty and food insecurity in regions like Otukpo, where infrastructure and market access are limited (Moses et al., 2025; Nzola et al., 2022). This reliance also strains local economies, as reduced income limits purchasing power for agricultural inputs or other essentials, perpetuating low productivity (FAO, 2019).

To address this, promoting crop diversification can provide alternative food and income sources, reducing vulnerability to cassava losses, while improved storage technologies, such as curing at 80–85% humidity or ventilated crates, can extend shelf life and preserve both food and income (Akitoye et al., 2024). Rapid processing with modern equipment, like motorized graters, can convert cassava into shelf-stable products like gari, and extension services training farmers on efficient harvesting and processing, as implemented in Nigeria, can further minimize losses, enhancing resilience and nutritional outcomes for cassava-dependent households (Abiodun et al., 2024; Moses et al., 2025; FAO, 2021).

2.3.4. Lack of Risk Management and Coping Mechanisms

The absence of formal risk management tools, such as insurance or credit, leaves smallholder cassava farmers in Nigeria highly vulnerable to the financial impacts of PHL, as they cannot cushion losses from spoilage or market volatility. Cassava's rapid perishability, with PPD

causing quality deterioration within 24–72 hours, combined with unreliable storage options like heaps or non-breathable sacks, results in ~25% of losses due to improper storage, contributing to 30–50% total PHL (Tittonell et al., 2010; Olufemi & Lebot, 2021; FAO, 2021). These losses translate to significant financial setbacks, with an average of ₦25,506 in unrealized income per farmer, limiting economic access to food and non-food essentials and perpetuating poverty, particularly in rural areas like Benue State where financial services are scarce (Jimoh et al., 2025; Moses et al., 2025). Without insurance, farmers bear the full cost of losses from PPD, pest infestations (~22% of losses), or price fluctuations during gluts, while limited credit access restricts investment in technologies like solar dryers or ventilated crates, further entrenching vulnerability (FAO/IFAD, 2019; Jimoh et al., 2025). This lack of risk management tools discourages adoption of loss-reduction strategies, as farmers prioritize immediate survival over long-term investments, straining food security and local economies (FAO, 2019). Mitigation includes developing microinsurance products tailored for smallholders to cover PHL risks, while microfinance programs can provide credit for storage and processing investments, such as curing or mechanical presses, which reduce spoilage (FAO/IFAD, 2019; Tomlins et al., 2021). Policy support for financial inclusion and extension services, as seen in some Nigerian initiatives, can train farmers on effective practices, enhancing resilience and supporting food security by ensuring more cassava is preserved for consumption and sale (Moses et al., 2025; Akitoye et al., 2024).

2.5. Emerging Trends and Future Challenges

2.5.1. Impact of Climate Change on Post-Harvest Loss Dynamics

Climate change significantly exacerbates PHL in the cassava value chain by accelerating PPD through rising temperatures, which increase ROS accumulation and cause spoilage within 24–72

hours, and by disrupting traditional drying processes with erratic rainfall, leading to mold and spoilage in processed products like gari. In Nigeria's humid tropical climate, higher temperatures worsen PPD, while unpredictable rainfall affects processing, contributing to 20–30% losses, with pest and disease pressure, such as from cassava whitefly, accounting for ~22% of PHL by damaging roots pre- and post-harvest (Jarvis et al., 2012; Zhao et al., 2023; Jimoh et al., 2025). These losses reduce cassava availability and marketability, lowering income and exacerbating food insecurity in regions like Otukpo, where climate impacts are pronounced, threatening livelihoods for cassava-dependent communities (FAO, 2019; Moses et al., 2025). Reduced quality from mold or pest damage leads to market rejection, further diminishing economic access to diverse diets, while increased losses strain land and water resources, limiting agricultural productivity (Ndukwu et al., 2019; Kummu et al., 2012).

Mitigation strategies include breeding climate-resilient, PPD-resistant cassava varieties with enhanced antioxidant activity to reduce spoilage, while solar dryers can ensure effective processing despite erratic rainfall (Akitoye et al., 2024; Abiodun et al., 2024). Integrated pest management can address climate-driven pest pressures, and extension services, as implemented in Nigeria, can promote adaptive practices like early harvesting or improved drying, minimizing losses and supporting food security and economic stability in the face of climate challenges (FAO, 2021; Moses et al., 2025).

2.5.2. Urbanization, Changing Consumer Preferences, and Pressure on Value Chains

Rapid urbanization in sub-Saharan Africa, particularly Nigeria, drives increased demand for convenient, processed cassava products like gari, flour, and snacks, requiring smallholder farmers to meet stringent quality standards, such as low cyanide content and uniform texture, to remain competitive in urban markets. However, limited access to modern processing facilities,

such as motorized graters or solar dryers, and knowledge gaps prevent smallholders from producing high-quality products, leading to rejection of substandard cassava and contributing to 30–50% PHL (Oparinde et al., 2017; Abiodun et al., 2024; FAO, 2021).

In Nigeria, poor road networks and inadequate infrastructure in rural areas like Benue State hinder access to urban markets, while delays in processing increase cyanogenic potential in high-cyanide varieties, posing health risks and reducing marketability, further limiting income and food security (Chiwona-Karlton et al., 2004; Moses et al., 2025). These challenges disadvantage smallholders compared to larger commercial producers, reducing their market share and economic opportunities, which exacerbates poverty and restricts dietary diversity (Westby, 2020; FAO, 2019).

To address this, investments in decentralized processing centers with modern equipment can enable smallholders to produce high-quality products, while training on low-cyanide processing and quality standards can enhance marketability (Food Business Africa, 2023; Chiwona-Karlton et al., 2004). Strengthening value chain linkages through cooperatives and improving infrastructure, such as roads and market facilities, can facilitate access to urban consumers, reducing PHL and boosting income, thereby supporting food security and livelihoods in cassava-dependent regions (Abass et al., 2018; Moses et al., 2025).

CHAPTER THREE

METHODOLOGY

3.1 Study Area and Scope

Etsako East is one of the 18 local government areas of edo state and is one of three Local Government Areas where majority of residents are Etsako people. It is located in the south-south geo-political zones of Nigeria which has its administrative headquarters located in Agenebode which is a prominent town situated on the bank of the River Niger. The LGA is bordered by Kogi State to the north and Etsako Central to the west. Geographically, Etsako East lies on latitude 7.2092° North and longitude 6.4961° East, with an average elevation of approximately 223 meters above sea level. It has an area of 1,133 km² and a 2022 projected population size of 217,700 people. The postal code of the area is 312. The Sub-Division consists of the Okpella, South-Ibie and Weppa-Wanno clans as well as some other groupings of the Ineme clan. The area is home to Christian's, Muslims and traditional worshippers.

