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Post-Harvest Challenges and Supply Chain Inefficiencies of Sweet Potato in Port Moresby's Urban Markets: Assessing Quality Losses, Market Access, and Distribution Challenges

A thesis presented in partial fulfilment of the requirements for the degree of Master of Agribusiness Management at Massey University, New Zealand



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Abstract

Sweet potato (*Ipomoea batatas*) is a major staple crop in Papua New Guinea (PNG), contributing significantly to food security, nutrition, and rural livelihoods. Despite its importance, post-harvest losses and supply chain inefficiencies continue to constrain its market potential, particularly in urban centres such as Port Moresby. This study investigates the post-harvest challenges and supply chain inefficiencies affecting sweet potatoes in Port Moresby's urban markets, with a focus on quality losses, market access barriers, and bottlenecks.

A qualitative research approach was employed using semi-structured interviews with key stakeholders, including smallholder farmers, transporters, wholesalers, vendors, and consumers. The data were analysed thematically to identify key challenges across different stages of the sweet potato value chain. The findings reveal that significant quality losses occur during harvesting, transportation, storage, and retailing due to poor handling practices, inadequate infrastructure, and the absence of cold chain systems. Market access challenges were found to be driven by high transportation costs, limited market information, and reliance on intermediaries, which reduce farmers' bargaining power and income. Distribution bottlenecks, including poor road conditions, shipping delays, port congestion, and overcrowded urban markets, further hinder efficient supply and contribute to price volatility and food losses. Additionally, informal trading practices were found to influence product quality, pricing inconsistencies, and consumer safety.

The study concludes that addressing post-harvest and supply chain inefficiencies requires targeted investments in infrastructure, improved post-harvest handling training, strengthened market information systems, and supportive policies to enhance market integration. The research provides practical recommendations for farmers, policymakers, and stakeholders to improve the efficiency and sustainability of the sweet potato supply chain in PNG's urban markets.

Keywords: Sweet potato, post-harvest losses, supply chain inefficiency, market access, distribution bottlenecks, urban markets.

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Chapter 1: Introduction

1.1 Background of Sweet Potato as a Crop

Sweet Potato, scientifically known as *Ipomea batatas,* is an important crop in Papua New Guinea's (PNG) agriculture sector as it is a staple food for the population. This tuber crop is widely cultivated across the country's diverse agro-ecological zones and also a key source of food security for rural communities (Fujinuma et al., 2018). Sweet Potato easily adapts to varying climatic and soil conditions making it an essential crop for subsistence farming. Most farmers prefer it, compared to other root crops due to its ability to withstand extreme climatic conditions such as droughts (Nhanala & Yencho, 2021).

With regards to dietary contributions, sweet potato serves as a source of energy, carbohydrates and other essential nutrients for the local population. Tuber crops in PNG provides almost 27% of the caloric intake nationally, with sweet potato being the main source as it accounts for over 12% of the total caloric consumed (Chang et al., 2007; Joseph et al., 2025). Sweet potato provides 65% of total production of staple food crop as no other staple provide more than 10% (by weight and food energy) (Bourke & Vlassak, 2004). Current sweet potato production in PNG is 721 308 tonnes of which 80% is produced in the highlands region for consumption and pig's feed (FAO, 2023). Bourke and Vlassek (2004) estimate that 75% of sweet potato produced nationally is for human consumption as PNG people love their sweet potatoes. The crop can be consumed in different forms such as boiled, baked, mashed or fried and is mixed into traditional dishes; therefore, it is a vital aspect of daily meals. Additionally, the availability of its

wide variety in PNG, provides distinct flavors, colors and textures, thus boosting its culinary versatility (Chang et al., 2007; Omot et al., 2010).

Apart from its nutritional value, sweet potato is vital in terms of cultural significance in PNG. Sweet potato is used in traditional customs, rituals and social gatherings. For example, during ceremonial occasions, sweet potato is used as the main source of gifts symbolizing abundance and hospitality (Bourke, 2005; Wiessner, 2005). The crop's cultivation and consumption are integrated into the cultural fabric of PNG, strengthening community ties and social identity among various ethnic groups. The harvest of sweet potato is celebrated during festivals where its importance and role in agriculture is highly emphasized.

Sweet Potato serves as a primary source of essential nutrients such as vitamins and minerals specifically vitamins A and C, potassium and dietary fibre. The presence of beta-carotene, which the body converts to vitamin A, is important, as deficiencies in vitamin A are a significant public health concern in PNG (World Health Organization, 2022). Due to its high nutritional qualities, it contributes significantly to eliminating malnutrition, particularly among children and pregnant woman resulting in boosting overall health and well-being (Mbela et al., 2021).Apart from this sweet potato contributes to food security as it is a cash crop used to generate income for families.

1.2 PNG Agricultural Context and Policy Environment

Papua New Guinea (PNG) is a geographically and socially diverse Pacific island country in which agriculture remains central to food security, household livelihoods and rural economic activity. Agriculture, forestry and fishing accounted for about 16.9% of GDP in

2019, while agriculture continues to provide the main source of food, employment and income for more than 85% of the population (FAO, 2021; World Bank, 2025). The importance of agriculture therefore extends beyond its contribution to national output because it supports the livelihoods of a large proportion of households and supplies food to both rural communities and the growing urban population.

The agricultural sector is dominated by smallholder production, with food crops playing an important role alongside export-oriented commodities. The sector nevertheless faces persistent constraints associated with infrastructure, market access, productivity, access to improved technologies, post-harvest management and linkages between producers and markets. These constraints are particularly important for perishable food crops because production gains do not necessarily translate into improved food availability or farmer income when produce is damaged or delayed before reaching consumers. Recent World Bank analysis emphasises the importance of improving smallholder productivity, market connectivity, infrastructure, post-harvest processing and agricultural value chains as part of PNG's broader development strategy (World Bank, 2025).

PNG's policy environment also recognises the importance of strengthening food production and agricultural market systems. The National Food Security Policy 2018–2027 identifies agriculture as a major source of food, employment and income and places emphasis on increasing productivity, strengthening resilience in food production and supply systems, improving efficiency along food value chains, empowering women in agriculture, and strengthening governance and coordination (Department of Agriculture and Livestock [DAL], 2018). The policy also recognises that food security requires coordinated action across agriculture, trade, transport infrastructure, health and other

sectors. Thus, improving the performance of staple-food supply chains is consistent with national policy priorities.

Sweet potato is not governed by a single stand-alone national commodity policy; rather, its development is supported through broader agricultural and food-security policies, national research programs and market-development initiatives. This policy setting is relevant to the present study because the research examines practical points in the food system-production-to-market handling, transport, market access and distribution-where policy and infrastructure conditions can influence the performance of the sweet potato sector.

1.3 Sweet Potato Production, Economic Importance and Sector Development

Sweet potato is the major staple food crop in PNG and has traditionally been concentrated in the Highlands, while also being cultivated in other agro-ecological regions. It contributes substantially to household food supply and is increasingly important as a source of cash income for smallholder farmers. Research indicates that sweet potato has been shifting from predominantly subsistence production towards more market-oriented production, particularly in the Highlands, where improved planting material, production practices and access to urban markets have created opportunities for commercialisation (ACIAR, 2017; Brown et al., 2019).

Production estimates also demonstrate the continuing scale of the crop. Recent FAOSTAT estimates indicate that national sweet potato production has remained broadly within the range of approximately 0.7–0.74 million tonnes in recent years. Rounded estimates show about 718,000 tonnes in 2018, 741,000 tonnes in 2020, approximately

699,000 tonnes in 2021 and about 735,000 tonnes in 2023 (FAO, 2024). The figures suggest that, although annual production fluctuates, sweet potato remains a large and relatively stable component of PNG's food-crop system. The variation between years also points to the importance of production conditions, climate, pests and diseases, and the ability of farmers to maintain productive systems.

The importance of the sector is not limited to production volume. Sweet potato contributes to food security, household consumption, animal feed and cash income. ACIAR-supported research has shown that commercialisation is increasing in the Highlands, with farmers adopting cleaner planting material and improved production practices and supplying higher-value markets, including supermarkets in Port Moresby (ACIAR, 2020; ACIAR, 2024). However, the expansion of production and commercial opportunities increases the importance of efficient post-harvest handling, transport and market coordination. If increased production is accompanied by high losses during harvesting, packing, transportation, storage or marketing, the potential economic and food-security benefits of the sector are reduced.

The sweet potato sector therefore involves a network of farmers, village aggregators or traders, transporters, wholesalers, market vendors, retailers and consumers, with government agencies, research organisations and development partners also influencing the enabling environment. Long-distance marketing from the Highlands to coastal markets such as Lae and Port Moresby has been documented for many years, and earlier research identified transport conditions, packaging, handling, storage and delays as important sources of losses. More recent ACIAR work similarly identifies infrastructure, technical capacity, market requirements, quality, consistency of supply and pricing as

continuing considerations in the commercialisation of the crop (ACIAR, 2013, 2017, 2024).



Figure 3.0 Sweet potato transport route from highlands to Port Moresby urban markets, PNG. Source: Satellite Map of PNG.

1.4 Significance of Post-Harvest Handling

Since sweet potato is a perishable product, and it must be handled with care to avoid spoilage. Like other produce, proper handling plays a critical role in the agricultural supply chain. Effective post-harvest handling is vital for ensuring quality and food safety is maintained and post-harvest losses are reduced. As a staple food in PNG, it is the primary source of essential nutrition for the population, therefore effective post-harvest handling is crucial for both farmers and consumers.

Like many tuber crops, sweet potatoes are prone to spoilage when not handled with care. The quality of the tuber can be easily reduced by pest attack and environmental conditions and through mechanical damage. Research indicates that improper handling techniques during harvesting, transportation, and storage can lead to significant quality losses, with losses exceeding 30% in some regions (Chang, 2014; Chang & Spriggs, 2007; Chang et al., 2007).Therefore, proper implementation of relevant techniques such as careful harvesting methods, proper cleaning, and adequate ventilation during storage can help preserve the nutritional and market value of sweet potatoes (Rundquist, 2020; Wilson et al., 1977).

Storage conditions play a vital role in extending the shelf life of sweet potatoes. Ideal storage conditions like cool, dry and dark environments are ideal as it reduces respiration rate and moisture loss resulting in extended shelf life of the crop (Amherst, 2013). Farmers do not have access to improved storage facilities in PNG, which further lead to increases in post-harvest losses. This is further compelled by traditional storage methods which are unsuitable to maintain shelf life, leading to rapid crop deterioration. Current improvements in storage facilities like use of insulated containers or community storage facilities have contributed to improved quality retention of sweet potatoes and reduced waste.

In addition to physical quality, post-harvest handling also encompasses food safety aspects. When not handled properly, pathogens can easily access sweet potatoes, posing health risk to consumers. Contaminated product during harvesting or processing may result in food-borne illnesses, which is a great concern in developing countries as

healthcare access are sometimes limited (Grace, 2023) . Therefore, farmers and vendors need to be made aware of hygiene practices like handwashing and equipment sanitation to ensure the safety of food products in urban markets. Furthermore, proper post-harvest handling practices also contribute in the long run to economic sustainability for farmers. By implementing proper post-harvest practices, farmers can reduce losses and improve the quality of sweet potatoes, thereby securing better prices in the market. Careful handling enhances the marketability of products, leading to better economic outcomes for farmers and communities. Studies have confirmed that investments in post-harvest training and facilities yield high returns, boosting income and encouraging further agricultural production (Schmit et al., 2020).

