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Examining the Effect of Post-Harvest Loses on Small Scale Farmers Livelihoods and Food Security: A Case Study of Small-Scale Farmers in Mulobezi District

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Abstract

This study was carried out to examine strategies for mitigating post-harvest losses with a focus on global, African, and Zambian perspectives. Post-harvest losses have continued to pose a major challenge to food security and farmer incomes, with global estimates showing that about 30% of food is lost before reaching consumers, while in Africa losses reach up to 40% for cereals and perishable crops. In Zambia, studies have shown that up to 30% of maize and over 40% of fruits and vegetables are lost mainly due to poor storage, weak market systems, and lack of access to preservation technologies. The objectives of the study were to establish the current practices being used to manage post-harvest losses, to examine the effectiveness of mitigation strategies such as storage, processing, and training, and to identify challenges and limitations in reducing these losses. The research adopted a mixed-methods approach, using both questionnaires and interviews to collect data from farmers, cooperatives, and agricultural officers. Data was analysed using descriptive statistics and thematic analysis to capture both numerical patterns and detailed experiences. The findings revealed that 55% of farmers relied on traditional storage methods, 30% had adopted hermetic bags, while only 15% accessed improved community storage facilities. About 40% of respondents reported involvement in value addition such as drying or processing, while 60% highlighted lack of financial resources as the main barrier. Improved storage technologies, agro-processing, training, and market linkages are key to reducing post-harvest losses. The results are expected to inform policymakers, NGOs, and farmer groups on practical interventions to improve food security and incomes in this country.

Keywords: Post-Harvest Losses, Food Security, Storage Technologies, Agro-Processing, Zambia

1. Introduction

1.1 Background

Post-harvest losses are a global challenge that affects food availability and farmers' livelihoods across many countries. According to the Food and Agriculture Organization (FAO, 2019) [13], about one-third of all food produced worldwide is lost or wasted, which contributes significantly to global food insecurity. These losses occur at different stages, including harvesting, handling, storage, and transportation, reducing the amount of food that reaches consumers. Globally, these losses not only impact food supply but also economic returns for farmers and national economies. Studies by Gustavsson *et al*. (2011) [15] argue that reducing post-harvest losses is essential to meeting the increasing food demand due to population growth and changing consumption patterns. Thus, managing these losses effectively can play a critical role in strengthening food security internationally.

In the African context, post-harvest losses are even more severe, with the FAO estimating losses of up to 30-40% in some countries (FAO, 2018) [12]. The challenges are worsened by inadequate infrastructure, poor storage facilities, and limited access to technology that can reduce losses. Many African farmers depend on traditional methods for handling and storing their produce, which often leads to spoilage and wastage. A case study by Mrema *et al*. (2020) in East Africa contends that post-harvest losses greatly affect household income and food availability, especially for small-scale farmers who produce the

majority of the continent's food. These losses exacerbate poverty and hunger, hindering efforts toward sustainable agricultural development and food security on the continent. Consequently, African countries are increasingly focusing on innovative strategies to address post-harvest losses as part of their food security policies.

Here in Zambia, post-harvest losses remain a major threat to small-scale farmers' livelihoods and national food security. The Ministry of Agriculture reports that losses can reach up to 30% for key staples such as maize, which is the country's main food crop (MAFF, 2021) [18]. Small-scale farmers, who form the backbone of agriculture in this country, often lack proper storage facilities and access to modern technologies that could reduce spoilage after harvest. The situation is particularly challenging in rural districts like Mulobezi, where transportation infrastructure is poor and markets are distant. The researcher notes that these losses not only reduce food availability but also decrease household incomes, making it harder for farmers to invest in their farms or meet other basic needs. As a result, addressing post-harvest losses is crucial to improving rural livelihoods and food security here in Zambia. This study will investigate existing coping mechanisms and potential new interventions that could be scaled up to benefit small-scale farmers. By focusing on the realities faced by farmers here in Mulobezi, this research aims to provide useful insights for policy makers, development organizations, and the farming communities themselves.

1.2 Statement of Problem

Post-harvest losses remain a major challenge that threatens the livelihoods of small-scale farmers and food security here in Mulobezi District and across many parts of this country. Despite the important role that agriculture plays in sustaining rural households, a significant portion of harvested crops is lost due to poor handling, inadequate storage facilities, and lack of access to modern technologies (MAFF, 2021) [18]. These losses reduce the amount of food available for consumption and sale, directly impacting farmers' incomes and their ability to improve their living standards (Chirwa, 2017) [5]. The problem is more severe among small-scale farmers who often rely on traditional methods that are insufficient to prevent spoilage and pest attacks (Nkole, 2020) [29]. As a result, food insecurity increases, with many families struggling to meet their nutritional needs, especially during the lean seasons (Mwape, 2019) [26]. In addition, these losses contribute to wider economic challenges, limiting the country's agricultural productivity and development goals (GRZ, 2017) [14]. Although policies exist to address these issues, implementation gaps and resource constraints mean that many farmers in Mulobezi continue to experience high post-harvest losses. This study, therefore, seeks to investigate the causes of these losses, their impact on food security and livelihoods, and to explore practical strategies for reducing them. Addressing this problem is critical if we are to improve rural incomes, ensure consistent food availability, and support sustainable agricultural development here in this country. Without understanding and tackling post-harvest losses, efforts to fight poverty and hunger among small-scale farmers will remain limited.

1.3 General Objective

To Examine the effect of post-harvest loses on small scale farmers livelihoods and food security.

1.3.1 Specific Objectives

1. To assess the cause of post-harvest losses among small scall farmers in Mulobezi district.
2. To examine effects of post-harvest losses on food security among small scale farmers.
3. To explore strategies for reducing post-harvest losses.

1.4 Research Questions

1. What are the main causes of post-harvest losses among small-scale farmers in Mulobezi District?
2. What are the effects of post-harvest losses on food security among small-scale farmers in Mulobezi District?
3. What strategies can be implemented to reduce post-harvest losses among small-scale farmers in Mulobezi District?

1.5 Theoretical Framework

The theoretical foundation of this study is based on the Post-Harvest Loss Reduction Theory, which was developed by James R. Porter in the early 1980s. This theory focuses on understanding the causes, impacts, and management of losses that occur after harvesting agricultural produce. It emphasizes that minimizing post-harvest losses is essential for improving food availability, increasing farmers' incomes, and enhancing food security (Porter, 1982) [33]. This framework is highly relevant for examining how post-harvest losses affect small-scale farmers' livelihoods and food security here in this country.

In applying this theory, it is important to understand the socio-economic conditions of the farmers. Porter's theory recognizes that factors such as poverty, education levels, and infrastructure availability influence the effectiveness of loss reduction strategies (Porter, 1982) [33]. The researcher will therefore consider these local realities to ensure the findings are relevant and actionable.

The theory's emphasis on technology adoption is particularly useful in this study. It suggests that small-scale farmers who adopt improved storage technologies, such as hermetic bags or metal silos, can reduce losses by up to 50% or more (Porter, 1982) [33]. The research will investigate whether such technologies are accessible and affordable to farmers in Mulobezi District.

Porter also contends that understanding traditional practices is key to developing appropriate interventions. In many communities, farmers rely on indigenous knowledge for crop storage and pest control. This theory supports blending traditional methods with modern technology to create effective, culturally acceptable solutions (Porter, 1982) [33]. The study will explore this balance in the local context.

1.6 Significance of Study

This study is important because it helps to understand the causes and effects of post-harvest losses among small-scale farmers in Mulobezi District. By identifying the main reasons why farmers lose part of their harvest, the study can provide valuable information that will guide efforts to reduce these losses. This is critical because post-harvest losses reduce the amount of food available for households and markets, affecting food security here in this country.