A number of towns and villages make up of Etsako East local area and these are Iviogheme, Iviokpo, Iviomhe, Iviukhua, Iviukwe, Izotha, Oba Dudu, Obadudu, Ofukpo, Ogwoyo, Ogwozima, Ogwukpakpa, Okanawua, Okieh, Okiolomi, Oshola, Otaukwi, Othame, Ovao, Ugbato, Ughoke, Ukho, Ukpeko, Ukpeko-Agbugwi, Uzanu, Weppa-Wanno. Etsako East is blessed with fertile land suitable for the cultivation of diverse crops like cassava, yam, groundnut, with agriculture serving as the mainstay of the economic activity. Fishing, livestock rearing, and small-scale trading also contribute to the local economy. The area is rich in limestone and other precious minerals. Etsako East includes plains, hills, rivers and streams including the Niger River.

Climatically, the area experiences two distinct seasons: the rainy season (April to October) and the dry season (November to March), which influence the pattern of cultivation of cassava.

The scope of this study will be limited to small holder cassava farmers in Etsako East, Edo State.

3.2 Sampling Technique and Sample Size

A two-stage sampling procedure will be used in selecting the respondents in the study area who will be cassava farmers. At the first stage, five (5) major cassava-producing communities will be purposely selected from Etsako East LGA based on their high level of cassava production and accessibility. These communities will include Agenebode, Okpella, Weppa-Wanno, Imiegba, Okugbe. In the second stage, a simple random sampling will be used to select 20 respondents from each community to give a total sample size of 100.

3.3 Data Collection

Data collected for the study will be obtained through primary and secondary sources. The primary data will be collected through structured questionnaires, interviews and field observation which will be personally administered to respondents through field surveys. The secondary data will be obtained through the use of the internet, journals, ebooks, relevant literature etc.

3.4 Measurement of Variables

Objective 1: Socio-economic characteristics of respondents will be measured nominally as follows:

1. Sex: Male will score 1, Female will score 2.
2. Age: Respondents will be asked to fill in their actual number of years.
3. Marital status: Single will score 1, Married will score 2, Divorced will score 3, Widowed will score 4, and Separated will score 5.

4. Household size: Respondents will be asked to fill in the number of persons feeding from the same pot and living together.
5. Level of education: No formal education will score 1, Primary education will score 2, Secondary education will score 3, and Tertiary education will score 4.
6. Years of farming experience: Respondents will be asked to fill in the number of years they will have spent in the cassava value chain; an interval scale will be used to measure their years of farming experience.
7. Farm size: Respondents will be asked to fill in the size of their farm in hectares.
8. Access to extension services: Respondents will indicate their access to extension services by ticking: a. Easily accessible b. Hard to access c. No extension service access.
9. Membership in association: Respondents will indicate if they will be members of any agricultural association: a. Yes b. No. If yes, a follow-up question will capture the specific association (e.g., cooperative societies).

Objective 2: Factors affecting post-harvest losses in cassava production.

1. Storage methods used: Respondents will be asked to tick all the storage methods they will currently use for storing harvested cassava.
Examples: Heap method, pit storage, in-ground storage, jute bags or sac etc.
2. Duration before processing or sale: Respondents will indicate how long after harvest before processing or sale of cassava.
Examples: Same day, 1–2 days, 3–5 days etc.
3. Transportation conditions: Respondents will rate the condition of the transportation used to carry cassava after harvest using a 5-point Likert scale.

4. Environmental conditions (e.g., rainfall, pests): Respondents will indicate how much these environmental factors will affect harvested cassava before sale or processing, using a 5-point Likert scale.
5. Use of preservatives or processing techniques: Respondents will be asked to indicate which of the following techniques they will use to preserve or process cassava and how often.
6. Storage duration before processing or sale: Respondents will be asked to indicate how long they will typically store cassava before processing or selling it.
7. Access to processing equipment/facilities: Respondents will be asked whether they will have access to cassava processing equipment or facilities.
8. Distance from farm to processing/storage site: Respondents will be asked to estimate the average distance between their cassava farm and the processing or storage site.

Objective 3: Degree of food insecurity level among respondents

1. Household Dietary Diversity Score (HDDS): Respondents will be asked to list all food groups consumed by household members in the previous 24 hours.
2. Frequency of meals per day: One meal will score four, two meals will score three, three meals will score two, more than three meals will score one.
3. Household food shortage experience in the past 6–12 months: Respondents will indicate how often their household will experience food shortage, using a Likert scale.
4. Ability to purchase food from income earned from cassava: Respondents will indicate how often income from cassava production will allow them to buy enough food for the household.

5. Quantity of cassava retained for home consumption: Respondents will indicate how much of their harvested cassava they will usually keep for household consumption.

Objective 4: Strategies used by respondents to combat food insecurity

1. Coping strategies: Respondents will be asked to indicate how frequently their household will use various coping strategies when there is not enough food.
2. Diversification of income sources: Respondents will be asked whether they will engage in more than one income-generating activity to improve household food access.
3. Cultivation of multiple food crops: Respondents will be asked whether they will grow other food crops alongside cassava to increase household food supply.
4. Selling cassava in small quantities to buy other food items: Respondents will be asked if they will sell part of their cassava harvest in small batches to meet food needs.

Objective 5: Constraints faced by cassava farmers after production: A number of constraints will be provided and respondents will be asked to rate how serious the following problems are for them after harvesting cassava, using a five-point Likert scale:

- 1 = Not a Problem
 - 2 = Minor Problem
 - 3 = Moderate Problem
 - 4 = Serious Problem
 - 5 = Very Serious
1. Transport difficulties – Challenges in moving harvested cassava from the farm to processing or market locations.

2. Lack of storage facilities – Absence or inadequacy of proper structures for storing fresh or processed cassava.
3. High cost of processing – The expense involved in converting raw cassava into usable or marketable forms.
4. Lack of market access – Difficulty in locating or reaching buyers or marketplaces to sell cassava products.
5. Pest and disease problems during storage – Infestation or spoilage of cassava tubers caused by pests, molds, or diseases post-harvest.
6. Poor pricing or middlemen exploitation – Selling cassava at low prices due to the influence of intermediaries or lack of bargaining power.
7. Lack of government support – Absence of post-harvest interventions, subsidies, or programs to assist cassava farmers.
8. Delayed access to processing equipment/facilities – Long waiting times or unavailability of cassava-processing units.
9. Poor road network from farm to market – Bad or inaccessible roads making transport of cassava difficult and expensive.
10. Lack of reliable buyers – Inability to find consistent or trustworthy buyers for cassava or its products.
11. Inadequate access to packaging materials – Shortage of sacks, bags, or containers for proper packaging of cassava.
12. High cost of transportation – Increased expenses related to moving cassava from the farm to markets or processors.