The importance of post-harvest handling extends beyond individual farms; it impacts the entire supply chain and food systems. Since PNG's urban population is increasing at an alarming rate, it is crucial to ensure consistent supply of quality sweet potatoes. Good post-harvest practices will address the gap between production and consumption, while simultaneously tackling the issues of food scarcity and price volatility in urban markets (He et al., 2020).

1.5 Challenges in Urban Markets of Port Moresby and Other PNG Areas

Sweet potato is marketed through local and urban markets across PNG, and Port Moresby is one of the major distant urban destinations for Highlands-produced sweet potato. The supply-chain and post-harvest problems considered in this study therefore occur within a wider PNG context. Evidence from the Highlands, Lae and Port Moresby indicates that poor road and transport conditions, multiple handling points, packaging practices,

inadequate storage and delays can contribute to quality deterioration and financial losses (ACIAR, 2013, 2017). In Port Moresby, these wider constraints are particularly relevant because produce may have travelled a long distance before entering urban markets. The present study consequently focuses on how these broader problems are experienced and connected within Port Moresby's urban market system.

Additionally, urban markets have improper storage facilities which can worsen post-harvest losses. Almost all vendors in urban markets do not have access to proper storage options and refrigeration required to maintain the quality of their produce, especially perishable produce like sweet potatoes (Paul et al., 2021). The lack of improved storage technologies further worsens these issues, restricting the availability of quality produce in the markets. Under these extreme conditions, crops can quickly deteriorate, resulting in waste and financial losses for both farmers and vendors.

Another concern smallholder farmers face is having good access to urban markets. These farmers make up a large proportion of sweet potato producers, and they struggle to reach urban markets due to geographic and economic barriers. The cost of transportation is often discouraging as it is very expensive, and without good access to markets, farmers face the challenge of having to sell their products at fair prices (Mukundi et al., 2013; Mutai et al., 2013). This issue of limited market access can perpetuate poverty and hinder economic opportunities for rural communities.

Moreover, the use of informal trade practices is reported to dominate the urban markets in Port Moresby, which leads to uneven quality and pricing of the products. Many vendors sell their products informally and do not follow the regulatory policies that

registered and well-established formal businesses have. Although this is beneficial for small scale-traders, it may result in the absence of accountability in terms of product quality and safety (Schanbacher et al., 2021). This often puts consumers in a challenging position to make informed purchasing decisions as they encounter differences in the freshness or quality of the products.

Furthermore, vendors face huge competition among themselves in the urban markets of Port Moresby. As urbanization increases, more people from rural areas and other provinces migrate to Port Moresby in search of jobs and education, consequently leading to an increase in small-scale trading as a source of livelihood. This further results in the over-saturation of market spaces, limiting the profit margin for vendors as competition increases. Unsustainable pricing wars may arise, where some vendors are compelled to lower prices in order to attract customers, which can negatively impact their ability to cover costs and thrive in the long term (Bonney et al., 2014; Sharp, 2021).

Finally, regulatory and policy challenges also play a role in shaping market dynamics. Inadequate government effort to support agricultural development and market infrastructure often burden smallholder farmers' ability to sell their produce and maintain the sustainability of their operations (Allen, 2009). Issues related to land tenure and access further increase the burden on farmers thus preventing them from thriving and establishing stable market relations.

1.6 Supply Chain Inefficiencies

The supply chain for perishable agricultural products, like sweet potato and other perishable products, is vital in determining the sustained availability of food and economic stability in urban markets. Numerous inefficiencies within this supply chain can significantly affect the distribution of fresh produce from rural farms in the highland's region of PNG to urban consumers in Port Moresby. One of the most important supply chain challenges in Port Moresby is the lack of transportation infrastructure. Almost all sweet potato-producing areas have poor road conditions and limited transport options (Chang et al., 2013a). Consequently, this problem contributes to extended delivery times which directly reduces the quality of the produce when reaching markets .Furthermore, inadequate cold chain logistics compounds the problems encountered by the sweet potato vendors in Port Moresby (Chang et al., 2016). Because sweet potatoes are perishable products, delays due to transport and infrastructure often result in spoilage and loss of marketability. Improved road conditions may address these issues, as farmers can deliver their produce on time therefore maintaining its quality and marketability. Tackling these inefficiencies is important as it promotes food security and supports the livelihoods of farmers and vendors.

Another contributing factor to supply chain inefficiencies is the absence of effective market information systems. Information regarding market prices, demand and supply trends are often lacking and if they are available, they are mostly inaccurate or not available on time. This gap in information often leads to mismatches between supply and demand leading to increase in product wastage or missed sales opportunities (Nguyen, 2021). For example, farmers who do not have knowledge of current price or fluctuating prices, may sell their produce at a lower or higher price than what consumers are willing

to pay. Implementing robust market information systems could provide farmers with crucial data, allowing them to make informed decisions and optimize their sales strategies.

The fragmented nature of the supply chain in PNG further contributes to the inefficiencies in the distribution of sweet potatoes. Sweet Potato supply chain includes wholesalers, those who buy sweet potatoes from the farmers, retailers /vendors prior to reaching the consumers. Each additional player in the supply chain adds costs and delays, which determines the purchasing price. (He et al., 2020). If farmers can do direct farm-to-market sales they could reduce the layers in the supply chain, making it possible for farmers to sell the final product at a higher price to the consumers. The impact of socio-economic factors cannot be underestimated when discussing supply chain inefficiencies. Many rural farmers in PNG operate at subsistence levels, hence limiting their ability to invest in production and post-harvest technologies (Schanbacher et al., 2021). This lack of investment can lead to outdated practices and tools, further undermining the efficiency of the supply chain. Access to microfinance or agricultural credit could help small-scale farmers improve their production and storage facilities, ultimately enhancing their capacity to contribute effectively to the supply chain.

Also, regulatory bottlenecks can hinder supply chain efficiency. Political setbacks such as permits and inspections, often delay the distribution of produce from vendors who are trying to sell in urban markets (NRI, 2023). Optimizing regulatory processes and providing clear guidelines could provide efficient transactions and improve the overall performance of the supply chain. Therefore, supply chain inefficiencies in Port Moresby

significantly determine the distribution and marketing of sweet potatoes. These inefficiencies need to be addressed through targeted investments, innovative practices, and improved regulations which may improve the overall performance of the supply chain thus bringing benefits for farmers, vendors, and consumers alike.

1.7 Rationale for Selecting Port Moresby as the Study Location

The challenges examined in this study are not assumed to be unique to Port Moresby. Evidence from other parts of PNG shows that sweet potato supply chains face similar constraints at production, handling, transport and marketing stages. Previous ACIAR-supported studies followed sweet potato consignments from the Eastern and Western Highlands to the coastal markets of Lae and Port Moresby and identified losses associated with harvesting, packing, packaging, handling, transport, storage and delays (ACIAR, 2013). The 2017 ACIAR project also reported that marketing opportunities in urban centres such as Lae and Port Moresby were constrained by transport and marketing infrastructure, post-harvest management, value-chain coordination and market orientation (ACIAR, 2017). Therefore, the problems identified in Port Moresby should be understood as part of wider supply-chain challenges affecting the PNG sweet potato sector, rather than as problems occurring only in the capital city.

Port Moresby was selected as the study location for several related reasons. First, it is the national capital and a major administrative, commercial and service centre, making it an important urban food market. Second, it is a major destination for sweet potato transported from the Highlands, meaning that produce entering Port Moresby can pass through multiple stages of loading, unloading, transport and trading before reaching

consumers. Earlier supply-chain research found that the longer supply route to Port Moresby was associated with additional handling and greater opportunities for physical and disease-related losses (ACIAR, 2013). Third, Port Moresby brings together a diverse group of downstream actors, including transporters, wholesalers, market vendors and consumers, allowing the study to examine several stages of the post-harvest and marketing system within a defined urban setting. Finally, focusing on Port Moresby provides a manageable case for a Master's-level qualitative study while addressing an urban market that is important for food availability, consumer access and farmer livelihoods. The study therefore uses Port Moresby as a strategically selected case through which wider PNG supply-chain issues can be examined, rather than claiming that the challenges are exclusive to Port Moresby.

1.8 Problem Statement

Sweet potato is a vital crop in PNG as it is a major source of subsistence and income for many rural communities and an important food for Papua New Guineans. Despite its socio-economic and nutritional importance (Fujinuma et al., 2018; Martin & Jagadish, 2006), the full potential of sweet potato to improve food security and livelihoods remains constrained by inadequate post-harvest management, limited storage and transport infrastructure, and weaknesses in market coordination. These challenges are documented across the PNG sweet potato sector and are not confined to Port Moresby; however, Port Moresby represents an important downstream market where the effects of long-distance transport, repeated handling, urban trading conditions and market access converge (ACIAR, 2013, 2017).

Studies have reported post-harvest losses exceeding 30% in root and tuber crops due to poor handling, inadequate storage, and insufficient transportation infrastructure (Boliko, 2019; Martin & Jagadish, 2006). In PNG, these losses range between 30%-50% ,which are extremely high as smallholder farmers, who are the main producers, lack access to proper storage technologies and efficient logistics systems (Chakraborty et al., 2017; Chang et al., 2007). In Port Moresby, the absence of cold chains, combined with informal trading environments and overr-saturated markets, have compromised product quality, reduced shelf life, and created economic losses for both vendors and producers (Schanbacher et al., 2021; He et al., 2020).

Furthermore, urban consumers face limited access to safe and fresh sweet potatoes due to deterioration in quality caused by long transit times and lack of market regulation. Smallholder farmers face several challenges, starting from high transportation costs to limited access to timely market information, which have hindered their ability to participate competitively in urban markets (Lankes, 2002). These challenges not only reduce farmers' incomes but also contribute to inefficiencies that negatively affects the overall food system in PNG's growing urban centres.

While previous studies have documented production, post-harvest, transport and marketing constraints in the PNG sweet potato sector, there is a more specific evidence gap concerning how these factors interact within Port Moresby's urban market system. Existing studies have often examined particular stages of the chain or have focused on production areas and long-distance marketing, while less attention has been given to integrating quality loss, market access, distribution bottlenecks and informal urban trade

from the perspectives of the different actors involved. This study addresses that gap by examining these interconnected issues in Port Moresby and by linking the findings to feasible interventions that can be considered by farmers, traders, transporters, vendors and policymakers.

This study aims to bridge this gap by exploring the extent of quality loss during post-harvest handling, identifying distribution bottlenecks, assessing market access constraints and examining informal trading practices in Port Moresby's urban sweet potato markets. The study uses these findings to identify feasible interventions for reducing losses and improving supply-chain efficiency.

1.9 Research Objectives

The primary aim of this research is to investigate the challenges, particularly associated with post-harvest and supply chain inefficiencies in sweet potatoes in the urban markets of Port Moresby, PNG. The specific objectives of this study are as follows:

- To assess quality losses in sweet potatoes by evaluating the various factors that contribute to quality deterioration during the post-harvest handling process.

- To analyze market access issues for sweet potato producers by exploring the barriers that smallholder farmers face in accessing urban markets.
- To identify distribution bottlenecks in the supply chain by mapping the logistics involved in the sweet potato supply chain, pinpointing specific bottlenecks that hinder the efficient flow of produce from rural areas to urban markets.