The findings of this study will also be useful for small-scale farmers themselves. Understanding how post-harvest losses affect their income and food supply can encourage farmers

to adopt better practices and technologies. This can improve their livelihoods by increasing the amount of produce they sell and consume. The study will therefore contribute directly to improving the well-being of rural communities in Mulobezi.

Non-governmental organizations and development partners will also benefit from this study. The insights gained can help these organizations tailor their interventions to the real needs of small-scale farmers. For example, they may focus on training, improving storage facilities, or providing better access to markets. This study will therefore help make development projects more relevant and impactful.

Finally, the study contributes to academic knowledge by filling a gap in research about post-harvest losses in Mulobezi District. While there are studies from other parts of Africa and the world, specific information about this area is limited. This research will add to the existing literature and provide a basis for future studies, helping to build a better understanding of how to support small-scale farmers in this country.

1.7 Scope of Study

This study focuses specifically on small-scale farmers in Mulobezi District. These farmers represent the majority of agricultural producers in the area and play a vital role in local food production and livelihoods. The research will examine their experiences with post-harvest losses, looking closely at the causes, effects, and possible solutions. By concentrating on this group, the study aims to provide relevant and practical information that can directly improve their farming practices and well-being.

Geographically, the study is limited to Mulobezi District, which is a rural area with unique agricultural conditions and challenges. This focus allows for an in-depth understanding of the local factors influencing post-harvest losses, such as climate, infrastructure, and market access. While findings from this district may share similarities with other rural areas here in this country, the study does not attempt to generalize results to the entire nation but rather to offer detailed insights specific to Mulobezi.

1.8 Operational Definitions of Concepts

Post-Harvest Losses: These refer to the reduction in quantity and quality of agricultural produce that occurs after harvesting and before consumption or sale. Losses can happen due to poor handling, pests, diseases, or inadequate storage (Porter, 1982) [33].

Small-Scale Farmers: This term describes farmers who cultivate relatively small plots of land, usually relying mainly on family labor and limited resources. They produce primarily for household consumption and local markets (Chirwa, 2013) [4].

Livelihoods: Livelihoods mean the means through which households secure food, income, and other basic needs. It includes farming activities, income from selling crops, and other sources of support that help families meet daily needs (Ellis, 2000) [9].

Food Security: Food security means having reliable access to enough safe and nutritious food for a healthy life at all times (FAO, 1996) [10].

Strategies for Reducing Post-Harvest Losses: These are practical actions or technologies aimed at minimizing losses after harvest. Examples include improved drying, better storage facilities, and pest control measures (Porter, 1982) [33].

2. Literature Review

2.1 To assess the cause of post-harvest losses among small scall farmers in Mulobezi district

Post-harvest losses are a significant challenge faced by small-scale farmers worldwide, especially in developing countries. Globally, these losses affect food availability, farmers' incomes, and overall food security (Kader, 2005). Post-harvest losses occur due to multiple factors ranging from poor harvesting techniques to inadequate storage facilities. In many Asian and Latin American countries, these losses can reach up to 30-40% of total production (Gustavsson *et al*., 2011) [15]. Understanding the causes of these losses is critical to designing interventions that reduce waste and improve farmer livelihoods.

One major cause of post-harvest losses internationally is poor harvesting methods. Improper timing and handling during harvest can damage crops, making them more vulnerable to spoilage. For example, in India, farmers often harvest fruits and vegetables manually without the use of proper tools, which leads to bruising and mechanical injury (Singh *et al*., 2017). Such damage shortens the shelf life of produce and increases vulnerability to pests and diseases during storage.

Another widely documented cause is inadequate drying of crops after harvest. In many countries in Southeast Asia, farmers rely on sun drying to reduce moisture content. However, unpredictable weather conditions like rain and high humidity often disrupt this process (Narayanamoorthy, 2013). As a result, high moisture content leads to fungal growth and mold, causing significant losses. Lack of proper drying equipment remains a key challenge for many smallholder farmers.

Storage facilities also play a vital role in post-harvest losses. In Latin America, studies have shown that many small-scale farmers store grains and produce in traditional structures made from materials like mud and wood (Smith & Wilson, 2015). These structures often lack ventilation, protection from pests, and temperature control, leading to infestations by rodents, insects, and microbial contamination. Poor storage conditions are estimated to cause between 15-25% loss of stored grains.

Transportation from farms to markets is another important factor causing losses internationally. In countries like Mexico and the Philippines, poor road infrastructure and lack of refrigerated transport mean that crops can spoil before reaching consumers (FAO, 2013). Long travel times combined with rough handling during loading and unloading cause mechanical damage to perishable produce such as fruits and vegetables, increasing losses.

The lack of access to appropriate technology and equipment contributes heavily to post-harvest losses. Many small-scale farmers in countries like Bangladesh and Vietnam still use outdated tools for harvesting, drying, and storage (Hoang & Nguyen, 2018). This limits their ability to reduce losses efficiently. Additionally, financial constraints often prevent farmers from investing in modern technologies that could preserve their harvest better.

Pests and diseases are a common cause of post-harvest losses worldwide. Stored grains are particularly vulnerable to insect infestations such as weevils and beetles. In countries like Thailand and Indonesia, these pests can destroy large portions of stored crops if not properly

controlled (Williams *et al*., 2014). The use of pesticides and pest management practices is often limited by lack of knowledge and resources among smallholder farmers.

One major cause of post-harvest losses in Zambia is poor harvesting techniques. Many small-scale farmers rely on manual methods that often damage crops during harvesting (Mwansa *et al*., 2020). Timing is another challenge, with farmers sometimes delaying harvest due to labor shortages or other commitments, which results in over-mature or spoiled crops. This problem is commonly reported in provinces like Southern and Western Zambia where subsistence farming predominates (Phiri & Mumba, 2018).

Drying methods used by many farmers in Zambia contribute substantially to crop losses. Open sun drying on bare ground or simple mats exposes produce to moisture, dust, and animals (Simukanga *et al*., 2021). In rainy seasons or humid areas, such as parts of Eastern Province, inadequate drying causes mold growth and fungal infections, further reducing crop quality. Limited access to solar dryers and other improved technologies remains a barrier to effective drying.

Storage practices among Zambian smallholder farmers also cause significant post-harvest losses. Traditional storage facilities such as granaries and woven baskets are often poorly ventilated and vulnerable to rodent and insect attacks (Chirwa & Banda, 2016). For example, maize and groundnuts stored in local warehouses in Lusaka and Central provinces have been reported to suffer heavy damage due to weevils and grain borers (Mwiinga & Kunda, 2019). Lack of affordable, improved storage solutions limits farmers' ability to maintain quality.

Transportation infrastructure plays a role in post-harvest losses within Zambia, especially in rural areas. Poor road networks in districts like Mulobezi hinder timely delivery of produce to markets, increasing the risk of spoilage (Kapungwe *et al*., 2017). Farmers often use bicycles or public transport not designed for fragile agricultural goods, leading to physical damage and quality deterioration. The absence of refrigerated transport worsens losses for perishable produce such as vegetables.

Pest infestations are a common cause of post-harvest losses in Zambia. Insect pests such as maize weevils, larger grain borers, and bean bruchids frequently infest stored crops (Mwila *et al*., 2018). Many farmers lack knowledge or resources to apply effective pest control measures. Additionally, rodent damage remains a persistent challenge, especially in districts with high rodent populations such as Southern and Eastern provinces (Phiri *et al*., 2020).

2.2 To examine effects of post-harvest losses on food security among small scale farmers

Post-harvest losses directly threaten food availability and access by reducing the quantity and quality of food that reaches consumers. According to Gustavsson *et al*. (2011) [15], approximately one-third of all food produced globally is lost or wasted, undermining efforts to eradicate hunger and malnutrition. This issue is especially serious in developing countries where storage and handling infrastructure are limited.