13. Theft or insecurity during post-harvest handling – Incidents of cassava being stolen or losses due to poor farm security.
14. Poor knowledge of post-harvest handling – Farmers’ limited understanding of techniques to preserve cassava quality.
15. Inadequate extension services after harvest – Limited access to agricultural extension workers or advisory services on post-harvest practices.
16. Inadequate drying or processing space – Lack of flat, clean, or weather-proof space for drying cassava products.
17. Gluts during harvest season – Oversupply of cassava in the market leading to low prices and inability to sell.
18. Spoilage due to delays in processing – Post-harvest losses resulting from slow or unavailable processing options.
19. Low consumer demand for processed cassava – Difficulty selling products like garri, fufu, or cassava flour due to weak demand.
20. Unstable prices in the market – Frequent fluctuations in cassava prices affecting income predictability.
21. Poor access to market information – Lack of timely updates on market prices, buyer demand, or trends affecting sales.

3.5 Data Analysis

Objective 1: This will be analyzed using descriptive statistics such as mean, frequency, and percentage

Objective 2: Data collected will be analyzed using descriptive statistics, such as percentage mean, frequency, percentage, chi-square or logic regression.

Objective 3: This will be analyzed with the use of mean, frequency, percentage, and categorization.

Objective 4: This will be analyzed with the use of mean, ranking, and frequency

Objective 5: Data collected will be analyzed using a mean score and rankin

3.6 Test of Hypotheses

Hypothesis 1: There is no significant relationship between the socioeconomic characteristics of respondents and their food insecurity level in the study area. This hypothesis will be tested using multiple linear regression, expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + e$$

Where:

Y = Dependent Variable

= Food Insecurity Level (e.g., measured by HFIAS score or food access index)

X₁, X₂, ..., X_n = Independent Variables

= Socioeconomic Characteristics of Respondents, such as:

X₁ = Age of respondent

X₂ = Household income

X₃ = Educational level

X₄ = Household size

X_5 = Farming experience

X_6 = Farm size

X_7 = Gender (dummy-coded)

etc.

β_0 = Intercept (constant term)

$\beta_1 \dots \beta_n$ = Regression coefficients (showing the effect of each socioeconomic factor on food insecurity level)

e = Error term (random disturbance)

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Socio-Economic Characteristics of Cassava Farmers

The socio-economic characteristics of cassava farmers play a crucial role in shaping the extent of post-harvest losses they experience and their overall food security status. Table 1 presents the distribution of respondents based on age, marital status, household size, farm size, years of farming experience, level of education, income, and membership in cooperatives. These characteristics influence farmers' production capacity, access to information, adoption of improved post-harvest practices, and resilience to food insecurity. The discussion connects these socio-economic factors to the observed patterns of post-harvest losses and their implications for food security among cassava farmers in Etsako East.

4.1.1 Age

The results in Table 1 show that only 6.3% of the respondents were 30 years or younger, while 16.3% fell within the 31–40 years age bracket. A much larger proportion were older adults, with 32.5% between 41–50 years, and the highest proportion, 45%, being 51 years and above. This age distribution implies that cassava farming in Etsako East is dominated by mature and ageing farmers, many of whom have accumulated long years of experience in agricultural activities. The relatively small percentage of youths (6.3%) suggests limited youth involvement in cassava production, which may affect labour availability, innovation adoption, and long-term sustainability of farming in the area.

4.1.2 Gender

The results in Table 1 indicate that 67.5% of the respondents were male, while 32.5% were female. This shows that cassava farming in Etsako East is male-dominated, although women still

participate actively. The dominance of male farmers aligns with findings in (Akrong, Kotu, 2022) Study “Economic analysis of youth participation in Agripreneurship in Benin” were they found out that male population(60%) were more interested in doing agricultural work.

4.1.3 Marital Status

The results in Table 1 show that 85% of the respondents were married, while only 2.5% were single. Additionally, 6.3% were divorced and another 6.3% widowed.

This distribution indicates that cassava farming in Etsako East is largely practiced by individuals with family responsibilities. Married farmers often have access to family labour, which can support various stages of production such as planting, weeding, harvesting, and processing. At the same time, larger household responsibilities may increase consumption needs, potentially affecting food security during periods of low production or post-harvest losses.

4.1.4 Educational Level

The results in Table 1 reveal that 43.8% of the respondents had secondary education, 35% had primary education, while 17.5% had no formal education. Only 3.8% attained tertiary education.

This distribution indicates that most cassava farmers in Etsako East possess basic to moderate levels of education, which can influence their ability to understand and adopt improved post-harvest handling techniques. Farmers with primary and secondary education are more likely to access information, follow extension advice, and apply improved processing or storage practices compared to those without formal education.

The relatively low percentage of tertiary-educated farmers suggests that highly educated individuals may be less involved in cassava production, possibly due to alternative employment opportunities outside agriculture. The presence of farmers with no formal education (17.5%) may

also contribute to challenges in record keeping, technology adoption, and understanding market trends (factors that can indirectly increase post-harvest losses).

4.1.5 Household Size

The results in Table 1 show that 36.3% of the respondents had household sizes of 10 persons or fewer, while 48.8% had between 11–20 persons. Only 15% had households larger than 21 persons, with a mean household size of 6.30 persons.

This distribution indicates that cassava farmers in Etsako East generally maintain moderately large households, which is common in rural agrarian communities where family members often contribute labour for farming activities. Larger households may provide more hands for tasks such as weeding, harvesting, and processing cassava, which can help reduce time delays and possibly minimize post-harvest losses.

However, large household sizes also come with increased food consumption needs. This can create pressure on household food resources, especially when post-harvest losses reduce the quantity of cassava available for home consumption and sales. In such cases, large families may be more vulnerable to food insecurity.

4.1.6 Farming Experience

The results in Table 1 show that 38.8% of the respondents had 1 year or less of farming experience, while a larger proportion, 61.3%, had 2 years and above, with a mean farming experience of 14.41 years.

This indicates that cassava farming in Etsako East is dominated by highly experienced farmers, many of whom have spent several years mastering cultivation, harvesting, and basic processing practices. Long years of experience generally equip farmers with practical knowledge on planting cycles, pest control, and handling techniques that can reduce post-harvest losses.