- To examine the impact of informal trade practices on product quality, pricing, and consumer safety in urban sweet potato markets.
- To identify feasible interventions for reducing post-harvest losses and improving supply chain efficiency in Port Moresby's urban sweet potato markets.

1.10 Research Questions

1. What is the extent of quality loss experienced by sweet potatoes during post-harvest handling, and at which stages do the most significant losses occur?

2. What specific challenges do smallholder farmers face in accessing urban markets for selling their sweet potatoes, and how do these barriers affect their economic well-being?

3. What are the primary bottlenecks of distribution present within the supply chain for sweet potatoes in Port Moresby, and how do these bottlenecks impact availability and pricing?

4. How does informal trade influence the market dynamics of sweet potatoes in Port Moresby, and what implications does this have for product quality and consumer safety?

5. What feasible interventions can be identified to reduce post-harvest losses and improve the efficiency of the sweet potato supply chain in Port Moresby's urban markets?

1.11 Conceptual Framework

The conceptual framework for this study links the identified research gap and problem to the research objectives. The framework assumes that post-harvest handling, storage, transport and logistics, market access and information, and informal trading and

regulatory conditions interact to influence the quality and market performance of sweet potato. These factors can contribute to physical damage, spoilage, reduced marketable volume, price and income effects, and consumer quality and safety concerns. The framework guides the collection and thematic analysis of qualitative evidence and provides a basis for identifying feasible interventions from the perspectives of the actors involved in the supply chain.

Table 1.1. Conceptual framework linking the research gap, problem, key factors, outcomes and research objectives.

Research gap	Research problem	Key factors examined	Outcomes	Linked objectives
Limited integrated evidence on how post-harvest, transport, market access and informal urban trade interact in Port Moresby.	Quality losses and supply-chain inefficiencies reduce the availability, marketability and economic value of sweet potato.	Post-harvest handling and storage; transport and logistics; market access and information; informal trade and regulatory conditions.	Physical damage and spoilage; reduced marketable supply; price and income effects; consumer quality and	Objectives 1–4 investigate the main problems and their effects; Objective 5 identifies feasible interventions.

			safety concerns.	

1.12 Significance of the Study

This study is important as its findings will benefit farmers, vendors, consumers, and policymakers. Firstly, it is imperative to understand the post-harvest handling and supply chain relationship and challenges encountered particularly for sweet potato given its significant contribution to improving food security in the region. By improving their availability and quality, it can contribute to better nutritional outcomes for consumers of the crop. This study aims to identify specific areas along the supply chain where quality losses occur and to provide recommendations that can help reduce waste and ensure consumers have sustainable access to fresh produce.

Secondly, the economic implications of this study are important. By examining the barriers that smallholder farmers face in accessing urban markets, the research emphasizes the challenges that limit their ability to connect with consumers effectively. Addressing these barriers through specific actions can support farmers in improving their livelihoods, thus contributing to overall rural development and poverty alleviation. Moreover, the study will explain the role of informal trade in the sweet potato market, which is particularly influential in PNG. Through these findings, the research investigates how informal practices impact quality, pricing, and safety, providing a foundation for recommendations that can enhance market efficiency.

Finally, the findings of this study will provide evidence for informing policy decisions and facilitate the development of strategies aimed at strengthening the agricultural supply chain in PNG. By identifying feasible interventions for reducing post-harvest losses and improving supply chain efficiency, the research aims to support better coordination among key stakeholders and contribute to a more resilient and sustainable food system in urban markets. Overall, this study aims to contribute to the body of knowledge on agribusiness and food systems, offering valuable insights for both academic research and practical applications.

Chapter 2: Literature Review

2.1 Introduction and Scope of the Review

This chapter reviews literature relevant to post-harvest quality loss, supply-chain inefficiencies, market access, distribution, informal trade, consumer demand, and the participation of different actors in agricultural markets, with particular attention to sweet potato. The review deliberately moves from the international literature to developing-country evidence and then to Papua New Guinea (PNG). This structure responds to the need to place the Port Moresby case within a wider body of knowledge rather than relying mainly on PNG studies. Evidence from Kenya, Uganda, Ethiopia, Benin, Zimbabwe and other developing-country settings is therefore considered alongside PNG research. The purpose is not to assume that findings from other countries apply directly to PNG, but to identify common mechanisms, important differences and concepts that can guide interpretation of the empirical findings.

The review also distinguishes clearly between a supply chain and a value chain. These concepts are related but are not used interchangeably in this thesis. Supply-chain management is used as the primary operational perspective for examining the physical, information and coordination flows that move sweet potato from production to urban consumers. Value-chain analysis is used as a complementary perspective for examining the activities undertaken by actors and how value, costs, risks and market opportunities are distributed among them. This distinction is important because the study investigates both physical inefficiencies in the movement of produce and the relationships among actors that influence market access and returns.

Four concepts are central to the review. First, post-harvest loss refers to loss of quantity or quality after harvest and before consumption or sale. Second, market access refers not simply to the physical ability to reach a market, but also to the ability to participate in that market under conditions that allow producers to sell at acceptable prices and meet buyer requirements. Third, a distribution bottleneck is a point in a distribution process where the movement of produce is constrained, delayed or made disproportionately costly relative to other stages, resulting in delays, increased costs, or deterioration. Fourth, informal trade refers to transactions that operate outside formal contracts, registered market structures or standardised systems of traceability and quality assurance. These concepts provide the basis for organising the literature and later interpreting the interview data.

2.2 Supply Chain and Value Chain: Distinct but Complementary Perspectives

Supply-chain management focuses on the coordination of activities and relationships required to move products, information and associated resources from upstream suppliers to downstream customers. Christopher (2016) emphasises that supply-chain management is broader than logistics because it involves the management of interconnected organisations and processes rather than transport alone. For a perishable agricultural product, this perspective is particularly useful because quality can be affected by delays, handling, storage, transport conditions, information gaps and coordination failures at several points in the chain. A supply-chain perspective therefore asks: how does the product move, who coordinates the movement, where are delays or losses introduced, and how do problems at one stage affect subsequent stages?

Value-chain analysis asks a different but complementary question: how is value created, captured and distributed among the activities and actors (figure 1.0) involved in bringing a product to the consumer? Porter (1985) developed value-chain analysis as a way of examining the activities through which value is created and costs are incurred. In agricultural systems, the approach can be adapted to trace activities such as production, aggregation, transport, sorting, wholesaling, retailing and marketing, while also considering supporting services and institutions. The value-chain perspective is therefore useful for this study when examining who performs each activity, what value is added, what costs and risks are carried by each actor, and where bargaining power or market opportunities may be uneven.

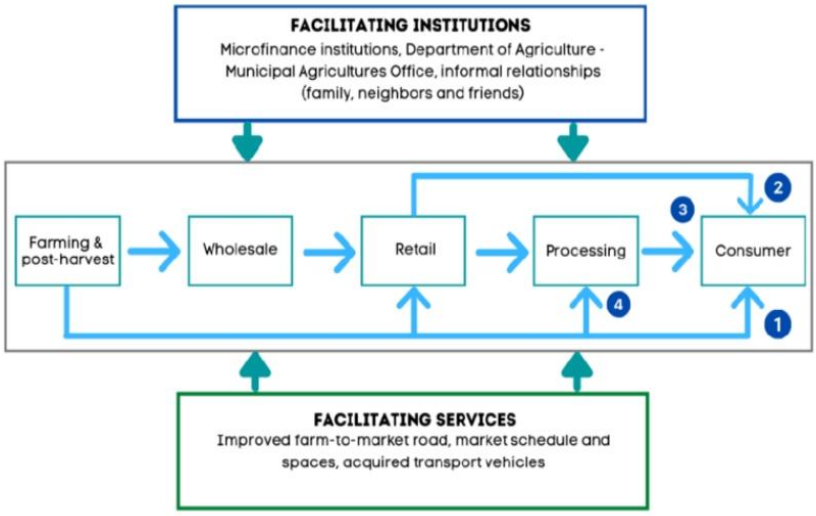

Figure 1.0 Sweet Potatoes Value chain (Cerio, 2021).

The two perspectives overlap in practice but should not be treated as synonyms. A supply-chain analysis is concerned primarily with the efficient flow and coordination of goods, information and related resources. A value-chain analysis is concerned more explicitly with value creation, distribution of returns, actor relationships and opportunities for upgrading. For example, a road delay is a supply-chain problem because it interrupts the physical flow of produce; the resulting loss of farmer income and changes in margins between farmers, wholesalers and vendors can be examined through a value-chain lens. Using the concepts separately allows this study to avoid the conceptual ambiguity identified by the examiner.

2.3 Theoretical Foundations of the Study

2.3.1 Supply Chain Management Perspective

The first theoretical foundation is the supply-chain management perspective. Agricultural supply chains involve multiple independent actors whose activities must be coordinated even when they do not share the same objectives or resources. Christopher (2016) shows that supply-chain performance depends on integration, responsiveness, lead-time management, information and coordination across the network. This is relevant to sweet potato because the crop is vulnerable to quality deterioration when the period between harvest and sale is extended or when handling conditions are poor. In the present study, supply-chain performance is therefore considered in relation to the flow of sweet potato from farms through transport, wholesale and retail stages to consumers. Table 1.0 shows

the sweet potato supply chain stages, key actors and bottlenecks that occur when moving sweet potato from the highland's region to Port Moresby urban markets.

Table 1.0 Summary of Sweet Potato supply chain (Stages, Key Actors and Bottlenecks).

Stage	**Key Actors**	**Key Bottlenecks**
Rural Production	Smallholder farmers	Low productivity, lack of post-harvest handling tools
Aggregation/Transport	Local traders, PMVs/truck owners	Poor roads, damage during transit, long travel times
Sea Shipping	Consort Express Lines, Lutheran Shipping, Bismark Maritime	No refrigeration in containers, shipping delays, weather disruptions
Port Handling	Motukea Terminal, customs officers, freight agents	Port congestion, offloading delays, high fees
Urban Markets	Vendors, wholesalers, consumers	Market overcrowding, informal practices, lack of quality assurance

Note: Table compiled by the Author-Authors' own work.

This perspective directs attention to the interaction between physical infrastructure and actor behaviour. Poor roads, vehicle breakdowns, port delays, inadequate storage and lack of protective packaging are not isolated problems. They can interact to increase lead times and expose produce to mechanical and environmental damage. Similarly, limited market information can affect decisions about when to harvest, how much to send to Port Moresby, which buyers to approach and what price to accept. The supply-chain perspective therefore provides an appropriate foundation for examining the study's first three research questions concerning quality losses, market access and distribution bottlenecks.

2.3.2 Value-Chain Analysis

The second analytical perspective is value-chain analysis. Porter (1985) conceptualises value creation as a sequence of activities through which products are produced, moved, marketed and delivered to customers. In agricultural value chains, this logic can be extended beyond a single firm to consider the sequence of actors and activities connecting producers with consumers. McGregor and Stice (2014a, 2014b) similarly present value-chain analysis as a practical tool for Pacific agriculture because it can identify actors, relationships, constraints and opportunities for improvement.

In this study, value-chain analysis is used to identify the roles of farmers, transporters, wholesalers, vendors, consumers and supporting institutions and to consider how costs, risks, information and returns are distributed. It is not used to create a literature-based

map of the actual Port Moresby chain. Instead, the literature establishes the types of actors and relationships that commonly occur in agricultural chains, while the actual sequence and relationships observed in the PNG sweet potato system are established from primary interviews. The diagram (figure 2.0) shows the causes of losses along the value chain of sweet potato.