In countries like India and Bangladesh, post-harvest losses have been shown to reduce food availability at household and market levels. A study by Kumar *et al*. (2018) reported that rice losses during harvesting, drying, and storage can reach 20% or more, significantly reducing the amount of grain available for consumption. These losses affect both household food security and national food reserves, increasing vulnerability to food shortages during lean seasons.

In Latin America, research demonstrates that post-harvest losses contribute to food insecurity by limiting farmers' income and ability to purchase food. For example, in Peru, losses in potato and maize due to poor storage and pest damage result in reduced income for small-scale farmers, making it difficult for them to buy diverse and nutritious foods (Bravo & Silva, 2019). This economic impact exacerbates food insecurity by affecting both food production and food access.

Food quality deterioration from post-harvest losses also affects nutritional security internationally. Studies from Southeast Asia show that damaged grains and vegetables lose essential nutrients during spoilage and fungal contamination (Nguyen & Tran, 2017). This reduction in nutritional value means even when food is available, it may not meet the dietary needs required for healthy living, increasing risks of malnutrition and related diseases.

In our country, post-harvest losses continue to be a serious concern for small-scale farmers and have significantly contributed to food insecurity in many rural areas. According to Mofya-Mukuka and Kuteya (2015), post-harvest losses in Zambia are particularly high for maize, which is the country's staple crop. Most farmers lack proper drying, storage, and handling facilities, leading to spoilage, pest damage, and mold infestation. These losses reduce the food available for consumption and for sale, limiting both food security and household income.

A study by the Indaba Agricultural Policy Research Institute (IAPRI) found that smallholder farmers in Eastern and Southern provinces lose up to 30% of their maize harvest due to inadequate post-harvest handling practices (Chapoto *et al*., 2014). This loss is especially high during the rainy season when farmers struggle to dry their crops properly. Without access to technologies like mechanical dryers or moisture meters, many farmers store grain while it is still damp, increasing the risk of fungal contamination and spoilage.

In Central Province, where many households rely on maize and groundnuts, poor storage techniques have been shown to contribute to seasonal hunger. Tembo *et al*. (2017) explain that many farmers use traditional storage methods such as woven baskets or grass-lined granaries, which are not effective in preventing insect infestation or moisture buildup. As a result, much of the harvested food is lost before the next planting season begins, putting families at risk of food shortages.

The effects of post-harvest losses are even more pronounced among farmers who grow perishable crops such as vegetables, tomatoes, and fruits. In areas like Chongwe and Kafue, farmers often face challenges transporting their produce to markets quickly, especially where road infrastructure is poor. According to the Ministry of Agriculture (2019), more than 40% of fruits and vegetables grown by small-scale farmers in Lusaka Province spoil before reaching the consumer due to the lack of cold storage and timely transport.

In Northern and Muchinga provinces, farmers face additional difficulties with storage pests such as larger grain borers and weevils, which attack stored maize and beans. Mwale and Mvunga (2020) argue that the lack of hermetic storage bags and metal silos in rural communities leads to

higher post-harvest losses, especially for farmers who cannot afford chemical treatments. These losses have long-term effects on food availability and income, making it difficult for families to afford other essential needs.

A study by the Zambia Agriculture Research Institute (ZARI) emphasizes that the loss of produce after harvest not only reduces food supply but also increases vulnerability to malnutrition, especially among children and pregnant women (ZARI, 2018). When staple foods are lost or spoiled, households are forced to cut back on the number and variety of meals, leading to dietary deficiencies. This situation is common in high-density rural communities where food stocks do not last the entire season.

In high-density rural and peri-urban areas such as Mpika and Chipata, post-harvest losses have created a pattern of food insecurity even during years of good harvest. According to the Food Reserve Agency (FRA), some farmers do not have access to storage depots or markets where they can quickly sell their produce (FRA, 2022). As a result, food that could have been preserved for months ends up wasted, while families still face hunger later in the year.

Lastly, research shows that addressing post-harvest losses could make a major difference in national food security. As pointed out by Sinkala and Mweemba (2023), even a 10% reduction in post-harvest losses would result in more food availability, higher incomes for farmers, and greater stability in local markets. Efforts to reduce these losses, especially through extension services, infrastructure development, and affordable storage technologies, could greatly improve the livelihoods of small-scale farmers across the country.

2.3 To explore strategies for reducing post-harvest losses

Globally, post-harvest losses (PHL) continue to be a major issue affecting food security and agricultural sustainability. According to the Food and Agriculture Organization (FAO, 2019) [13], an estimated one-third of food produced for human consumption is lost or wasted, with post-harvest losses accounting for a significant portion. These losses occur at various stages including harvesting, handling, storage, processing, and transportation. In many countries, efforts have been made to implement strategies that reduce these losses, especially through improved technologies and training.

One common global strategy involves investing in improved storage infrastructure. In countries like India and China, the introduction of hermetic storage technologies and cold storage facilities has led to measurable reductions in losses for perishable crops such as fruits, vegetables, and grains (Kitinoja, 2013). These facilities help maintain the quality of produce by protecting it from pests, moisture, and spoilage. The use of solar-powered cold rooms in rural communities has been particularly effective in minimizing vegetable spoilage and extending shelf life.

Another widely adopted approach is the implementation of standardized post-harvest handling procedures. For example, in the United States, training farmers and handlers on proper sorting, grading, and packaging practices has significantly reduced mechanical damage and spoilage (Parfitt *et al*., 2010). These measures, combined with improved logistics and quick market access, ensure that fresh produce retains its value and quality throughout the supply chain.

Digital tools and smart technologies are also becoming increasingly important in post-harvest loss mitigation. In countries like Israel and the Netherlands, precision agriculture and Internet of Things (IoT) solutions are being used to monitor environmental conditions in real-time and optimize storage conditions (Kumar & Kalita, 2017). These systems can alert users to temperature changes or humidity levels that might lead to spoilage, allowing for quick corrective action.

Global efforts have also focused on reducing post-harvest losses through policy frameworks and market reforms. In countries such as Brazil and Vietnam, governments have established policies that promote farmer cooperatives, access to markets, and investment in rural infrastructure. These policies encourage the aggregation of produce, improving bargaining power and reducing the time produce spends in unregulated and loss-prone environments (World Bank, 2018).

Capacity-building programs have been emphasized across several Asian countries. In Bangladesh, agricultural extension services have provided training in modern drying techniques, pest management, and storage systems. These interventions have led to a reported 20-30% reduction in rice and maize losses (FAO, 2011). Simple but effective practices, such as drying grains on raised platforms and using moisture meters, have empowered smallholders to better manage their harvests.

Agro-processing initiatives also serve as a critical post-harvest loss mitigation strategy. In countries like Thailand and the Philippines, governments have supported the development of food processing clusters where farmers can process perishable crops into products like juices, flours, or dried snacks (Sheahan & Barrett, 2017). This strategy not only reduces losses but also adds value to agricultural outputs, increasing farmer incomes.

Farmer training and awareness programs have also been key in addressing post-harvest losses. In Nigeria, agricultural extension programs have included modules on proper harvesting timing, drying techniques, pest control, and safe storage practices. According to Okon and Etim (2015), farmers who participated in these training programs reported a reduction of post-harvest losses by about 25% on average. Simple interventions such as drying maize on tarpaulins instead of bare ground have made a significant difference in grain quality.

Another important approach in Africa is the development of local agro-processing initiatives. In Ghana and Uganda, governments have promoted small-scale processing of cassava, mangoes, and tomatoes into flour, juice, and paste. This approach not only reduces losses of highly perishable produce but also adds value and increases farmer income (Sheahan & Barrett, 2017). In Rwanda, farmer cooperatives have begun turning excess produce into dried fruits and tomato powder, which can be sold even during the off-season.

Improved market access and logistics have also been emphasized in African countries. Poor road networks and long travel distances often cause significant delays in transporting produce to market, leading to spoilage. In Senegal and Mozambique, investments in rural feeder roads and market centers have helped reduce travel time and improved the flow of goods from farms to consumers. These infrastructure improvements have been supported by the World Bank and other donors to reduce food losses along the value chain.