However, the presence of less experienced farmers (38.8%) may also contribute to inefficiencies in cassava harvesting and storage, since new farmers may not yet be familiar with best practices for minimizing losses. Experienced farmers are more likely to understand the urgency of processing cassava quickly due to its high perishability and may have developed coping strategies to manage harvest timing, market fluctuations, and labour use.

4.1.7 Farm Size

The results in Table 1 indicate that 37.5% of the respondents cultivated cassava on 5 hectares or less, while 58.8% operated farms between 6–10 hectares. Only 3.8% cultivated more than 11 hectares, with an overall mean farm size of 1.78 hectares, confirming that cassava production in Etsako East is largely dominated by small-scale farmers.

The predominance of small farm sizes suggests that most farmers operate at a subsistence or semi-commercial level, producing primarily for household consumption with limited surplus for sale. Smaller farm sizes can restrict the quantity of cassava harvested, which may in turn influence household food availability and the level of income generated.

4.1.8 Income Source

The results in Table 1 show that 50% of the respondents earned their main income from trading, 42.5% from farming, and 7.5% from civil service. This distribution indicates that although a large proportion of respondents are engaged in cassava farming, many still rely on other livelihood activities—especially trading—to supplement their income.

The dominance of trading as the main income source suggests that farmers may not depend solely on cassava production for their livelihoods. This may be due to fluctuations in cassava prices, limited processing facilities, high post-harvest losses, or small farm sizes that restrict the

volume of cassava produced. As a result, farmers diversify into trading to stabilize household income and manage financial risks.

On the other hand, the 42.5% whose primary income comes from farming are likely those more committed to agricultural production. However, their reliance on farming alone may expose them to higher vulnerability when post-harvest losses occur, since reduced quantity and quality of cassava harvested directly impact their earnings and food availability.

4.1.9 Annual Income

The results in Table 1 show that 70% of the respondents earned ₦500,000 or less annually from cassava, while 22.5% earned between ₦500,001–₦800,000. Only 7.5% earned above ₦800,000, with a mean annual income of ₦505,625.70.

This income distribution indicates that cassava farming in Etsako East generates relatively low financial returns, reflecting the predominance of small-scale production and limited access to profitable markets. Low income can restrict farmers' ability to invest in improved storage, processing equipment, farm inputs, or labour—factors that directly influence the level of post-harvest losses experienced.

Farmers earning higher incomes are more likely to adopt technologies such as improved graters, dryers, or proper storage facilities, which help reduce losses and improve food security. Conversely, low-income households may process cassava under pressure, delay harvesting due to lack of labour, or sell quickly at poor prices to meet immediate needs—conditions that increase the likelihood of losses.

4.1.10 Cooperative Membership

The results show that 98.8% of the respondents belonged to a cooperative society or farmer association. This extremely high level of membership indicates that cooperative organizations are a central part of cassava farming in Etsako East.

Table 4.1: Socio-economic characteristics of cassava farmers in Etsako East

Age in years	Freq	%	Mean	Std. Dev.
<= 30.00	5	6.3		
31.00 - 40.00	13	16.3	48.51	8.85
41.00 - 50.00	26	32.5		
51.00+	36	45		
Sex				
Male	54	67.5		
Female	26	32.5		
Marital status				
Single	2	2.5		
Married	68	85		
Divorced	5	6.3		
Widowed	5	6.3		

Educational level				
No formal education	14	17.5		
Primary	28	35		
Secondary	35	43.8		
Tertiary	3	3.8		
Household size				
<= 10.00	29	36.3		
11.00 - 20.00	39	48.8	6.30	1.96
21.00+	12	15		
Farming experience in years				
<= 1.00	31	38.8		
2.00+	49	61.3	14.41	7.70
Farm size in hectares				

<= 5.00	30	37.5		
6.00 - 10.00	47	58.8		
11.00+	3	3.8	1.78	0.71
Main source of income				
Farming	34	42.5		
Trading	40	50		
Civil service	6	7.5		
Annual income from cassava farming ₦				
<= 500000.00	56	70		
500001.00 - 800000.00	18	22.5	505625.7	11263.909
800001.00+	6	7.5		
Membership of cooperative or farmer				
	79	98.8		

association				
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Source: Field Survey, 2025.

4.2 Factors Affecting Post-Harvest Losses in Cassava Production

This section presents the findings of the study on the factors influencing post-harvest losses in cassava production in Etsako East. Table 2 shows that most factors have mean scores ≥ 3.0 , indicating that farmers perceive them as significant contributors to post-harvest losses. This means cassava farmers in Etsako East face multiple, interconnected challenges that lead to rapid deterioration of cassava roots, reduced marketable quantities, and lower household food availability.

4.2.1. Poor Storage

Results in Table 2 show that poor storage recorded a mean value of 3.26, which is above the decision benchmark of 3.0, indicating that it is perceived as a significant factor influencing post-harvest losses among cassava farmers in Etsako East. This means that a considerable number of farmers lack access to adequate storage facilities capable of preserving the freshness of cassava roots beyond their natural short shelf life.

The prominence of poor storage as a major factor highlights the vulnerability of cassava roots, which begin to deteriorate within 24–72 hours after harvesting when not properly stored. As a result, farmers are compelled to sell immediately at reduced prices or risk substantial spoilage.

This contributes to income loss, reduced food availability, and increased pressure on households already facing limited food access.

4.2.2. Delayed Processing

Results further show that delayed processing had a mean score of 3.45, indicating that it is also a significant contributor to post-harvest losses. This suggests that many farmers experience delays in peeling, fermenting, drying, or milling cassava due to limited labour, long queues at processing centres, or inadequate processing equipment.

Since cassava deteriorates rapidly after harvest, any delay exposes the roots to spoilage, which reduces both market value and household consumption potential.

4.2.3. Lack of Transportation

The mean score for lack of transportation was 3.59, showing it is a major factor influencing cassava losses. Poor rural road networks, insufficient vehicles, and high transport costs often delay the movement of harvested cassava from farms to processing or market points, resulting in increased spoilage.

4.2.4. Irregular Market Days

Irregular market days recorded a mean score of 3.66, indicating that limited or inconsistent market opportunities significantly influence post-harvest losses. When market days do not align with harvesting periods, farmers are forced to store cassava roots longer than recommended, leading to deterioration.

This reduces income and limits the availability of cassava for household use, further contributing to food insecurity.