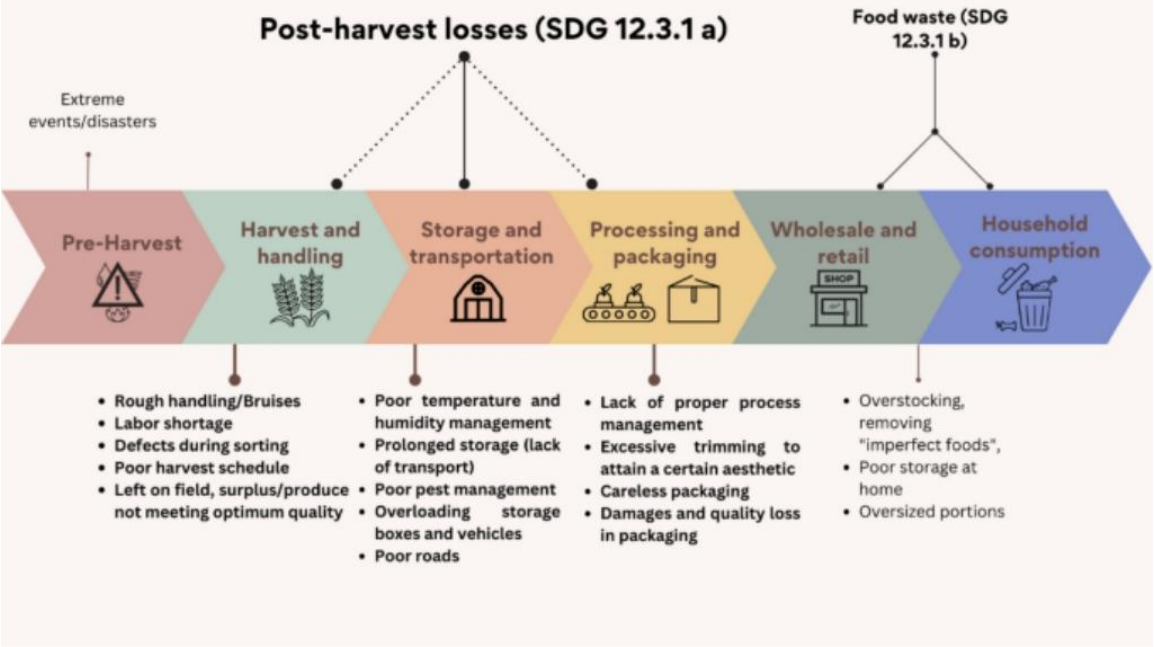

Figure 2.0 Post harvest losses along the sweet potato value chain (Khan et al., 2024).

Sweet Potato travels from the highlands region of PNG to Port Moresby Urban market through the following route;

1.Production (Highland's regions of PNG) Almost 80% of the sweet potato producers are made up of small farmers in the highland's region of PNG which is made up of six provinces: Southern Highlands, Western Highlands, Eastern Highlands, Enga, Hela and Chimbu Province. However, farming is largely subsistence-based with limited access to agricultural extension services, improved tools, or post-harvest technologies. Almost 60%

of the producers are from the Western highlands and the rest from other highland provinces. Other coastal urban areas such as Lae and Port Moresby also produce sweet potatoes but in small quantities compared to the highland's region.

2. Local Aggregation and Bulking

After harvesting, the sweet potatoes are graded, cleaned and packed. They are then sold to local buyers or middlemen at the sweet potato farms (farm-gate) or nearby village markets. The farmers often faced losses during transportation due to poor road conditions (landslides, potholes, flooding), and lack of ventilated or cushioned transport which often result in high mechanical damage, and which fuel and transport costs.

3. Transportation to Lae (by road)

Sweet potatoes are transported over land via trucks or PMVs (public motor vehicles) to Lae, the main port city. Many of the smallholder farmers from the highlands region transport their sweet potatoes directly to Lae's main market while a majority of the Western and Eastern Highlands farmers ship their produce to Port Moresby's urban markets from Lae. Some of the bottlenecks encountered by the farmers are mostly associated with infrastructure. The road conditions are often poor, especially in remote areas, causing delays and physical damage to the produce (e.g., bruising, spoilage). Long transit times also increase crop perishability.

4.Shipping from Lae to Port Moresby (by sea)

From Lae, the sweet potatoes are loaded into containers and shipped by sea to Port Moresby, often taking several days. There are few major shipping companies that ship fresh produce from Lae wharf to Port Moresby, and they are Consort Express Line,

Bismark Maritime and Lutheran Shipping company. However, problems often experienced are irregular shipping schedules and lack of cold chain or temperature-controlled containers during sea transport which leads to further crop deterioration

5.Off-loading and Wholesale Markets (Port Moresby)

Upon arrival, sweet potatoes are sold to wholesale buyers or directly to vendors in urban markets. The issue of Port congestion is common, which includes high unloading costs, and lack of storage space at arrival points that contribute to delays and losses.

6. Retail in Urban Markets

Vendors transport sweet potatoes to retail markets (e.g., Gordons Market, Koki Market). The urban markets often lack proper infrastructure (e.g., shade, clean surfaces, or refrigeration), making it hard to preserve crop quality. Furthermore, high vendor competition and informal practices reduce price consistency and undermine consumer trust.

2.3.3 Transaction Cost Economics and Informal Exchange

A third theoretical lens, Transaction Cost Economics (TCE), is useful for explaining why farmers and traders may use intermediaries and informal arrangements even when direct marketing appears theoretically more profitable. Williamson (1985) argues that economic exchange involves costs associated with finding information, negotiating, monitoring and enforcing agreements. In agricultural markets where producers are geographically dispersed, information is incomplete and formal contracting is costly, intermediaries can perform coordination functions that reduce some transaction costs. At the same time, dependence on intermediaries can create unequal bargaining positions when farmers have limited alternative buyers.

This perspective is particularly relevant to the PNG context. Informal traders and wholesalers should not automatically be treated as sources of inefficiency. They may provide transport coordination, market information, immediate payment, aggregation and access to distant urban markets. However, where farmers have few alternative buyers or limited information about prices, the same relationships may reduce bargaining power. TCE therefore helps the study interpret informal trade as a governance response to market constraints rather than simply as an undesirable practice. This provides a stronger theoretical basis for Research Question 4, which examines the effects of informal trade on quality, pricing and consumer safety.

2.4 Actors in Agricultural Supply and Value Chains

A clear identification of actors is necessary before analysing inefficiency. Agricultural chains commonly involve producers, assemblers or traders, transporters, wholesalers, retailers and consumers, together with public and private organisations that provide finance, extension, infrastructure, regulation and market information. The roles of these actors are not identical. Some add physical value through handling, storage or transport; others facilitate exchange by providing information, credit, aggregation or market access.

For the sweet potato chain examined in this study, smallholder farmers are the primary producers. They decide when and how to harvest, sort and pack the roots and whether to sell locally or send produce towards larger markets. Transporters connect production areas with aggregation points and urban markets and influence travel time, handling conditions and freight costs. Wholesalers and other intermediaries aggregate produce, undertake sorting or repacking and connect dispersed producers with urban vendors. Vendors provide the final retail interface with consumers and make decisions about display, repackaging, pricing and stock turnover. Consumers determine demand through their purchasing choices, quality perceptions and price sensitivity. Government agencies and development organisations provide enabling or regulatory functions, including extension, infrastructure, food-safety oversight and market development.

The actor structure (Table 2.0) identified in the literature is directly relevant to this study because the empirical research included farmers, transporters, wholesalers, vendors, consumers and government/NGO representatives. The literature therefore provides an analytical starting point, while the interviews establish how these roles are actually

performed in the Port Moresby supply system. The study does not assume that all actors perform the same functions or experience the same constraints.

Table 3.0. Roles of major actors considered in the literature on the sweet potato supply chain.

Actor	Primary role	Potential contribution to efficiency	Potential source of inefficiency or risk
Smallholder farmers	Production, harvesting, initial sorting and packing	Local knowledge, production, early quality management	Limited storage, packaging, finance, information and market alternatives
Transporters / logistics providers	Collection and movement between production and market nodes	Aggregation, timely delivery and geographic connectivity	Poor roads, breakdowns, delays, rough handling, high freight costs
Wholesalers / intermediaries	Aggregation, sorting, repacking, resale and market coordination	Reduce search and transaction costs; connect dispersed	Unequal bargaining power, limited price transparency, weak traceability

		farmers to urban demand	
Vendors / retailers	Display, retailing, stock management and price setting	Match products with consumers and provide market feedback	Inadequate shade/storage, repackaging damage, competition and spoilage
Consumers	Final demand, quality and price selection	Provide market signals through preferences and willingness to pay	Appearance-based rejection and strong price sensitivity can increase waste
Government / NGOs / support agencies	Regulation, infrastructure, extension, training and market support	Standards, training, information and enabling infrastructure	Weak coordination, limited resources or gaps in enforcement

2.5 Sweet Potato Production and Farm Level Constraints

Distribution of sweet potato in PNG is hindered by significant logistical and infrastructural challenges. While the crop is transported to urban centers like Port Moresby and Lae, the movement from rural production (figure 3.0) areas especially the Highlands to markets is hampered by poor road conditions and high transportation costs (Allen et al., 2005). The Mount Hagen Market plays a central role in regional aggregation

and trade, and women are heavily involved in the marketing and informal sale of sweet potato throughout the country (Curry et al., 2012). However, commercialization is still limited, and farmers often receive less profit due to a lack of cold storage, poor handling, and price fluctuations. In spite of these challenges, there is growing recognition of the potential for sweet potato to contribute to national food security and income generation, particularly given the increase in urban demand and opportunities for value-added products (Bourke, 2010).These production challenges in PNG also reflect broader patterns observed in other developing countries, though PNG's geography and cultural practices create some unique dynamics. These production challenges directly connect to Objective 1 (quality losses), since poor handling and lack of storage reduce tuber quality, and to Objective 2 (market access barriers), as infrastructure and transport costs limit farmers' access to urban markets.

The supply chain inefficiencies related to sweet potatoes in (PNG) reflect many of the broader challenges observed in developing countries, while also exhibiting distinctive features caused by its unique geographical, cultural, and economic context. In PNG, sweet potatoes serve as a source of food which is a staple crop and as a cultural icon. However, due to various challenges along the supply chain, its efficiency is reduced, like those faced in other developing nations, especially regarding infrastructure, market access, and post-harvest handling.

A key similarity between the sweet potato supply chains in PNG and other developing countries is the poor state of infrastructure. PNG's rural mountainous terrain poses logistical challenges that slow the movement of sweet potatoes from remote farming areas to urban markets. According to a report by the Asian Development Bank (2021), many rural regions in PNG lack all-weather road access, which leads to an increase in transportation costs and contributes to high post-harvest losses (Chang et al., 2013a). In line with findings from other developing countries, such as Uganda and Nigeria (Rubagumya et al., 2023), inadequate infrastructure severely limits farmers' market access and increases the spoilage of perishable crops like sweet potatoes. This similarity shows infrastructure as a systemic weakness across contexts, though PNG's rugged geography makes the problem even worse.