Digital innovations have started playing a role in some African countries. In Ghana, mobile apps like AgroCenta

help farmers access market information, connect with buyers, and arrange transportation. These services reduce the time that produce remains in storage or with middlemen, which in turn helps cut post-harvest losses (Nabwiire *et al*., 2020). While such digital tools are still emerging, they show promise in streamlining the supply chain and improving coordination among value chain actors.

National policy frameworks are gradually incorporating post-harvest loss reduction as a development priority. For instance, Nigeria's Agricultural Promotion Policy (2016–2020) included specific objectives for improving post-harvest handling and reducing food waste. Likewise, Ethiopia's Growth and Transformation Plan recognized the need for investment in storage and agro-processing to support food security (FAO, 2019) [13]. However, actual implementation of these policies remains slow due to limited funding and institutional capacity.

Regional cooperation efforts have also begun to emerge. The African Union's Malabo Declaration on Agricultural Transformation committed to halving post-harvest losses by 2025. In line with this, countries like Zambia, Malawi, and Zimbabwe have taken steps to measure their food loss baselines and monitor progress. These efforts are supported by partnerships with the FAO, African Development Bank, and Rockefeller Foundation under the African Post-Harvest Losses Information System (APHLIS) project.

In our country, post-harvest losses continue to threaten the progress of smallholder farmers and national food security. According to the Indaba Agricultural Policy Research Institute (IAPRI, 2020), Zambia loses up to 30% of its maize and over 40% of fruits and vegetables before they reach consumers. These losses mainly happen because of poor storage, inefficient transportation, and lack of access to preservation technologies. As agriculture is the main source of livelihood for many rural households, finding sustainable strategies to reduce these losses remains an urgent priority.

One of the strategies that has shown positive results in Zambia is the promotion of hermetic storage technologies such as PICS bags. These airtight bags prevent pest infestation and reduce the need for chemical preservatives. The Ministry of Agriculture, together with partners like the World Food Programme (WFP), has distributed PICS bags in several districts, including Eastern and Southern Provinces. Farmers who have adopted these bags report a significant reduction in grain spoilage and better prices at the market (IAPRI, 2021).

Zambia has also seen some progress in agro-processing initiatives, especially among farmer cooperatives and small enterprises. For example, in places like Chipata and Mumbwa, local cooperatives have begun turning tomatoes into paste and drying mangoes for sale during the off-season. This form of value addition not only reduces waste of perishable goods but also increases farmers' incomes. However, limited access to processing equipment and capital continues to affect the scale of these efforts.

Efforts have also been made to improve storage infrastructure in rural areas. Through projects like the Enhanced Smallholder Livelihood and Agribusiness Project (E-SLIP), the government has supported the construction of improved storage sheds and community silos. These facilities help reduce exposure of crops to rain, rodents, and mold. However, many smallholder farmers still lack access to these facilities due to high transport costs or inadequate community organization.

Another strategy has been training and capacity-building. Extension officers in Zambia have worked with farmers to teach better post-harvest handling techniques such as proper harvesting times, drying methods, and grain cleaning. For instance, in Northern and Muchinga provinces, the Conservation Farming Unit (CFU) has included post-harvest management in its training modules. Farmers who practice raised platform drying and use tarpaulins instead of drying on bare ground report fewer losses from moisture and contamination.

The use of solar dryers has also begun gaining attention, especially among farmers dealing with vegetables, fish, and fruits. Organizations such as Musika and SNV have introduced solar drying technologies that are low-cost and easy to maintain. These dryers allow farmers to preserve their products longer without depending on electricity or expensive equipment. In districts like Luangwa and Chongwe, some women groups are using these dryers to process dried vegetables (like bondwe and okra) for urban markets.

In terms of market linkages, Zambia still faces challenges with road networks and access to reliable buyers. However, mobile platforms like Lima Links have been developed to connect farmers with buyers and share information on fair prices. This helps reduce the time produce spends in storage while waiting for a market, which is a key contributor to spoilage. While usage is still limited in rural areas due to poor internet coverage, this strategy holds great promise if scaled up effectively.

Government policies have slowly begun to recognize post-harvest management as a key area in agriculture. The National Agricultural Policy (2016–2020) mentions the need to invest in storage, agro-processing, and market systems. However, implementation of these strategies remains uneven due to budget constraints and limited monitoring. For real change to happen, more targeted support is needed from the government and its partners to ensure policies are matched by action on the ground.

Research institutions like the Zambia Agriculture Research Institute (ZARI) have played a role in testing improved storage and processing technologies. However, the link between research findings and community-level implementation remains weak. More effort is needed to translate research into practice and ensure that farmers can access the tools and knowledge needed to reduce post-harvest losses.

2.4 Personal Critique of Literature

One thing I noticed from the literature reviewed is that many researchers focused mostly on technical challenges like poor storage and pest infestation, but they did not go deep into the social or cultural factors that affect how farmers manage their harvest. For example, Sitko *et al*. (2011) [34] mainly discussed traditional storage methods, but they did not explain why farmers continue to use them despite high losses. I think understanding the beliefs, habits, or local knowledge behind these methods could help design better interventions.

Another issue is that most studies relied on quantitative data such as percentages of losses or the number of farmers affected. While this information is useful, it misses the human side of the story. For example, Tembo and Sitko (2013) [35] reported how few farmers have access to modern storage, but they didn't share the personal experiences or

voices of the farmers themselves. Including qualitative data, like interviews or focus groups, would have added more depth to their findings.

Some of the literature also seemed to repeat similar findings without adding new ideas. For instance, several authors like Mofya-Mukuka and Kuhlgatz (2015) [19] and Zulu-Mbata *et al*. (2020) [36] talked about financial limitations, but they didn't suggest detailed or practical solutions beyond general statements like "farmers lack access to credit." I believe research should not just describe problems—it should also offer clear and realistic ways forward that consider rural conditions.

A strength I appreciate is that many authors acknowledged the role of poor infrastructure, especially roads, in increasing post-harvest losses. This point was consistent in several studies and aligns with what we see in rural Zambia. However, I think the literature could have gone further by comparing how infrastructure affects different types of crops. Perishable crops like tomatoes might be more affected than maize, but this comparison was mostly missing.

Another gap in the literature is the lack of focus on climate change and its link to post-harvest losses. Only a few studies, like Chisanga *et al*. (2017) [6], touched on how changing weather patterns affect harvesting and drying. I think this is a major oversight because unpredictable rains and heatwaves are becoming common in our country, and farmers need guidance on how to adapt their storage and drying techniques under these new conditions.

Gender was also discussed, but not in enough detail. Muleya and Chibwe (2019) [22] mentioned that women have less access to storage technologies, but they did not explore how gender roles within households influence post-harvest decisions. In many communities, women are in charge of storing and processing food, so ignoring their perspective makes the research feel incomplete. More gender-sensitive analysis would improve the usefulness of the literature.

I also observed that most of the reviewed studies focused on maize, which is our staple crop, but they gave less attention to other important crops like groundnuts, beans, and vegetables. For example, Njobvu and Chikoye (2018) [28] discussed packaging issues, but mainly in relation to maize. Including a wider range of crops would give a fuller picture of the post-harvest challenges that small-scale farmers face.

Another limitation is that the policy analysis in the literature was too general. The PMRC (2018) [32] report noted that most support goes to production rather than post-harvest management, which is a good point. However, the study did not evaluate the actual effectiveness of the few post-harvest policies that do exist. Without this analysis, we cannot know whether current government efforts are helping or not.

The literature also missed the opportunity to highlight innovations by farmers themselves. Sometimes, rural farmers create low-cost solutions or adapt traditional methods in smart ways, but these local innovations were not well-documented in the literature. I think future studies should look at what farmers are already doing right and find ways to build on that.