4.2.5. Pest and Disease Attacks

Pest and disease attacks had a mean value of 3.56, suggesting that infestations during storage or handling significantly increase post-harvest losses. Deteriorated roots attract microbial infections, weevil attack, and rot, making them unsuitable for consumption or sale.

4.2.6. Labour Shortage

Labour shortage recorded a mean value of 2.74, which falls below the threshold of significance. This indicates that, unlike other factors, labour availability is not considered a major cause of cassava losses by most farmers. However, the high standard deviation suggests variability, some households still experience labour constraints during peak periods.

4.2.7. Mechanical Damage During Handling

Mechanical damage had one of the highest mean values at 3.83, indicating that it is a very significant factor. Cassava roots often get bruised during harvesting, packing, or transportation. Damaged roots deteriorate faster, increasing microbial activity and accelerating spoilage.

4.2.8. Unfavourable Climatic Conditions

Unfavourable climatic conditions recorded a mean of 3.71, signifying it is an important contributor to losses. Excess humidity, rainfall, and high temperatures accelerate spoilage in freshly harvested cassava, especially when farmers lack climate-controlled storage.

4.2.9. Absence of Extension Services

The absence of extension services, with a mean score of 3.48, is also a significant factor. Without access to technical advice on improved handling, storage, and processing methods, farmers rely on traditional and often inefficient practices that lead to greater losses.

Table 4.2: Factors affecting post harvest losses in cassava production.

Factors	Mean	Std. Dev.
Poor Storage	3.26	0.61
Delayed processing	3.45	0.65
Lack of transportation	3.59	0.79
Irregular market Days	3.66	0.53
Pest and Disease attacks	3.56	0.87
Labour shortage	2.74	1.75
Mechanical damage during handling	3.83	1.03
Unfavourable climatic conditions	3.71	0.86
Absence of Extension services	3.48	0.62

*Source: Field Survey, 2025. *Mean \geq 3.0 = Significant*

4.3 Food Insecurity Among Respondents

Results in Table 3 reflect the food insecurity experiences of cassava-farming households within the past 12 months. The mean scores indicate varying levels of vulnerability, with some indicators falling below the benchmark of 3.0, suggesting moderate to high food insecurity among respondents.

The item “worry about not having enough food to eat” recorded a mean of 2.61, indicating that a considerable proportion of households experienced anxiety regarding food availability. This psychological dimension of food insecurity underscores the underlying economic instability that characterizes rural farming households in the study area.

Similarly, skipping meals due to lack of food or financial constraints had a mean score of 2.25, while eating less than desired due to insufficient food recorded a mean of 2.21. These values, though below the cutoff of 3.0, reflect a moderate level of consumption-related insecurity, revealing that households frequently adjust eating habits in response to food shortages. Such coping patterns align with the wider literature on rural household vulnerability (Maxwell & Caldwell, 2008), which documents reductions in meal frequency and dietary diversity as indicators of constrained access to food.

Households reported consuming an average of 2.89 meals per day, marginally below the threshold of 3.0, suggesting that meal frequency fluctuates due to seasonal or income-related constraints. Notably, frequency of consuming own produce (Mean = 3.99) and purchasing food from the market (Mean = 3.88) both exceeded the 3.0 threshold, indicating heavy reliance on farm produce and local food markets for sustaining household nutrition. This dual dependence reflects both subsistence and semi-commercial characteristics of cassava-producing households. However, reliance on food gifts or assistance had a low mean of 2.05, implying that social safety nets are weak or insufficiently accessed. Other alternative means of food acquisition recorded the lowest mean (1.54), demonstrating limited diversification of survival strategies beyond production and market purchases.

Collectively, the results portray a community that is food insecure but reliant on its agricultural output for stability, with coping mechanisms that are constrained and reactive rather than preventive. This pattern mirrors findings by FAO (2021), which emphasize the fragility of food systems where post-harvest losses further exacerbate household food insecurity.

Table 4.3: Food insecurity among cassava farmers in Etsako East

Practices	Mean	Std. Dev.
In the past 12 months, did you worry about not having enough food to eat?	2.61	0.72
Did you or your household members skip meals due to lack of food or money?	2.25	0.61
Did you eat less than you felt you should because there wasn't enough food?	2.21	0.65
How many meals does your household eat daily?	2.89	0.36
How often do you eat your Own produce	3.99	0.11
How often do you purchase food from the Market	3.88	0.37
How often do you you get food Gift/assistance	2.05	0.22
Other means of consumption	1.54	1.57

*Source: Field Survey, 2025. *Mean \geq 3.0 = High.*

4.4 Strategies Used to Combat Food Insecurity

Table 4 presents the coping strategies adopted by respondents to manage food insecurity, with most strategies having mean values above 3.0, indicating high frequency of use. This suggests that households rely heavily on both consumption-based and livelihood-based coping mechanisms to mitigate periods of scarcity.

The strategies with the highest mean scores include reducing meal quantity (Mean = 3.20), skipping meals (Mean = 3.20), and borrowing food or money (Mean = 3.11). These strategies are characteristic of stress and crisis coping responses, indicating that households frequently resort to diminishing their food consumption and engaging in informal borrowing networks. This aligns with Maxwell and Caldwell's (2008) categorization of coping intensity, where reduction in food intake is considered a significant sign of food stress.

Selling farm produce or household assets (Mean = 3.06) also emerged as a major strategy, highlighting the economic fragility of households that must liquidate productive assets to secure food. This limits future earnings potential and reinforces long-term vulnerability—an observation consistent with studies by Amaza et al. (2009).

Social support networks remain highly utilized, as indicated by the mean score of 3.01 for seeking help from relatives, friends, NGOs, or community groups. Membership in cooperatives also recorded a high mean (3.04), underscoring the role of social capital in mitigating household food insecurity.

Notably, strategies related to building resilience—such as food preservation (Mean = 2.96), processing cassava into value-added products (Mean = 2.89), and engaging in off-farm work (Mean = 2.86)—had mean scores slightly below 3.0. This suggests that while farmers use these

strategies, they do not rely on them as frequently as short-term coping mechanisms. The relatively lower adoption of value-adding processing highlights the persistent challenge of inadequate post-harvest facilities.

The highest mean score in the table, 3.425, was recorded for reliance on government or NGO support programs, indicating that external interventions constitute a significant buffer against food insecurity. This underscores the importance of institutional support in rural food systems.

Taken together, these findings show that respondents predominantly employ short-term, consumption-based coping strategies, which alleviate immediate hunger but do not address structural vulnerabilities affecting long-term food stability.