Also, the fragmented market structure seen in PNG has similarities with global patterns, where smallholder farmers dominate sweet potato production. These farmers rely on the supply chain intermediaries, which compromise their negotiating power and often result in low pricing (Chang et al., 2013a; Chang & Spriggs, 2007). In PNG, this reliance on intermediaries is further worsened by traditional trade practices and cultural norms that can hinder market efficiency. Research by Maimoona et al. (2019) reveals that many sweet potato farmers in PNG still engage in the barter system, further limiting their market reach resulting in unsatisfactory selling prices. This difference implies that while reliance on middlemen is widespread, PNG's socio-cultural practices create an additional layer of inefficiency that requires solutions that are tailored to this specific situation.

PNG's post-harvest management has many challenges that are like those faced in other developing countries; however, some factors are unique to PNG, and this emphasizes the need for targeted and strategic solutions. A lack of effective storage facilities and educational programs which are designed to address proper post-harvest handling techniques have therefore led to significant losses in sweet potato quality. Research indicates that inadequate curing and storage practices can result in post-harvest losses of 30% to 50%, like the data reported in the broader literature (Chang et al., 2013a). Training programs that focused on improving farmers skills in post-harvest management may help reduce waste and improve the overall efficiency of the supply chain. This variation shows that while challenges are shared, PNG is way behind in adopting modern mitigation strategies.

These comparisons support the importance of Objective 3 (distribution bottlenecks), showing that PNG's case is part of a wider global pattern but also shaped by unique geography and socio-cultural systems. They also point toward the research gap: although international literature explores infrastructure and market dynamics, fewer studies analyse how these play out specifically in Port Moresby's urban market.

Furthermore, the role of information dissemination and technology adoption in PNG's agricultural landscape parallels trends seen in other developing countries. Limited access to market information hinders farmers' ability to make informed decisions about pricing

and crop management (Donnelly et al., 2023). While other regions have increasingly adopted digital platforms to streamline market access, in the case of PNG this has been lagging due to infrastructural and educational barriers. Overall, a combination of the above has hindered farmers' timely access to key markets

At the beginning of the supply chain, smallholder farmers contribute significantly to the production of sweet potatoes, and they mainly engage with traditional agricultural practices. Though the demand for sweet potato is high, there are some factors like 'soil degradation, adverse climatic conditions and limited access to agricultural inputs which can negatively affect the storage and quality (McGregor & Stice, 2014b). These constraints lead to the variability of product quality, which may result in influencing market perceptions and acceptance in urban centers such as Port Moresby. The lack of standardized classification and sorting processes intensify this problem, since consumers often have difficulty in evaluating the quality of the product prior to buying (Villano et al., 2016).

The transition from production to the market has many inefficiencies and bottlenecks. Farmers commonly sell their products in small local markets rather than through established formal supply chains (Chang et al., 2013a). This method of sales restricts farmers' access to the market, since many don't have direct link to urban distribution networks or retail sales chains that could provide better prices. In addition, research McGregor & Stice (2014b), shows that transport challenges, in particular lack of infrastructure and unreliable availability of vehicles, lead to major delays and greater post-harvest losses. The inability to transport fresh produce efficiently affects the ability

of farmers to sell their sweet potatoes at optimal prices and reduces the overall competitiveness of sweet potatoes in urban markets (Chang et al., 2013a).

Overall, these production-stage challenges link to Objective 1 (quality losses), since poor farm-level practices and lack of grading reduce quality, and to Objective 2 (market access barriers), as limited infrastructure and reliance on intermediaries restrict farmers' participation in urban markets.

2.6 Post-Harvest Handling, Curing and Storage

Post-harvest management is central to this study because sweet potato roots can suffer physical damage and quality deterioration between harvesting and consumption. Abong et al. (2016), reviewing evidence from Kenya and Uganda, show that losses are associated with inadequate post-harvest knowledge, technologies and facilities. Parmar et al. (2017), studying the sweet potato value chain in southern Ethiopia, similarly identified handling and storage conditions as important contributors to food loss. These international studies demonstrate that post-harvest loss is a wider developing-country problem rather than a uniquely PNG problem.

Almost all developing countries face the challenges of inadequate infrastructure, particularly transportation and storage facilities. Deteriorating road conditions and reduced access to cold storage facilities further adds to high post- harvest losses, often estimated between 20% to 40%, which severely affect the profitability of sweet potato production (G. Abong et al., 2016; Abrham et al., 2021; Parmar et al., 2017) . While Abong et al. (2016) emphasize physical deterioration during transport, Parmar et al. (2017) mention consumer rejection of visibly damaged roots as an equally important

driver of waste. This contrast suggests that post-harvest challenges are not only technical but also market-driven, requiring solutions that address both handling practices and consumer quality expectations. This scenario is common in regions where rural areas are isolated, making it difficult for farmers to transport their crops to urban centres where demand is higher.

The fragmented nature of the agricultural market further worsens these inefficiencies. In many developing countries, sweet potato farming is conducted by smallholder farmers most of whom lack direct access to markets (Tavva & Nedunchezhiyan, 2012). These smallholder farmers rely on middlemen who control the pricing of the produce often resulting in low prices. According to a study by De Bock et al. (2019), this reliance on intermediaries not only reduces farmers' profit margins but also creates a significant gap between producer and consumer pricing. Similar findings are reported in African contexts, where dependence on intermediaries ppromotes inefficiency (Rubagumya et al., 2023). However, in PNG, reliance on informal networks is even more distinct due to the absence of cooperatives, which increases the impact of poor handling and limits farmers' bargaining power. As a result, many farmers are unable to reinvest in their farms or improve productivity, often resulting in a cycle of poverty that constrains rural development. This difference shows that while inter-mediation is a common challenge globally, PNG's lack of farmer cooperatives makes its supply chain especially vulnerable to post-harvest losses.

Moreover, inadequate access to information on market trends, pricing, and innovative agricultural practices further increases the problem along the sweet potato supply chain.

This is because most farmers are not aware of the market trends and pricing that could help them optimize production and marketing strategies.

Post-harvest management practices in sweet potato production also play a crucial role in determining the overall efficiency of the supply chain. Many farmers lack access to proper training on post-harvest handling techniques, which may include curing, storage, and transportation methods to minimize losses (Henao et al., 2020). As a result, the perishable nature of sweet potatoes often leads to decreased quality and increased waste. Studies emphasize the need for extended education and training programs targeted toward enhancing farmers' understanding of effective post-harvest management to reduce losses and improve product quality (Wang et al., 2018).

When farmers are well trained and educated on effectively managed sweet potato after harvest, it will result in the significant reduction of post-harvest losses along the supply chain.

Research indicates that if sweet potatoes are not managed with care, up to 30% of the products can be made unmarketable before reaching consumers (Chang et al., 2007). This high percentage not only leads to an increase in waste, but also decreases the income of farmers, since non-marketable products cannot be sold in often limited and competitive markets. While Chang emphasizes physical deterioration from poor handling, Okrupa et al. (2017) stress that even minor injuries accelerate pathogen entry, making effective curing an essential preventive step. This distinction underlines that curing is not simply about prolonging storage life but also about protecting against disease-related spoilage.

In addition, the hardening process, which is essential to improve the conservation quality of sweet potatoes, is often overlooked (Okrupa et al., 2017). They underline that inadequate curing conditions, temperature and humidity accelerate deterioration and loss of quality after the harvest (Chang et al., 2013a). Specifically, Port Moresby, where environmental conditions may not support ideal hardening, existing practices often cannot extend the shelf life of sweet potato effectively. Without adequate curing, sweet potatoes are subject to rapid sprouting and decay, which not only lead to direct economic losses for farmers but also influence the entire supply chain through inefficiencies and waste increases (Hu & Tanaka, 2007). Compared to regions where temperature-controlled facilities exist, PNG farmers face heightened vulnerability since natural environmental conditions cannot substitute for proper infrastructure.

Storage limitations compound these issues. Farmers in PNG often rely on traditional or improvised storage systems, which provide little protection from pests, humidity, or temperature fluctuations. These practices are similar to those observed in sub-Saharan Africa, where lack of climate-controlled storage leads to rapid sprouting and rot (Parmar et al., 2017). However, unlike Africa, where community-level storage initiatives are emerging, PNG still lacks coordinated investment in collective or commercial storage facilities. This gap reinforces the persistence of post-harvest losses.

2.4.3 Consumer Perceptions of Quality

Smooth access to markets is relevant for the formation of quality perceptions among consumers. Okrupa et al. (2017) argue that poor-quality roots quickly lead to consumer rejection, directly reducing demand and prices. Villano et al. (2016) add that buyers in

Port Moresby prioritize visual appeal, freshness, uniformity, and absence of defects, over other attributes. Together, these findings suggest that consumer quality standards are primarily appearance-driven, making post-harvest damage a significant barrier to sales.

They illustrate that consumers in urban areas such as Port Moresby have set reference parameters for quality which, if not satisfactory, can lead to substantial losses for sellers. The deterioration of quality during the post-harvest phase, therefore, directly affects market accessibility (Villano et al., 2016). Buyers tend to give priority to fresh and visually attractive products compared to sweet potatoes that show signs of imperfections or decay, with consequent additional pressures for producers and expectations to adopt better management and storage innovations (Villano et al., 2016).

Comparative evidence supports this pattern. In African markets, visible defects also result in steep price penalties (Parmar et al., 2017). However, unlike Africa where grading and quality standards are slowly being institutionalized, PNG's largely informal markets lack regulation, leaving consumers themselves to act as "quality controllers" at the stall. This difference shows a structural gap: while formal standards can buffer producers against individual buyer judgments, PNG's sellers remain highly vulnerable to subjective consumer preferences.

The distribution bottlenecks further complicate quality problems, thus affecting the timely availability of fresh sweet potatoes in urban markets. The inefficient transport systems, combined with the lack of cold chain logistics, limit the ability of farmers and retailers to transport sweet potatoes quickly and in optimal conditions (Chang & Kewa, 2014). Okrupa et al. (2017) note that the logistical challenges present not only extend the

time from the harvest to the market but also expose products to adverse environmental conditions that contribute to the loss of quality. These factors, manipulation, curing, market expectations and distribution, form barriers along the supply chain that decrease both the economic profitability of sweet potato farming and the nutritional benefits offered to consumers (Okrupa et al., 2017). Unlike in contexts where cold chains exist but are underutilized, PNG's problem lies in their absence, which systematically constrains quality at the consumer end.

Post-harvest handling and storage challenges link directly to Objective 1 (quality losses), since poor curing, mechanical damage, and lack of storage infrastructure reduce tuber quality, and also contribute to Objective 3 (distribution bottlenecks), as delays and inadequate logistics amplify deterioration.

2.7 Transport, Logistics and Distribution Bottlenecks

Transport is a critical component of agricultural supply chains because perishable produce must move between dispersed production areas and markets within a suitable time and under appropriate conditions. Christopher (2016) identifies lead time, coordination, transport and network integration as important components of supply-chain performance. In developing-country agricultural systems, weak roads, high transport costs, unreliable vehicles and long travel times can increase both financial costs and physical losses. Transport represents fundamental stage in the supply chain which contributes to a loss of quality. Culas and Pombre (2023) argue that transport conditions for sweet potatoes in Port Moresby are often far from optimal, and many farmers rely on open transport vehicles that expose products to detrimental environmental conditions.