Finally, I feel the reviewed literature needs to be more forward-looking. Most of the studies focused on what is wrong but didn't give enough attention to potential changes in markets, technology, or youth involvement in agriculture. For example, Kunda and Munsaka (2022) briefly mentioned digital tools, but this area deserves more detailed exploration. The future of farming, including post-harvest practices, will depend a lot on how young people and technology are integrated into agriculture.

2.5 Establishment of Research Gap

One of the most noticeable gaps in the literature reviewed under the first specific objective is the limited attention given to the local innovations and indigenous knowledge systems that farmers use in post-harvest handling. While international and African studies highlighted the importance of proper storage and handling, they often ignored how farmers in this country creatively adapt to challenges using locally available materials or traditional techniques. This omission creates a gap in understanding the practical realities and coping mechanisms of small-scale farmers here in Zambia. Recognizing and building on such local solutions could make interventions more sustainable and acceptable to farmers.

Another major gap is that most of the literature, especially from outside Africa, focused heavily on technical solutions such as mechanized storage systems or advanced drying technologies. These studies did not consider the economic constraints rural farmers in developing countries face, particularly here in Zambia. As a result, the recommendations made in those studies are often not practical for the local context. There is a need for more context-specific research that considers limited financial resources, cultural practices, and local climate conditions when discussing post-harvest handling practices.

From the African context, many studies emphasized broad national policies or regional strategies for reducing post-harvest losses but did not zoom in on community-level practices and challenges. For example, several studies mentioned the role of governments in providing infrastructure and extension services, but they did not explore how these services reach or fail to reach the rural farmer. This creates a research gap in understanding the actual implementation of policies and whether smallholder farmers are truly benefiting from them. The situation on the ground often differs from what is planned at policy level, and this disconnection is rarely examined.

When it comes to literature from Zambia, most studies provided general overviews of post-harvest challenges faced by farmers but did not explore the differences between regions, crops, or gender roles in enough detail. For example, challenges faced by women farmers in Eastern Province may be different from those in Western or Southern Province, yet the literature often treated small-scale farmers as a uniform group. This gap limits our understanding of how tailored solutions could better serve different groups within the farming community. More disaggregated data and analysis are needed.

Under the second specific objective, international literature often discussed risk identification and contingency planning in the context of large-scale commercial farming or agribusinesses, which are quite different from the smallholder farming systems found in this country. These studies rarely addressed the limited access to insurance, credit, and market information that local farmers face. This means there is a gap in understanding how risk management practices can be effectively adapted for use by small-scale rural farmers in developing countries like ours.

3. Research Methodology

3.1 Research Design

This study adopted a descriptive research design. The main purpose of using this design was to describe and explain the relationship between post-harvest losses and the livelihoods and food security of small-scale farmers in Mulobezi District. A descriptive design was suitable when a researcher aimed to gain a clear understanding of a specific issue by observing and recording facts without manipulating any variables (Kothari, 2004) [17]. This design allowed the researcher to collect both qualitative and quantitative data, which helped in getting a broader and deeper understanding of the experiences and challenges small-scale farmers faced after harvesting their crops.

3.2 Sampling Design

This study used a purposive sampling design to select participants who were most relevant to the research objectives. Purposive sampling, also known as judgmental sampling, involved deliberately choosing individuals based on specific characteristics—in this case, small-scale farmers in Mulobezi District who had experienced post-harvest losses. As Patton (2015) [30] explains, purposive sampling allowed the researcher to focus on participants who possessed firsthand knowledge of the issue being studied, making the data more insightful and meaningful.

3.3 Sampling Size determination

The sample size for this study was limited to a maximum of 100 respondents, drawn from small-scale farmers in Mulobezi District. This number was considered manageable and sufficient for gathering meaningful data that reflected the experiences and challenges of the target population. According to Mugenda and Mugenda (2003) [20], a sample size of at least 10% of the accessible population is generally acceptable for social science research, especially when the study area is not very large. The selected sample allowed the researcher to obtain diverse perspectives without compromising the depth and quality of the information.

3.4 Data Collection methods

This study used questionnaires as the main method of data collection. Questionnaires were effective tools for collecting information from a large number of respondents within a short period of time (Kothari, 2004) [17]. The researcher designed both open-ended and closed-ended questions to allow participants to express their views freely while also providing structured responses that were easy to analyse. The questionnaires were administered face-to-face to ensure that the respondents clearly understood the questions, especially since some of them had limited literacy levels.

3.5 Data Analysis

The data collected in this study were analysed using both quantitative and qualitative methods. Quantitative data from the closed-ended questionnaire responses were analysed using SPSS and Microsoft Excel to generate simple statistical summaries such as frequencies, percentages, and charts. This helped in identifying patterns and trends in post-harvest losses and their effects on small-scale farmers' livelihoods and food security. On the other hand, qualitative data from open-ended responses were analysed through thematic analysis by grouping similar responses into common themes (Creswell, 2014) [7].

3.6 Triangulation

This study used triangulation to increase the validity and reliability of the findings. Triangulation involved using more than one method or source of data to cross-check and confirm the results (Denzin, 1978) [8]. In this research, data were collected through both open-ended and closed-ended questions within the same questionnaire, allowing the researcher to compare qualitative and quantitative responses. This approach helped reduce bias and provided a more accurate understanding of the effects of post-harvest losses on small-scale farmers' livelihoods and food security.

3.7 Limitations of the study

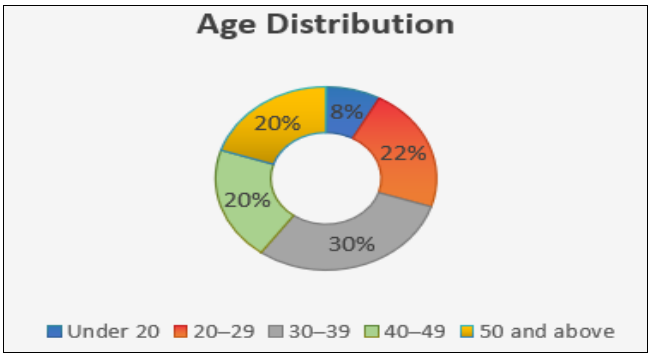
One challenge the researcher encountered during data collection was the unwillingness of some respondents to share honest information due to fear, suspicion, or lack of understanding of the purpose of the study. In rural areas like Mulobezi District, some small-scale farmers were hesitant to participate, especially if they associated the study with government inspections or feared that their responses could have negative consequences. Limited literacy levels also posed a challenge, as some respondents had difficulty understanding the questionnaire, requiring more time and explanation (Creswell, 2014) [7].

3.8 Ethical Considerations

When collecting data for this study, several ethical considerations were carefully observed to protect the rights and well-being of the participants. The researcher ensured that all respondents provided informed consent before taking part in the study, meaning they were fully informed about the purpose of the research, how their data would be used, and their right to withdraw at any time without penalty (Bryman, 2016) [3]. Confidentiality and privacy were maintained by keeping all personal information anonymous and securely stored, so that no individual could be identified in the research findings. The researcher also respected cultural norms and avoided any form of coercion or pressure on participants to respond. Care was taken to ensure that questions were respectful and not intrusive.