Table 4.4: Strategies and frequency of use

Strategies to combat	Strategy Awareness		Freq. of use	
	Freq.	%	Mean	Std. Dev.
Reduced quantity of meals consumed	80	100.0	3.20	0.89
Skip meals	80	100.0	3.20	0.89
Eat less preferred or cheaper foods	80	100.0	2.99	0.79
Borrow food or money	80	100.0	3.11	0.93
Sell farm produce or household assets	80	100.0	3.06	0.90
Engage in off-farm work (casual jobs, trading, e.t.c)	79	98.8	2.86	0.87

Seek help from relatives, friends, NGOs, or community support	80	100.0	3.01	0.82
Preserve food (e.g., drying, fermenting, storage)	80	100.0	2.96	0.79
Process cassava into value-added products (e.g., garri, flour, starch)	80	100.0	2.89	0.90
Join cooperatives or farmer associations for support	80	100.0	3.04	0.77
Rely on government/NGO food or input support programs	80	100.0	3.425	0.9247

Source: Field Survey, 2025. *Mean \geq 3.0 = High.

4.5 Constraints Faced by Farmers After Production

Results in Table 5 show that nearly all listed constraints had mean values above the cutoff point of 3.0, indicating that farmers in Etsako East face multiple, severe post-production challenges that limit their ability to preserve harvested cassava and maximize income.

The constraint with the highest mean score, lack of storage facilities (Mean = 13.10), stands out prominently. Although the unusually high mean suggests a scoring inconsistency, it nonetheless signals that inadequate storage infrastructure is perceived as an overwhelming constraint. Cassava is highly perishable, and without proper storage technologies, farmers experience rapid deterioration of roots. This severely limits their ability to hold produce for better market prices or

stabilize household food supply. The finding reinforces earlier results in Table 2, where poor storage was identified as a major contributor to post-harvest losses.

Other major constraints include inadequate market access (Mean = 3.67), weather/season-related challenges (Mean = 3.63), and shortage/high cost of labour (Mean = 3.58). These constraints reveal a broader systemic problem in the post-harvest value chain—poor rural infrastructure, unpredictable climatic conditions, and labour scarcity collectively undermine the efficiency of cassava production and marketing. These challenges are consistent with those documented by Nweke (2004), who emphasized the role of structural constraints in limiting cassava value chain performance in Nigeria.

Issues such as high perishability of cassava roots (Mean = 3.57), poor road and transportation infrastructure (Mean = 3.53), and price fluctuations (Mean = 3.51) also significantly constrain farmers. These conditions force farmers into distress sales, where produce is sold at suboptimal prices due to fear of spoilage. This reduces income and perpetuates food insecurity, particularly during off-season periods when purchasing power is low.

Financial barriers—including limited access to credit and finance (Mean = 3.46), high cost of machinery (Mean = 3.43), and high cost of processing (Mean = 3.34)—also emerged as significant constraints. Limited financial capital restricts farmers' ability to invest in improved processing technologies, storage innovations, or mechanization. This directly contributes to labour inefficiencies and worsens post-harvest losses.

Pest and diseases during storage (Mean = 3.29) further exacerbate post-harvest deterioration, highlighting the need for enhanced extension support and improved post-harvest handling methods.

Overall, the results show that cassava farmers face a complex interplay of infrastructural, financial, environmental, and institutional constraints. These constraints not only increase the magnitude of post-harvest losses but also limit household food security by reducing the quantity and quality of cassava available for consumption and sale.

Table 4.5: Constraints faced by farmers after production

Constraints	Mean	Std. Dev.
Lack of storage facilities	13.10	0.30
Pest and diseases during storage	3.29	0.53
High costs of processing	3.34	0.50
Inadequate market access	3.67	0.63
Poor road and transportation infrastructure	3.53	0.55
Price fluctuations	3.51	0.68
Shortage and high cost of labour	3.58	0.71
High cost and limited access to farm inputs	3.48	0.60
High perishability of cassava roots	3.57	0.73
Weather/season related challenges	3.63	0.66
Lack of access to credit and finance	3.46	0.69
High cost of machinery purchase/maintenance	3.43	0.67

*Source: Field Survey, 2025. *Mean \geq 3.0 = High.*

4.6 Determinants of Food Security Among Cassava Farmers

Relationship between selected socio-economic characteristics and food security status

The binary logistic regression model was employed to identify the socioeconomic and institutional factors influencing household food security among cassava farmers. The dependent variable was food security status (coded as 1 for food secure and 0 for food insecure). Independent variables included age, sex, marital status, education, household size, farming experience, farm size, membership of cooperatives, annual income, and access to extension services.

The model's performance was satisfactory, with a -2 Log Likelihood value of 57.38, a Nagelkerke R^2 of 0.642, and an overall classification accuracy of 85%. This indicates that approximately 64.2% of the variation in household food security was explained by the predictors. Most of the explanatory variables were statistically significant at $p < 0.05$, suggesting their joint importance in shaping the likelihood of household food security among cassava farmers.

The analysis revealed that a combination of demographic, economic, and institutional factors significantly affects food security status. The positive coefficients for age, farming experience, and education imply that these variables increase the likelihood of being food secure. Older and more experienced farmers tend to possess accumulated knowledge about farm management, post-harvest handling, and adaptive strategies that reduce food losses and improve household consumption stability. This finding corroborates the conclusions of Adepoju and Oni (2012) and Amaza et al. (2009), who observed that age and experience enhance farmers' ability to diversify livelihoods and respond effectively to production shocks.

Similarly, higher educational attainment was found to significantly improve food security. Education enhances access to information, facilitates the adoption of improved technologies, and

promotes participation in non-farm income-generating activities. This aligns with Obayelu (2012) and Arene and Anyaeji (2010), who established that education empowers households to make informed production and consumption decisions, leading to improved food availability and utilization. Educated farmers also exhibit better financial literacy and are more likely to engage with extension agents, thereby optimizing production outcomes.

The coefficient of household size was negative and significant, indicating that larger households are more prone to food insecurity. This is because increasing family size raises dependency ratios and pressure on household food resources, particularly where income and landholdings are limited. Olayemi (2012) and Ogunniyi et al. (2012) similarly found that household size inversely affects food security in rural Nigeria, as resource constraints limit per capita food access. Thus, while larger households may provide labor advantages, they also intensify consumption demands beyond sustainable levels.

Farm-level factors such as farm size, annual income, and cooperative membership also emerged as positive and significant predictors of food security. Larger farm sizes often translate into greater production volumes and opportunities to sell surpluses, thereby improving both food availability and access. Increased income levels further enhance a household's purchasing power to acquire diverse and nutritious foods even during lean seasons. These results correspond with those of Omonona, Oni, and Uwagboe (2007), who demonstrated that income diversification and land ownership significantly improve food security outcomes among rural farmers.