This aligns with Chang (2018), who mentions that long journeys from the Highlands to Port Moresby expose sweet potatoes to fluctuating temperatures and physical stress. Both studies conclude that inadequate logistics speed up post-harvest deterioration. The absence of temperature-controlled vehicles worsens these problems, exposing crops to extreme heat, which significantly reduces shelf life and affects overall quality (Doyle et al., 2015). These conditions extremely affect smallholder farmers who often lack access to modern transport methods.

Evidence from PNG indicates that distance, infrastructure and transport conditions have long affected agricultural marketing. Chang et al. (2013a, 2013b) identify transport and post-harvest management as important components of sweet potato marketing efficiency in PNG. Allen et al. (2005) also document the difficulty of connecting rural producers with markets in a country characterised by dispersed settlements and challenging terrain. These constraints are particularly relevant to a sweet potato system supplying Port Moresby from the Highlands because the product may experience several transport stages before reaching the final consumer.

International evidence provides useful comparisons. Rubagumya et al. (2023), examining fruit and vegetable supply chains in Eastern Africa, found that post-harvest losses can occur at several points along urban supply chains and are associated with handling, transport and market conditions. Parmar et al. (2017) similarly demonstrate that transport and post-harvest practices interact to affect losses in Ethiopia. Munyaka et al. (2024), using simulation to examine the sweet potato supply chain in Zimbabwe, demonstrate the importance of considering production, distribution and market dynamics together rather than analysing each stage independently. The relevance to PNG is that delays at one stage

may create problems at another: a late truck can cause missed shipping schedules, which can extend storage time and increase deterioration before retail.

In this thesis, the term “bottleneck” is therefore used in a specific sense. A bottleneck is a point or process that constrains the movement of produce or information and causes disproportionate delay, cost, capacity loss or quality deterioration. Examples may include an impassable road, vehicle breakdown, port delay, lack of unloading capacity, shortage of storage space or poor coordination between actors. The term is not used simply as a synonym for “challenge”. A challenge becomes a bottleneck when it restricts flow or creates a downstream effect on supply-chain performance(Culas & Pombre, 2023). This distinction is important for the empirical analysis. The study does not assume from the literature that particular locations are bottlenecks. Instead, interviews with farmers, transporters, wholesalers, vendors and other stakeholders were used to identify where participants experienced delays, constraints or interruptions

The distribution bottlenecks, an important problem in the sweet potato supply chain, have been documented in several agricultural sectors in PNG. The horticulture sector has illustrated how improved infrastructure, and the best logistics management can significantly relieve these bottlenecks. For example, a study done show that strategic partnerships with transport providers can reduce costs and improve reliability, suggesting solutions that PNG has yet to fully adopt (Guest & Walton, 2016).Their findings contrast with (Sharma et al., 2021), who mentioned that urban congestion in Port Moresby as a cause of delays and income loss for vendors. Together, these studies suggest that both rural-to-urban and intra-urban distribution systems are failing simultaneously.

Hamilton et al. (2014) extend this point by comparing PNG to other Pacific island nations, where small, fragmented markets create similar inefficiencies. However, Port Moresby's challenges are more severe due to rapid urbanization and dependence on imports, which worsens congestion at distribution hubs. Unlike Fiji or Solomon Islands, where market scales are smaller but relatively stable, PNG's market is both growing and strained, increasing bottlenecks.

In addition, combination of technology within other agricultural supply chains has also shown promising results in addressing the inefficiencies of the supply chain. Guest and Walton (2016) mentioned how digital platforms have been used to facilitate the transparency of the supply chain and improve the flow of information in real time, which allows producers to respond immediately to the market demands. Yet in the sweet potato sector, such systems are absent, leaving producers and vendors to operate re-actively. This contrast shows that proven models exist within PNG agriculture, but learning across various sectors has not occurred.

Access to the market is also hampered by distribution hurdles linked to regulatory standards surrounding food transport and market operations (Hamilton et al., 2014) .Many small-scale producers do not have the knowledge or resources necessary to navigate regulatory requirements imposed on food sales, which can lead to delays, increased transaction costs, and even market exclusion (Wera, 2017). Bureaucratic obstacles in licensing and certification processes serve as significant barriers to entry, which limits smallholders' ability to capitalize on market opportunities.

The socio-economic dynamics of Port Moresby also worsen distribution challenges. The concentration of urban consumers in specific districts often leads to congestion in distribution points such as markets and transportation centers, creating delays in product turnover (Sharma et al., 2021). These bottlenecks disrupt the supply chain because aggregate demand cannot be satisfied quickly, resulting in waste and loss of income opportunities for farmers and vendors.

2.8 Market Access, Intermediaries, Pricing and Informal Trade

Market access involves more than physical proximity to a market. It includes the ability to reach buyers, obtain relevant market information, meet quality requirements, transport produce at acceptable cost and negotiate prices. Mutai et al. (2013) show that smallholder participation in different market options is influenced by a range of farm and market characteristics. Mukundi et al. (2013) highlight collective action as a possible mechanism for improving marketing opportunities. These findings suggest that market access is shaped by both infrastructure and institutional relationships.

Intermediaries can play an important role in overcoming these constraints. In fragmented agricultural systems, traders may aggregate produce from many small farmers and connect them to urban demand. This can reduce the search and coordination costs faced by farmers and buyers. However, where farmers have limited market information or few alternative buyers, intermediaries may also have greater bargaining power. Williamson's (1985) Transaction Cost Economics perspective helps explain this dual role: intermediaries may exist because they reduce transaction costs, while the same institutional arrangement can produce unequal outcomes when information and alternatives are unevenly distributed.

Studies have shown the importance of intermediary relationships. Ezin et al. (2018) found that sweet potato prices at farmer level were lower than those received by other actors in the value chain in Benin. Mutai et al. (2013) found that Kenyan smallholders use different market channels, while Mukundi et al. (2013) emphasised collective action as a way of strengthening smallholder market participation. In PNG, Chang et al. (2007, 2013a) and McGregor and Stice (2014a) similarly identify market organisation, transport and coordination as important issues in sweet potato marketing. The common pattern is that the structure of market relationships can influence both access and returns.

Informal trade should therefore be understood as a form of market organisation rather than simply as illegal or inefficient trading. Informal markets can provide low-entry-cost opportunities for farmers and vendors and may be essential where formal distribution infrastructure is limited. At the same time, informality may be associated with weak traceability, inconsistent quality standards, limited documentation and less predictable pricing. These characteristics can create risks for consumers and make it difficult to establish responsibility when quality problems occur. The empirical study consequently examines how informal trading is experienced by different actors rather than assuming in advance that informality has only negative effects.

Price formation is closely related to market access and product quality. Villano et al. (2016) show that consumers' willingness to pay in PNG is affected by perceived quality. Chang et al. (2007) document price variation in PNG sweet potato markets. Together, these studies suggest that prices reflect not only production costs but also transport conditions, supply availability, consumer preferences and perceived quality. Where quality deteriorates during transport or storage, vendors may have to discount produce,

which can reduce returns to upstream actors even if the original farm-gate price was unchanged.

Rural farmers often struggle to connect with urban centers due to inadequate infrastructure and the lack of organized markets. Benny et al. (2022) suggested the need to improve transport networks, which are vital to link production areas with markets in Port Moresby, a challenge mentioned by Candemir et al. (2021), who stress the importance of cooperatives in improving bargaining power. Both studies mention infrastructure and collective action as central to strengthening farmer-market. Comparative literature shows similar patterns globally. In sub-Saharan Africa, cooperative models have improved smallholders' access to urban centers and enhanced their negotiating power with wholesalers (Guest & Walton, 2016). In PNG, however, cooperative development has been limited, leaving farmers heavily dependent on intermediaries. This contrast points to a missed opportunity: while other regions are leveraging collective structures, PNG's fragmented supply chain remains dominated by individual transactions.

The distribution bottlenecks often arise from the deficiencies in the management of the cold chain (CCM), where the lack of storage and transportation controlled by temperature leads to the quick deterioration of products. Benny et al. (2022) argue that investment in refrigerated trucks and warehouses can drastically improve market efficiency. Yet Wera (2017b) shows that regulatory problems, such as licensing delays, further restrict smallholders from benefiting even if infrastructure were improved. The tension here is clear: while technical solutions exist, governance barriers prevent effective adoption.

Furthermore, policy interventions should also focus on improving financial access for small farmers. Benny et al. (2022) mentioned that limited access to financial and credit services restrict the ability of farmers to invest in better production techniques and infrastructure improvements. Strategies that facilitate access to microfinance opportunities or specific subsidies for supplies costs can help farmers to improve the quality and efficiency of their production (Benny et al., 2022).Investing in these policy recommendations as described in Benny et al. (2022) is crucial to overcome the numerous postharvest challenges facing the sweet potato supply chain in PNG. Addressing problems of quality loss, access to the market and distribution bottlenecks through coordinated measures can lead to a more resilient and efficient agricultural sector capable of satisfying the growing demand for sweet potatoes in urban markets such as Port Moresby (Benny et al., 2022).

The comparative analysis of the agricultural value chains in PNG provides a critical view through which the sweet potato sector can evaluate post-harvest challenges and inefficiencies faced within its supply chain. Guests and Walton (2016) offer a valuable framework for understanding the patterns observed in other agricultural sectors such as coffee, cocoa and horticulture, which often share similar logistics and infrastructure limitations. The coffee value chain, for example, has successfully achieved quality retention and market access through the implementation of improved processing techniques after harvesting and strict quality control measures (Guest & Walton, 2016). These strategies have not only supported visual attractiveness and product market value but have also improved the ability of farmers to obtain higher prices. In addition, the cocoa value chain has taken advantage of cooperative models to overcome market access

problems, facilitating a united front that allows small farmers to collectively bargain for better prices and access to markets (Guest & Walton, 2016). This differs strongly from the approach commonly observed in the sweet potato sector, which can lead to fragmentation and inefficiencies. If sweet potato farmers could form cooperative structures, like those of cocoa, the sector could improve access to larger markets, thus boosting its competitive strength and financial resilience.

2.9 Sweet Potato Pricing in Port Moresby

Market access plays a key role in determining the prices that farmers can make for their sweet potatoes. Farmers in Port Moresby peri-urban areas and highlands region often face barriers while trying to reach wider markets(Hainzer, 2023) . This observation aligns with Chang et al. (2007), who documented frequent price fluctuations in urban markets. Together, these studies show that prices are not only unstable but also systematically dis advantage producers.

Limited access to transport infrastructure and high costs associated with logistics mean that many farmers cannot sell directly to larger consumers or retailers. This results in dependence on intermediaries, which usually have more bargaining power to dictate prices. Consequently, farmers receive less profit that does not properly reflect the high effort, and the resources invested in production. The disparity between agricultural gates prices and retail prices points to an inefficient market system that negatively affects local producers but benefit intermediaries.

The issue of price dynamics is even more complicated by the competitive scenario for sweet potatoes. As described by Hainzer (2023), market participants, including larger agribusiness companies, usually take advantage of their scale and resources to exercise pressure on prices, thus undermining smallholder farmers' ability to effectively compete. This type of practice by companies can lead to market saturation or price undercutting, which forces smallholders to reduce their prices or completely seek alternative crops. This cycle not only compromises the income of these farmers but also threatens the agricultural sustainability of sweet potato cultivation within the region.