4. Presentation of Research Findings

4.1 Presentation of results on background characteristics of the respondents

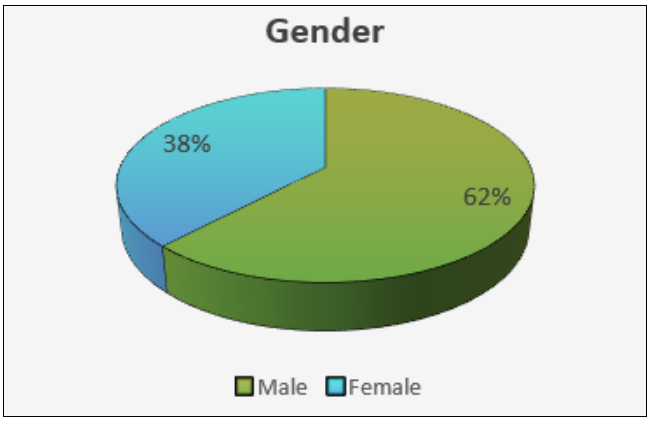


Source: Field data (2025)

Fig 4.1: Ages of respondents

The largest proportion of respondents (30%) are aged between 30 and 39 years, reflecting a relatively young and active farming population. Together with the 22% in the 20–29 group, over half the farmers are below 40, suggesting

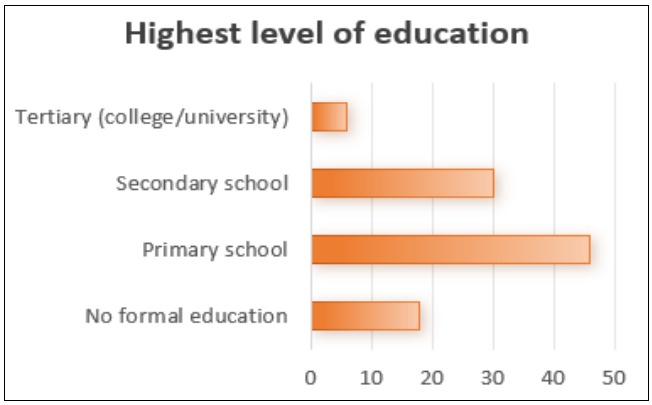
that a strong workforce is engaged in agriculture. Farmers aged 40 and above make up 40% of the sample, showing that older and more experienced farmers still play a crucial role. The 8% of respondents under 20 could represent youths supporting their households or starting farming early. This age distribution is important because it highlights the balance between experienced farmers with traditional knowledge and younger farmers more likely to adopt innovations.



Source: Field data (2025)

Fig 4.1.2: The gender of respondent

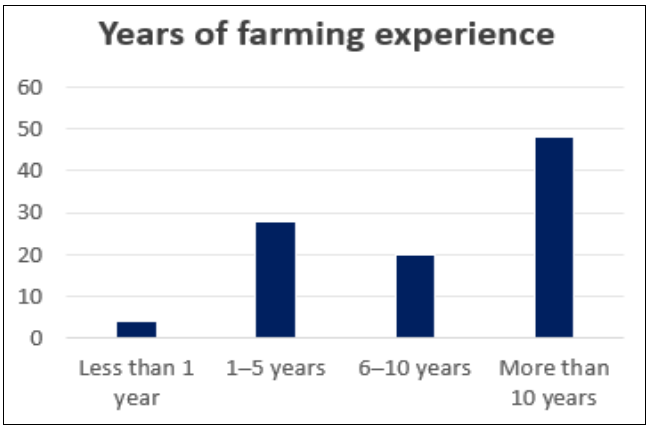
The findings indicate that men make up the majority of respondents (62%), while women represent 38%. This demonstrates that agriculture in the study area is still male-dominated, although women also play a significant role. The proportion of women highlights the need to consider gender-sensitive interventions, since women are often responsible for food storage, processing, and household food security. The absence of respondents identifying as "Other" reflects the cultural and social context of the rural setting.



Source: Field data (2025)

Fig 4.1.3: Highest level of education

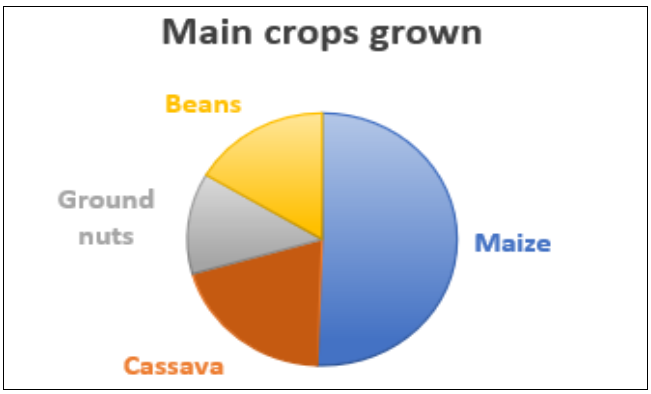
Almost half of the respondents (46%) reported having only primary-level education, while 30% reached secondary level. A smaller proportion, 18%, had no formal education, and only 6% attained tertiary education. This distribution shows that many farmers have limited formal education, which can influence their access to technical knowledge and their ability to adopt new technologies. The low number of tertiary graduates suggests that advanced training opportunities are limited in the community.



Source: Field data (2025)

Fig 4.1.4: Years of farming experience

The results show that nearly half of the respondents (48%) have over ten years of farming experience, which means most participants are well established in agricultural practices. Another 28% have farmed between one and five years, suggesting an influx of relatively new farmers. Those with six to ten years of experience (20%) represent a middle group who have already gained some stability but are not as seasoned as older farmers. Only 4% of the respondents have farmed for less than a year, indicating that agriculture is not dominated by complete beginners.

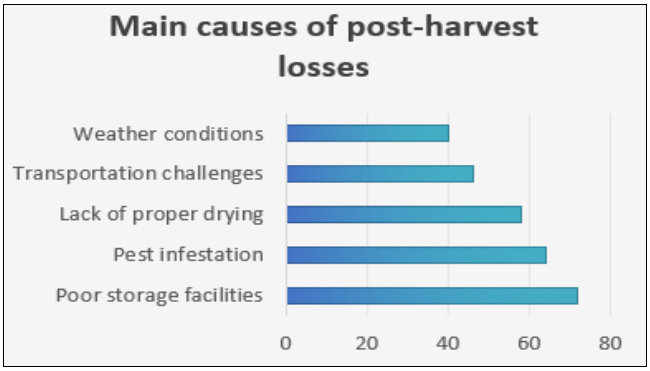


Source: Field data (2025)

Fig 4.1.5: Main crops grown

Rspondents were asked which crops they grow and most mentioned two or more crops. However, Maize is the most commonly grown crop, cultivated by 86% of the respondents, which reflects its status as the staple food crop in Zambia. Cassava (34%), beans (28%), and groundnuts (22%) are also significant, suggesting that farmers practice mixed cropping. The presence of other crops (10%) highlights some level of diversification, though on a smaller scale. This crop mix influences the types of post-harvest losses experienced, since each crop has different storage and handling requirements.

4.2 Presentation of findings on Causes of Post-Harvest Losses



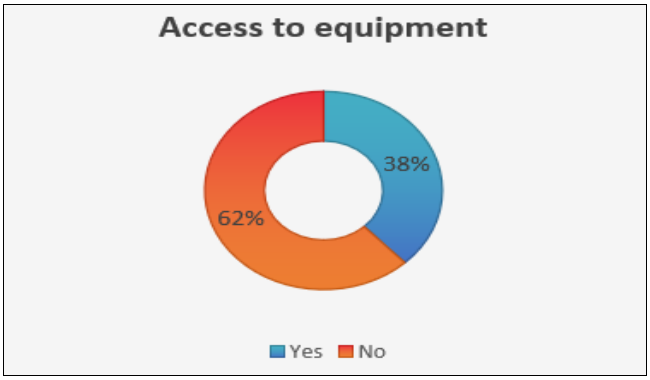
Source: Field data (2025)

Fig 4.2.1: Main causes of post-harvest losses

The findings show that poor storage facilities (72%) and pest infestations (64%) are the most common causes of post-harvest losses. Lack of proper drying (58%) also ranks high, indicating that moisture management is a key issue. Transportation challenges (46%) and weather conditions (40%) add further stress to harvested produce, particularly during movement to markets or storage.