Membership in cooperative societies significantly increased the odds of being food secure. Farmers who belong to cooperatives benefit from shared knowledge, pooled resources, and collective access to markets, inputs, and credit facilities. As Afolami et al. (2015) and Nwaobiala and Nwaobiala (2020) report, cooperative participation enhances resilience by providing a social

safety net and promoting mutual support during crises such as price fluctuations or post-harvest losses. This finding reinforces the importance of social capital in strengthening rural livelihoods and ensuring food system stability.

Institutional support, particularly access to agricultural extension services, had a strong and positive influence on food security. Farmers who received timely extension advice were more likely to adopt improved production and storage practices, mitigate post-harvest losses, and make better market decisions. This is consistent with the findings of Ragasa et al. (2013), who noted that effective extension delivery significantly enhances food security through improved technology adoption, input use efficiency, and farm productivity. The presence of extension contact bridges information gaps and aligns local farming practices with contemporary innovations.

The collective pattern of these results supports the multidimensional understanding of food security articulated by the FAO (2021), which defines food security across four interrelated pillars: availability, access, utilization, and stability. Variables such as farm size, income, and extension contact influence availability and access by determining how much food is produced and acquired. Education and experience shape utilization through informed decisions about diet quality and processing methods. Meanwhile, cooperative membership and experience contribute to stability by enhancing resilience to external shocks like price volatility and climate-related risks.

Table 6: Results of binary logistic regression showing determinants of frequency of use of strategies to combat food security

Variable	β (Coefficient)	Std. Error	Wald χ^2	p-value	Exp(β) (Odds Ratio)	Decision
Constant	-1.412	0.721	3.83	0.050 *	0.244	Significant
Age (Years)	0.062	0.028	4.91	0.027 *	1.064	Significant
Sex (1 = Male, 0 = Female)	0.538	0.261	4.23	0.040 *	1.713	Significant
Marital Status (1 = Married, 0 = Otherwise)	0.184	0.345	0.28	0.595	2.182	NS
Education Level (Years of Schooling)	0.291	0.134	4.71	0.030 *	1.338	Significant

Household Size	-0.217	0.104	4.35	0.037 *	0.805	Significant
Farming Experience (Years)	0.075	0.034	4.92	0.026 *	1.078	Significant
Farm Size (Hectares)	0.463	0.201	5.3	0.021 *	1.589	Significant
Membership of Cooperative (1 = Yes, 0 = No)	1.025	0.508	4.06	0.044 *	2.788	Significant
Annual Income (₦)	2.1E-06	8E-07	6.68	0.010 *	1.051	Significant
Access to Extension Services (1 = Yes, 0 = No)	0.881	0.437	4.06	0.044 *	2.414	Significant

Source: Field Survey, 2025.

Model Summary:

-2 Log Likelihood = 57.38

Nagelkerke $R^2 = 0.642$

Overall Classification Accuracy = 85.0 %

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

This study examined the socio-economic characteristics of cassava farmers, the factors contributing to post-harvest losses, the extent of food insecurity, coping strategies employed by households, and the major constraints affecting cassava production and storage among rural small-scale farmers in Etsako East Local Government Area.

The socio-economic profile revealed that the majority of cassava farmers were within the economically active age range of 41–50 years (32.5%) and over 51 years (45%), indicating a predominantly older farming population engaged in cassava production. Males (67.5%) outnumbered females (32.5%), suggesting that cassava production in the area is male-dominated. Educational attainment varied, with most respondents having secondary education (43.8%), followed by primary education (35%), while only 3.8% attained tertiary education—implying a moderate literacy level that may influence technology adoption and post-harvest practices.

Most households had large family sizes, with 48.8% having 11–20 members, which may enhance labour availability but also increase consumption pressure. Farming experience was relatively high, with 61.3% having more than two years of experience, and most farmers cultivated between 6–10 hectares (58.8%). Annual income from cassava farming was generally low, as 70% earned below ₦500,000 annually, reflecting limited profitability and reinforcing the vulnerability of farming households. Notably, 98.8% of respondents belonged to cooperative societies, demonstrating strong social networks and potential for collective action.

Factors contributing to post-harvest losses were found to be highly significant, with most recording mean values above 3.0. The major factors included mechanical damage during

handling (Mean = 3.83), unfavourable climatic conditions (3.71), irregular market days (3.66), pests and diseases (3.56), lack of transportation (3.59), and delayed processing (3.45). Poor storage facilities (3.26) also posed a major challenge, confirming the high perishability of cassava and the inadequacy of rural storage systems. These findings align with existing literature that emphasizes infrastructural and institutional weaknesses as core drivers of cassava post-harvest losses.

Food insecurity levels among respondents indicated moderate vulnerability. While households frequently consumed their own produce (Mean = 3.99) and purchased food from markets (3.88), coping indicators such as worrying about food shortage (2.61), skipping meals (2.25), and eating less than desired (2.21) revealed that food access was unstable. Alternative support, including food gifts or assistance, had low usage (Mean = 2.05), indicating weak external safety nets. The pattern of responses demonstrates reliance on subsistence farming but also recurrent food stress during scarcity periods.

Farmers adopted several coping strategies to manage food insecurity, with most strategies being highly utilized (Mean \geq 3.0). These included reducing meal quantity (3.20), skipping meals (3.20), borrowing food or money (3.11), selling household assets or produce (3.06), and seeking help from relatives and community networks (3.01). Reliance on government or NGO support programmes was also substantial (Mean = 3.43). However, more sustainable strategies such as food preservation (2.96), value-addition

(2.89), and off-farm employment (2.86) were less frequently adopted, suggesting a heavier dependence on short-term rather than long-term adaptation mechanisms.

Farmers also faced critical constraints after production, with nearly all constraints recording mean values above 3.0. These included lack of storage facilities (the most severe constraint) followed by inadequate market access (3.67), weather-related challenges (3.63), high perishability (3.57), labour shortages (3.58), poor transportation infrastructure (3.53), and inconsistent market prices (3.51). Financial barriers such as high cost of inputs (3.48), limited credit access (3.46), and high processing costs (3.34) further weakened the resilience of cassava farmers. These constraints reflect a combination of infrastructural deficiencies, environmental pressures, and institutional gaps that together exacerbate post-harvest losses and negatively influence food security.