In addition to the challenges of competition and market access, Hainzer (2023) observe the impact of fluctuating consumer preferences and external economic conditions on price structures. Chang et al. (2007) also found that consumers in Goroka and Port Moresby (figure 3.0) reduce purchases or switch foods when prices rise, showing strong price sensitivity. This elasticity increases volatility, as even small supply disruptions cause disproportionate swings in price.

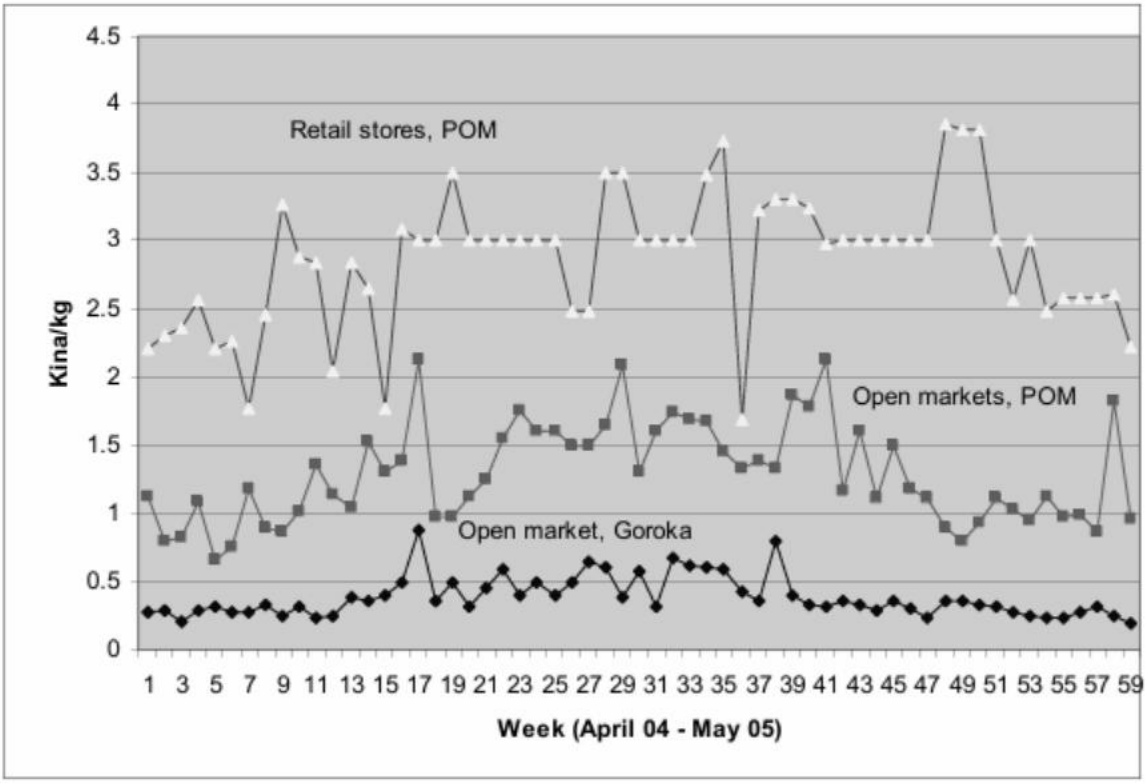

Figure 3.0 Price fluctuation in Goroka and Port Moresby's urban markets (Chang et al., 2007).

2.10 Consumer Demand and Consumption Pattern

Consumer demand in Port Moresby plays an important role in shaping the sweet potato supply chain, as preferences directly influence prices, quality standards, and farmer incentives. Okrupa et al. (2017) emphasize that urban consumers have established reference points for quality, rejecting damaged or deteriorated tubers and thereby reducing sales. Villano et al. (2016) similarly found that buyers go for visual appeal like freshness, uniformity, and absence of defects, with willingness to pay high price for produce that meets these criteria. These studies converge on the view that appearance is the most critical factor determining consumer behaviour.

At the same time, consumer responses are highly sensitive to price. Chang et al. (2007) observed significant price elasticity in Port Moresby and Goroka: when sweet potato prices rise, consumers quickly reduce purchases or switch to alternative staples as they cannot afford. This elasticity increases volatility within the chain, as small supply disruptions or quality losses result in reduce demand for the produce. McGregor and Stice (2014a) further stated that some buyers such as restaurants and schools, occasionally substitute other staples when sweet potato quality is unreliable, reflecting a lack of trust in supply consistency.

Literature supports these patterns while also mentioning PNG's unique vulnerabilities. In African markets, for instance, visible defects are also heavily penalized by consumers (Parmar et al., 2017). However, many countries are gradually implementing grading standards and quality controls that stabilize buyer expectations. PNG, by contrast, operates almost entirely through informal markets, meaning consumer judgment at the stall substitutes for formal quality assurance. This reliance exposes farmers and vendors to higher risk, as any deterioration during transport or storage result in consumer rejection without standardized grading.

Emerging trends add further complexity. Georgeou et al. (2022) report rising interest in value-added products (e.g., sweet potato flour or chips) and in specific varieties such as orange-fleshed types for their health benefits. These shifts indicate growing market segmentation, but without adequate market information systems, farmers in PNG struggle to adapt supply to evolving consumer preferences. Compared with regions where digital

platforms provide real-time demand signals, PNG's farmers face knowledge gap that prevents responsive production decisions.

Overall, consumer demand and consumption patterns link directly to Objective 1 (quality losses), as appearance-driven rejection translates into waste; to Objective 2 (market access barriers), since high price sensitivity constrains farmers' returns; and to Objective 4 (informal trade impacts), as the absence of grading standards leaves buyers as the ultimate judge of quality. The literature identifies consensus on appearance and price as key drivers but also reveals a clear gap: systematic studies on Port Moresby consumers are limited, particularly regarding willingness to pay for quality improvements or tolerance of defects.

2.11 Cross-Cutting Issues

2.11.1 Gender and Socio-Economic Considerations

Gender and socio-economic conditions are relevant because actors do not enter agricultural supply chains with equal access to land, finance, transport, information, labour, technology or decision-making. FAO (2016) argues that gender needs to be integrated into value-chain analysis because women and men can occupy different positions within chains and experience different constraints and opportunities. This is particularly relevant to PNG, where women have important roles in agricultural production and marketing but may face barriers to resources, services and decision-making. Chang et al. (2010) specifically examined women in sweet potato marketing in PNG, demonstrating that gender is relevant to the organisation of the sector.

As such, it becomes crucial to integrate socio-economic considerations into political frameworks aimed at improving post-harvest management, market access and distribution logistics for sweet potatoes in Port Moresby. The results of Culas and Pombre show the importance of not simply adopting new agricultural practices but also allowing fair access to the resources and infrastructures that support the transitions of farmers towards better production methods. Without dealing with these socio-economic dynamics, the efforts to address the post-harvest challenges of sweet potatoes could prove futile, especially if the underlying issues persist and are not mitigated. Therefore, global strategies that include both production and socio-economic empowerment must be considered to encourage a sustainable sweet potato supply chain. The discussion surrounding gender inclusion in agricultural practices, particularly with respect to sweet potato production and market access in Port Moresby, requires a critical examination given the vital role that women play in this sector. Kosec et al. (2022) clarify that women not only contribute to agricultural work but are fundamental in the configuration of value chains that connect production with the market. The intersection of gender, agricultural practice and economic access reveals systemic barriers that often limit the full participation of women in this sector, with broader social economic implications on stability.

In Port Moresby, women are typically responsible for a substantial portion of the sweet potato production and the subsequent harvest management. Despite this, gender biases and cultural norms persistently hinder their opportunities to participate completely within the broader supply chain (Chang et al., 2010). Kosec et al. (2022) indicate that the limited access of women to resources, such as land, credit and technology, heighten the challenges after harvest, contributing directly to the loss of quality. For example,

insufficient access to storage facilities and inadequate processing technologies results in higher losses after harvesting, which undermines the potential profitability of its products.

In addition, access to the market remains favorable for male farmers, who often have stronger networks and better access to information about market prices and demands (Kosec et al., 2022).Women, on the other hand, can trust intermediaries or merchants to market their sweet potatoes, which not only decreases their negotiation power, but also imposes additional costs that further reduce gains margins. Literature emphasizes that it empowers women through specific interventions, such as financial education programs and cooperative structures, it can facilitate the most equitable access of the market and, ultimately, improve the quality of sweet potatoes (Chang et al., 2010; Kosec et al., 2022).The dynamics of distribution bottlenecks also reflects gender disparities within the sweet potato supply chain. Kosec et al. (2022), emphasize that women often face logistic challenges related to transport that arise mainly from existing social norms and security concerns. Gender expectations surrounding mobility can restrict women's ability to transport their products effectively to markets, resulting in greater quality degradation due to delays and inappropriate management. These distribution inefficiencies disproportionately affect women, effectively excluding them from decision -making processes that could optimize supply chain strategies and improve general productivity (Chang et al., 2010).

When examining these discussions, it becomes evident that improving gender inclusion is not simply a matter of equity; It is essential to address inherent inefficiencies in sweet

potato chains. As Kosec et al. (2022) mentioned, promoting the active participation of women in agricultural value chains can lead to more resistant agricultural practices and a better market response capacity. Addressing the challenges faced by women in the Port Moresby sweet potato sector could lead to significant improvements both in the dynamics of the supply chain and in the general welfare of the community.

Therefore, conversation about gender inclusion must be integrated into broader discussions about agricultural policy and practice, emphasizing the need for various strategies that address systemic barriers and market inefficiencies. Such approach could transform not only the livelihood of women involved in the production and distribution of sweet potatoes but also catalyze changes in the economic view of the agricultural economy of Port Moresby.

These findings are similar to research from Pacific Island nations such as Fiji and Solomon Islands, where women dominate informal horticultural markets but remain excluded from decision-making roles (Koczberski, 2012). However, PNG's cultural norms around land tenure and market space make women even more vulnerable, since they often lack secure rights to farmland or urban selling locations.

2.11.3 Climate Change and Post-Harvest Impacts

Climate change presents significant vulnerability to the sweet potato sector, with implications for practices after harvesting and general food security. The change in the climate such as ; higher temperatures, altered rainfall patterns and the prevalence of extreme climatic events, each contributing to the degradation of crop quality and the

variability of performance (Bourke, 2018). Root crops such as sweet potatoes are particularly sensitive to climatic changes, since they require specific soil moisture levels and temperature ranges for optimal growth (Stice & McGregor, 2016). When these conditions are interrupted due to climatic variability, the resulting stress in the crop can lead to a greater incidence of diseases and pests, which finally results in lower quality products that enter the supply chain (Bourke, 2018).

The loss of quality associated with climate-induced tensions cannot be exaggerated. As climatic conditions, nutritional quality and physical integrity of sweet potatoes decrease which leads to a product that is less desirable in local markets. The diminished attractiveness of such products further complicates market access for farmers, particularly small producers in Port Moresby and the highlands region, who lack resources to compete with larger suppliers or to adapt to changing standards in agricultural practices. Access to the inadequate market worsens the financial tension of these producers, since lower quality products obtain reduced prices, creating a vicious circle in which farmers cannot reinvest in improved practices after harvest.