4.2.1 How pests affect crops

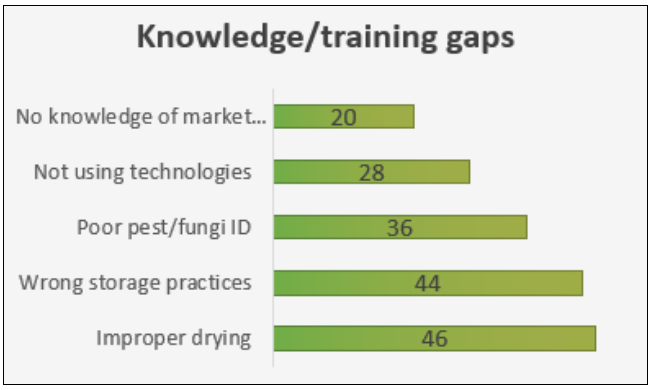
When respondents were asked this open ended question, Multiple themes emerged. Over half of the respondents (52%) indicated that pests directly consume stored grains, leading to reduced quantities available for household use or sale. Another 44% highlighted quality loss that reduces the market value of their produce. Spoilage and contamination were mentioned by 28%, showing that pests create indirect risks such as mould and aflatoxin. About 30% reported being forced to sell crops early due to pest threats, which negatively affects their bargaining power. Only 6% reported no major pest effects, showing that pests are a widespread problem that significantly contributes to post-harvest losses.



Source: Field data (2025)

Fig 4.2.3: Access to equipment/materials

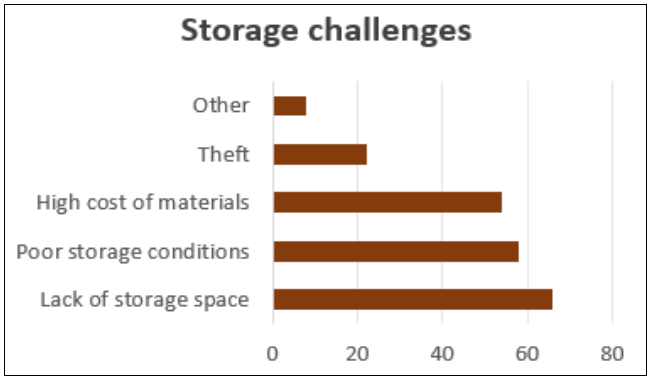
A majority of respondents (62%) reported no access to equipment or materials to reduce post-harvest losses, leaving only 38% with some form of support. Among those with access, hermetic bags were the most common (47%), followed by tarpaulins and raised platforms (26%). Improved silos and storage sheds were rare (16%), indicating cost barriers to large-scale solutions. Pesticides and repellents (21%) were also used, although their effectiveness depends on proper training.



Source: Field data (2025)

Fig 4.2.4: Knowledge/training gaps

Nearly half the respondents (46%) indicated poor drying practices as a key knowledge gap, which aligns with earlier findings about drying as a major loss factor. Wrong storage methods were mentioned by 44%, showing that many farmers lack basic training in safe grain handling. Poor identification of pests and fungi (36%) suggests that farmers may not recognize early signs of infestation or contamination. Not using available technologies due to ignorance (28%) further highlights the role of limited training. Additionally, 20% mentioned weak knowledge of market timing, showing that post-harvest training should combine storage techniques with marketing skills.

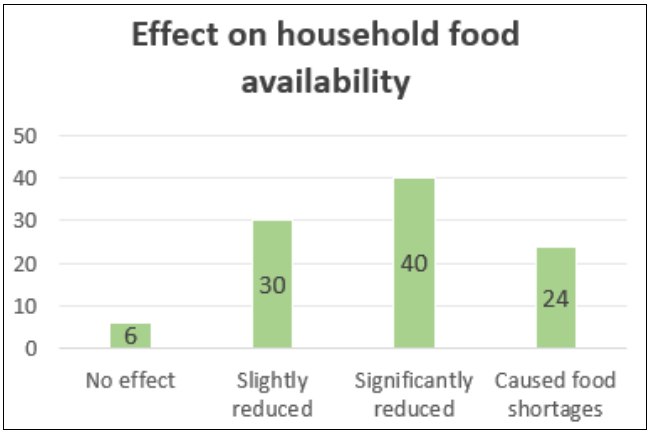


Source: Field data (2025)

Fig 4.2.5: Storage challenges

The most reported challenge was lack of storage space (66%), indicating that farmers struggle to keep their harvests safely. Poor storage conditions (58%) such as high humidity or temperature also cause significant spoilage. The high cost of materials (54%) shows that financial barriers prevent farmers from adopting improved solutions. Theft was identified by 22% of respondents, suggesting security is an additional concern in some areas. These challenges highlight the need for low-cost, secure, and climate-appropriate storage technologies that farmers can realistically afford and adopt.

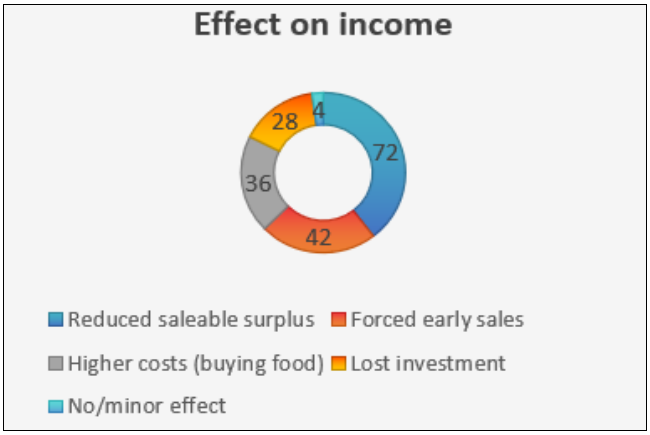
4.3 Findings on Effects on Food Security



Source: Field data (2025)

Fig 4.3.1: Effect on household food availability

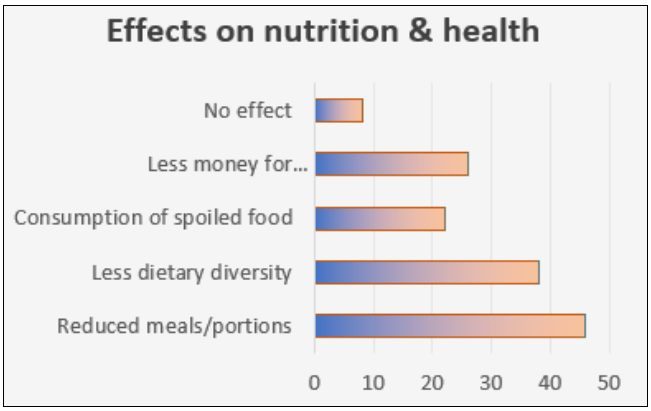
The results show that 64% of respondents experienced either significant reductions in food availability (40%) or outright shortages (24%). Another 30% reported slight reductions, while only 6% said post-harvest losses had no effect on their food supply. This indicates that post-harvest losses directly impact household consumption and food security in most cases. Families that experience shortages may face periods of hunger or be forced to reduce meal frequency. These findings demonstrate that reducing post-harvest losses would not only increase incomes but also enhance household nutrition and resilience.



Source: Field data (2025)

Fig 4.3.2: Effect on income

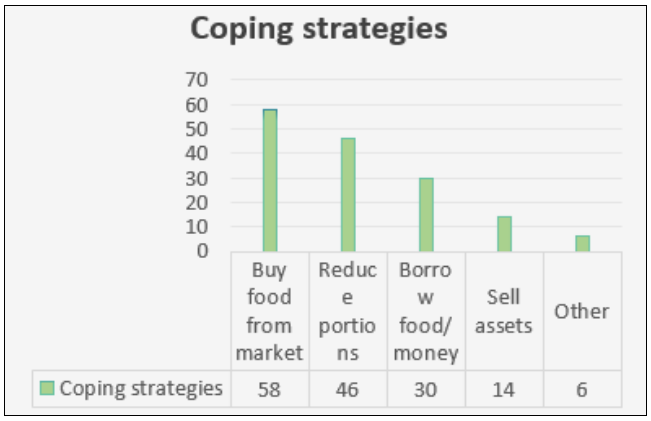
Most respondents (72%) indicated that post-harvest losses reduce the surplus available for sale, which is the main way they earn income. Many (42%) also reported being forced to sell early, often at lower prices, due to spoilage threats. Higher household costs were reported by 36%, as families have to buy food to replace lost stocks. Another 28% noted that losses prevent them from recovering investments such as seeds and fertilizer.