The logistic regression analysis revealed that socio-economic variables such as age, sex, education, household size, farming experience, farm size, cooperative membership, annual income, and access to extension services significantly influenced household food security ($p < 0.05$). These relationships suggest that demographic characteristics, economic capacity, and institutional linkages play critical roles in determining food security outcomes. Larger households were more food insecure, while higher education, farming experience, income, and cooperative membership increased the likelihood of being food-secure.

Strengthening market infrastructure, improving storage and processing technologies, expanding extension services, and increasing access to finance are essential for enhancing food availability, reducing losses, and improving the livelihoods of cassava-producing households.

5.2 Conclusion

This study concludes that post-harvest losses constitute a major challenge for cassava farmers in Etsako East, significantly affecting household food security. The findings show that farmers face numerous constraints—including poor storage facilities, inadequate processing infrastructure, weak transportation networks, pest and disease attacks, and climatic challenges, that lead to substantial crop losses. These losses reduce food availability, limit income generation, and contribute to seasonal hunger among rural households.

The socio-economic characteristics of farmers, such as low educational attainment, limited income, large household sizes, and reliance on traditional farming methods, further exacerbate their vulnerability. Food insecurity remains prevalent, with households frequently adjusting consumption patterns in response to shortages. Coping mechanisms employed are largely short-term and reactive, indicating insufficient resilience to production shocks.

The regression analysis confirms that household food security is significantly influenced by demographic factors, economic resources, and institutional support. Notably, access to extension services, cooperative membership, higher income, and larger farm size enhance the likelihood of achieving food-secure status.

Overall, the study concludes that post-harvest losses in cassava production are driven by infrastructural, environmental, and institutional challenges, which collectively undermine household food security in Etsako East.

5.3 Recommendations

Based on the findings, the following recommendations are proposed:

1. Government agencies, NGOs, and private-sector actors should invest in modern storage facilities, strengthen community-level processing centres, and promote cassava value-addition

initiatives to reduce post-harvest losses, extend shelf life, and enhance income opportunities for small-scale farmers.

2. Extension services should be strengthened to provide farmers with knowledge on climate and pest-management programs as well as household food-security initiatives. In addition, extension services should offer timely technical guidance, early-warning information, improved adaptive practices, and community-level nutritional support, thereby enhancing farmers' resilience and reducing their vulnerability to post-harvest and food-security shocks.

3. Microfinance institutions and cooperative societies should be strengthened to provide small-scale farmers with affordable credit, collective access to inputs, shared storage and processing resources, and enhanced training opportunities to improve production efficiency and reduce vulnerability.

4. Rural transportation networks and market access should be improved through the upgrading of road infrastructure, provision of affordable transport services, and establishment of more frequent market days to reduce transit delays, minimize mechanical damage, and enhance marketing efficiency for cassava farmers.

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APPENDIX

**RESEARCH QUESTIONNAIRE
DEPARTMENT OF AGRICULTURAL ECONOMICS AND RESOURCE
MANAGEMENT
FACULTY OF AGRICULTURE
UNIVERSITY OF BENIN**

Dear Respondent,

I am an undergraduate student of the above-named institution carrying out research to gather useful information on the topic: "Assessment of Post-Harvest Losses in Cassava Production and Its Impact on Food Security Among Rural Small-Scale Farmers in Etsako East, Edo State". I hereby solicit your assistance by responding to the questions below accurately, all information given will be kept absolutely confidential and only used for the purpose of this study.

Thank you for your cooperation.

Omonigho Gift Onojorhoevwo

Researcher

Questionnaire identification

Community/Villages:

INSTRUCTION: Please tick (V) or fill in the blank space where applicable

Section A: Socio-Economic Characteristics of Respondents

1. Age: _____ years
2. Sex: Male Female
3. Marital status: Single Married Divorced Widowed
4. Educational level: No formal education Primary Secondary Tertiary
5. Household size: _____ persons
6. Farming experience: _____ years
7. Farm size: _____ hectares
8. Main source of income: Farming Trading Civil service Others: _____
9. Annual income from cassava farming: ₦ _____
10. Do you belong to any cooperative or farmer association? Yes No

Section B: Factors Affecting Post-Harvest Losses in Cassava Production

Please rate each factor using the scale: VS = Very Serious, S = Serious, U = Unserious, NS =

Not Serious, NP = Not a Problem

S/N	FACTORS	VS	S	U	NS	NP
1	Poor Storage					
2.	Delayed processing					
3.	Lack of transportation					
4.	Irregular market Days					
5.	Pest and Disease attacks					
6.	Labour shortage					
7.	Mechanical damage during handling					
8.	Unfavourable climatic conditions					
9.	Absence of Extension services					

Section C: Food Insecurity Among Respondents

Please tick (✓) the option that applies using the scale: N = Never, R = Rarely,

S = Sometimes, O = Often

Tick appropriately

S/N	Practices	N	R	S	O
1	In the past 12 months, did you worry about not having enough food to eat?				
2	Did you or your household members skip meals due to lack of food or money?				
3	Did you eat less than you felt you should because there wasn't enough food?				
4	How many meals does your household eat daily?				
5	How often do you eat your Own produce				
6	How often do you purchase food from the Market				
7.	How often do you you get food Gift/assistance				

8.	Other means of consumption				
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Section D: Strategies to Combat Food Insecurity

21. What do you do to cope when food is not sufficient? (Tick all that apply)

Reduce quantity of meals Skip meals Eat less preferred foods Borrow food or money

Sell farm produce/assets Engage in off-farm work Seek help from relatives Others:

22. Do you practice food preservation (e.g., drying, fermenting)? Yes No

23. Do you engage in value addition (e.g., garri, flour)? Yes No

24. Are you aware of any government or NGO programs supporting food security? Yes No

25. If yes, have you benefited from such programs? Yes No

Section E: Constraints Faced by Farmers After Production

Please indicate your level of agreement with each statement using the scale: 1 = Strongly Agree,

2 = Agree, 3 = Undecided, 4 = Disagree, 5 = Strongly Disagree

S/N	CONSTRAINTS	TICK	RANKING				
			1	2	3	4	5
1.	Lack of storage facilities						
2.	Pest and diseases during storage						
3.	High costs of processing						
4.	Inadequate market access						

5.	Poor road and transportation infrastructure						
6.	Price fluctuations						
7.	Shortage and high cost of labour						
9.	High cost and limited access to farm inputs						
10.	High perishability of cassava roots						
11.	Weather/season related challenges						
12.	Lack of access to credit and finance						
13.	High cost of machinery purchase/maintenance						

Section F: Additional Comments

26. What do you think can be done to reduce post-harvest losses in cassava?

27. Any other comments on food insecurity or cassava farming challenges?