Source: Field data (2025)

Fig 4.3.4: Effects on nutrition & health

Nearly half (46%) of the respondents said post-harvest losses reduced their meal sizes or frequency, indicating a direct effect on nutrition. A further 38% reported reduced dietary diversity, as families may consume fewer types of food. Consumption of spoiled food was noted by 22%, which poses health risks such as foodborne illness and exposure to toxins. About 26% said losses reduced their ability to afford healthcare and education, showing indirect socio-economic effects. These findings suggest that post-harvest losses not only reduce the quantity of food available but also compromise quality and long-term household welfare.



Source: Field data (2025)

Fig 4.3.5: Coping strategies

The most common coping strategy was buying food from the market (58%), which places additional financial pressure on households. Nearly half (46%) reduced portion sizes, directly affecting nutrition. Borrowing (30%) shows reliance on social networks or informal credit systems, which may create debts. A smaller share (14%) reported selling assets, a harmful coping mechanism that erodes long-term resilience. These coping strategies reveal that post-harvest losses force households into trade-offs that compromise both food security and economic stability.

4.4 Discussion of Research Findings

1. Demographic Information of Respondents

The demographic characteristics of the respondents provide an important foundation for understanding the study results. The age distribution showed that 30% of farmers were between 30 and 39 years, while 22% were aged 20–29. Together, these two categories represent more than half (52%) of the farmers, which suggests that the farming population in the study area is relatively young and active. These findings confirm what was reported in Chapter Two by Mwaura (2017) [23], who explained that younger farmers are more energetic and more willing to adopt new technologies. At the same time, the study showed that 40% of respondents were above 40 years, which indicates that older farmers remain an important part of the agricultural system. This blend of youth and experience provides opportunities for knowledge sharing, but it also highlights the challenge of designing extension programs that appeal to both younger and older generations.

2. Causes of Post-Harvest Losses

The study identified several causes of post-harvest losses, with poor storage facilities (72%) and pest infestations (64%) being the most common. These results confirm the literature reviewed in Chapter Two, such as FAO (2017) [11], which highlighted poor storage and pests as leading contributors to grain losses in sub-Saharan Africa. The fact that over two-thirds of farmers in this study identified storage as a major problem demonstrates the urgency of addressing this challenge. Pest infestation was also widely reported, confirming findings from Mulenga (2015) [21], who explained that pests such as weevils and rodents cause both quantity and quality losses. By presenting exact percentages, this study contributes stronger evidence compared to earlier studies that often discussed causes in general terms.

3. Effects of Post-Harvest Losses on Food Security

The study revealed that post-harvest losses had significant effects on household food availability. A total of 40% of farmers said losses significantly reduced food availability, and 24% said they caused outright shortages. These findings confirm the argument made in Chapter Two by FAO (2018) [12], which linked post-harvest losses to increased food insecurity in rural households. Only 6% reported no effect, which shows that losses affect almost every household in one way or another. This demonstrates that reducing post-harvest losses is not only an economic issue but also a food security and nutrition priority. By quantifying the degree of effect, the study provides empirical evidence that was lacking in earlier literature, where food insecurity was often discussed without linking it to post-harvest loss percentages.

4. Challenges in Electronic Land Record Management at Lusaka City Council

The study revealed that inadequate infrastructure is one of the biggest challenges. Only a few departments had computers connected to the internet, leaving most staff without access to electronic systems. This finding is consistent with Makgahlela (2021), who reported similar gaps in South African municipalities. this study adds to the literature by showing the direct effects of poor infrastructure on LCC, such as unequal access and dependence on personal devices. This practical detail addresses the literature gap by explaining how infrastructure shortages specifically affect record management in Zambia.

5. Strategies for Reducing Post-Harvest Losses

The study revealed that farmers are already using several methods to reduce losses. The most common practices were proper drying (48%) and use of pesticides (42%). Improved storage was used by 36%, while timely harvesting was practiced by 40%. These findings confirm the literature reviewed in Chapter Two, such as Mwansa (2018) [25], who noted that farmers often use low-cost methods such as drying and pesticides to protect their crops. However, the relatively low use of improved storage confirms the literature that high costs and low availability remain barriers to adoption. This study fills a gap in the literature by showing the exact percentages of adoption, which provides a stronger basis for planning interventions.

5. Conclusion and Recommendations

5.1 Conclusion

The study set out to investigate the causes and effects of post-harvest losses among smallholder farmers and to explore strategies that could help reduce them. The findings showed that losses were influenced by many factors, including poor storage facilities, pest infestation, lack of proper drying, transportation challenges, and weather conditions. These results confirmed what earlier studies had highlighted but also provided new evidence by presenting clear statistics from the field. The study therefore achieved its objectives by identifying the main sources of losses and showing how they affect farmers in different ways. The study confirms that post-harvest losses remain a serious challenge for smallholder farmers but also shows that solutions are possible. The results demonstrate that technical, social, and economic factors all interact to create losses, which means that interventions must be comprehensive. The research adds to the existing literature by providing detailed evidence from the field and addressing knowledge gaps about farmer perceptions, coping strategies, and willingness to change. Most importantly, the findings provide a strong basis for practical recommendations that can guide farmers, policymakers, and development partners in reducing post-harvest losses and strengthening food security in rural communities.

5.2 Recommendations

The first recommendation is to improve access to affordable storage facilities for smallholder farmers. Since 72% of farmers reported poor storage as a major cause of losses, interventions should prioritize low-cost solutions such as hermetic bags, metal silos, and improved storage sheds. Government agencies, NGOs, and private suppliers can work together to subsidize these technologies or make them available through farmer cooperatives. By doing so, farmers will be able to store their produce for longer periods without the risk of pests and spoilage. This would reduce losses and allow farmers to sell their produce at better prices.

Secondly, based on the findings, I recommentd that farmers be trained in post-harvest handling practices. Findings showed that many losses were caused by poor drying methods (58%) and wrong storage practices (44%). Training should be practical and tailored to farmers with low literacy levels, using demonstrations and visual materials. Extension services should also focus on teaching farmers how to identify early signs of pest infestation and contamination.

Regular refresher training will help farmers keep up with changing climatic conditions and emerging storage technologies.

Another important recommendation is to increase access to finance for smallholder farmers. Many respondents explained that the high cost of materials prevented them from adopting improved practices. Microfinance institutions, farmer cooperatives, and government programs can provide small loans or subsidies to help farmers purchase storage equipment and drying tools. Access to credit will also allow farmers to avoid distress sales, as they will not be forced to sell early at low prices to cover immediate needs. This approach would directly address the financial barriers that farmers identified in the study.

6. Acknowledgment

I would like to sincerely thank everyone who contributed to the success of this study. Special gratitude goes to the supervisor, Dr. Chisala Bwalya, for his guidance, patience, and valuable advice throughout the research process. Appreciation is also extended to the lecturers and staff of the School of Humanities and Social Sciences at Information and Communications University for their academic support. I am deeply grateful to the small-scale farmers of Mulobezi District who kindly participated in the study and shared their experiences, without whom this research would not have been possible. Lastly, heartfelt thanks go to family and friends for their encouragement, prayers, and unwavering support during the entire journey of this research.

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