In addition, distribution bottlenecks are pronounced considering climatic challenges. Seasonal variations dictate not only planting and harvest schedules, but also transportation logistics (Sapakhova et al., 2023). The greatest probability of extreme climatic events can cause infrastructure damage, which further prevents farmers from distributing products efficiently from their farms to markets. According to Stice and McGregor (2016), such bottlenecks are particularly harmful to post management after the harvest, since they increase the time that the sweet potatoes spend in transit, thus

exacerbating quality degradation. As perishable products, sweet potatoes are particularly susceptible to deterioration, and ineffective distribution systems can lead to economic losses.

Furthermore, understanding the socio -economic implications of climate change in the sweet potato sector is essential to inform the policies aimed at strengthening food security in Port Moresby. Stice and McGregor (2016) emphasize that integrated approaches are necessary, integrating climate resilience into agricultural planning, including the efficient allocation of resources and support systems for farmers. When addressing the broader systemic problems inherent to the food supply chain, interested parties can work collectively towards achieving a more sustainable sweet potato sector that is less vulnerable to the challenges of climate change.

Climate change is another cross-cutting issue that affects sweet potato supply chains in PNG. Variability in rainfall, rising temperatures, and increased incidence of extreme weather events disrupt production and transport, thereby influencing both quality and availability of crops (McGregor & Stice, 2014b). For example, heavy rainfall often damages rural roads and bridges, causing transport delays and increasing the risk of spoilage before sweet potatoes reach Port Moresby's markets.

At the production stage, prolonged droughts or floods reduce yields and affect tuber size and quality (Allen, 2015). Post-harvest processes are also affected, as higher temperatures increase susceptibility to sprouting and rot. Without effective storage or cold chain facilities, climate stress accelerates deterioration along the supply chain (Chang et al., 2013a).

Similar challenges are documented in sub-Saharan Africa, where extreme weather events reduce shelf life and increase post-harvest losses (Parmar et al., 2017). However, PNG's geographic isolation and dependence on sea transport exacerbate these impacts, since climate-induced shipping delays have no easy alternatives.

These cross-cutting issues are critical for this study because they highlight structural and environmental constraints that cut across all stages of the value chain. They connect to Objective 2 (market access barriers) by showing how gender inequality limits participation, and to Objective 3 (distribution bottlenecks) by demonstrating how climate variability worsens delays and losses.

2.12 Identified Research Gap and Study Contribution

Despite extensive research on sweet potato supply chains in developing countries and rural PNG, a gap exists concerning the urban market segment, particularly within Port Moresby. Existing studies primarily focus on rural production, general logistics, or policy-level discussions, with limited attention to urban realities such as market vendors' challenges, informal distribution, cold storage availability, and intra-city transportation. For instance, (Chang & Kewa, 2014) identified significant issues related to long travel distances, high transport costs, poor road conditions, inadequate post-harvest management, and lack of proper storage facilities in the sweet potato value chain. Additionally, post-harvest losses have been reported to reach up to 30-50% upon arrival in Port Moresby, especially when there are substantial shipping delays (Chang et al., 2007) . Furthermore, women farmers face specific marketing challenges, including heavy workloads, unreliable transport, poor market facilities, and instances of harassment and

violence (Chang et al., 2010). This study aims to fill that gap by generating data on quality losses, infrastructure barriers, and market dynamics affecting sweet potatoes in Port Moresby's urban markets, providing a more comprehensive understanding of the supply chain and supporting evidence-based decision-making for developing a resilient urban food system.

2.13 Theoretical Framework for the Study

Based on the literature reviewed above, the study adopts an integrated theoretical framework in which Supply Chain Management provides the primary lens for analysing the movement and coordination of sweet potato, Value-Chain Analysis provides the lens for examining actor roles, value creation and distribution of costs and benefits, and Transaction Cost Economics provides an explanation for the governance of exchanges, particularly the role of intermediaries and informal trade. These perspectives are complementary but analytically distinct.

The framework begins with structural and contextual conditions: infrastructure quality, market information, storage and transport facilities, access to finance and services, institutional arrangements, gender relations and climate conditions. These conditions influence the capabilities and choices of actors. The main actors are farmers, transporters, wholesalers/intermediaries, vendors and consumers, supported or regulated by government and development organisations. Their interactions determine supply-chain processes including harvesting, packing, aggregation, transport, storage, wholesaling, retailing, pricing and information exchange.

When these processes are poorly coordinated or constrained, bottlenecks can occur. Bottlenecks may increase lead time, handling, cost or exposure to environmental

conditions, which can contribute to physical and quality loss. At the market end, quality perceptions, food-safety concerns and price sensitivity affect demand and the returns received by different actors. Informal trading relationships may reduce transaction costs and enable market participation, but may also create information asymmetry, weak traceability or unequal bargaining power. The framework therefore treats inefficiency as a systemic outcome of interactions among infrastructure, actor behaviour, governance and market conditions rather than simply as a failure of individual farmers.

The framework guides the qualitative analysis in two ways. First, it provides sensitising concepts for the interview questions and initial coding: quality loss, handling, storage, transport, market access, actor relationships, information, informal trade, pricing, gender and environmental stress. Second, because the research is qualitative and inductive, the framework does not force participants' experiences into predetermined categories. Themes can emerge from the data, and the theoretical perspectives are then used to interpret relationships among the themes. This is consistent with the flexible use of thematic analysis described by Braun and Clarke (2006). The resulting framework is therefore both theoretically informed and responsive to participants' lived experiences.

Framework element	Theoretical lens	What it examines in this study	Expected qualitative evidence
Context and resources	Supply Chain Management	Infrastructure, storage, transport, information and service conditions	Descriptions of roads, facilities, information and resource constraints

Actors and activities	Value-Chain Analysis	Who performs production, aggregation, transport, wholesale, retail and consumption activities	Actor roles, responsibilities, costs, risks and value-adding activities
Coordination and exchange	Transaction Cost Economics	Intermediaries, informal trade, bargaining, information and transaction relationships	Reasons for using intermediaries, trust, price negotiation, information gaps and dependence
Flow performance	Supply Chain Management	Lead time, delays, handling, coordination and distribution	Transport delays, breakdowns, storage constraints and points where flow is interrupted
Outcomes	Integrated interpretation	Quality loss, market access, prices, food	Perceived causes and consequences reported by

		safety and consumer response	different stakeholder groups

Table 2.2. Theoretical framework linking the study concepts, actor relationships and qualitative evidence.

2.14 Summary of Literature Review

Loss in quality of sweet potato remains a major concern in PNG, due to inadequate post-harvest handling practices and insufficient transport and storage infrastructure. According to Connell et al. (2019), these issues lead to the severe degradation of the physical and nutritional quality of sweet potatoes, resulting in decrease in consumer acceptance and the overall marketability of the produce. Without adequate methods to maintain post-harvest quality, whole harvests is subject to significant losses even before they reach the consumer (Connell et al., 2019). The incorporation of enhanced handling protocols, as suggested by several studies, can mitigate these losses. Investing and using modern storage and facilitating training for farmers in appropriate harvesting techniques are essential steps that need to be prioritized to ensure that potatoes keep their quality throughout the supply chain.

Market access, another critical challenge, is usually limited by factors such as geographic isolation and inadequate infrastructure. Many farmers outside Port Moresby find it extremely difficult to reach urban markets, where demand is high due to bad road conditions and underdeveloped transport network (Connell et al., 2020) . The lack of reliable transport facilities not only restricts farmers' ability to sell their products, but also contributes to increasing costs and uncertainty, which can compel potential producers not

to continue to invest in sweet potato cultivation. Specialist solutions include the improvement of rural transportation services and the establishment of cooperative networks among farmers to improve their bargaining power and collective access to markets, thus addressing the challenges associated with market accessibility.

In addition, bottlenecks severely prevent the smooth flow of sweet potatoes from production areas to consumers. These bottlenecks usually arise from the lack of coordination between the actors in the supply chain and inefficient logistics systems (Connell et al., 2020a). Stakeholders often face difficulties in coordinating their operations, resulting in delays that further worsen loss of quality and contribute to food waste. The implementation of technology-based solutions such as supply chain management systems can significantly improve the situation. By promoting transparency and better communication between producers, carriers and retailers, these systems can facilitate proper distribution processes and reduce inefficiencies thus benefiting all parties.

In summary, the improvement of the potato supply chain in Port Moresby depends largely on efforts to address the complex quality management challenges, market accessibility and distribution efficiency. Through targeted strategies, including education on handling practices, infrastructure improvements and coordinated management systems, the full potential of the sweet potato sector can be improved significantly. By adopting a comprehensive approach that encompasses post-harvest handling, transportation solutions and market structures, key stakeholders can work collaboratively to transform post-harvest challenges into opportunities for growth and sustainability. It is imperative that these efforts are prioritized not only to improve the subsistence

livelihoods of local farmers but also ensure a reliable, quality, and sustainable sweet potato supply for urban consumers.

Chapter 3: Method of Analysis

3.1 Research Design

This study adopted a qualitative research design to explore the post-harvest challenges and supply chain inefficiencies affecting sweet potato distribution in Port Moresby's urban markets. A qualitative approach is appropriate when a study seeks to understand experiences, perceptions, practices, relationships and processes from the perspectives of the people involved, rather than to measure relationships statistically [i] (Poth, 2016).The study was exploratory and inductive, allowing themes to emerge from participants' accounts while using the theoretical perspectives developed in Chapter 2 as sensitising concepts.

The choice of a qualitative design was guided by the nature of the research problem. Post-harvest losses and supply chain inefficiencies are not only technical problems; they are also influenced by how farmers, transporters, wholesalers, vendors, consumers and government or development actors understand and respond to issues such as handling, storage, transport delays, market information, pricing, informal trading relationships and infrastructure. These issues involve experiences and interactions that may not be adequately captured through a structured quantitative questionnaire alone. Semi-structured qualitative interviews therefore provided an opportunity to obtain detailed explanations and to ask follow-up questions when participants identified issues that were not anticipated in advance (Kvale & Brinkmann, 2015).

The qualitative approach has both strengths and limitations. Its main strength for this study is that it provides depth and context and allows participants to explain why particular practices occur, how different actors interact, and how problems are experienced at different stages of the supply chain. It is also flexible enough to identify unexpected issues and differences between stakeholder groups. However, qualitative research is generally based on smaller, purposively selected samples and therefore does not provide statistical estimates that can be generalised to the entire PNG sweet potato sector. The findings may also be influenced by participant recall, willingness to disclose information and the researcher's interpretation of the data. These limitations were addressed, where possible, through purposive sampling across several stakeholder groups, systematic thematic coding, repeated review of codes and themes, reflexive notes and member checking.

To enhance the trustworthiness of the findings, member checking was used by sharing key interpretations with selected participants for verification. A reflexive journal was also maintained throughout the study to document analytical decisions and to encourage awareness of the researcher's assumptions. See Appendix A Figure 7 for an example of the reflexive notes kept during coding.

3.2 Research Approach

To achieve the research objectives, semi-structured in-depth interviews were used as the primary method of data collection. Semi-structured interviews combine a consistent set of topics with sufficient flexibility for participants to explain their experiences in their own words and for the researcher to ask probing or follow-up questions (Kvale & Brinkmann,

2015). This was particularly suitable for the present study because the researcher needed to obtain information from different actors while maintaining sufficient consistency to compare responses across stakeholder groups.

The interview approach also allowed the researcher to examine issues that could be difficult to observe or measure directly, including informal trading arrangements, reasons for using particular transport or marketing channels, perceptions of quality, causes of delays, relationships between actors and experiences with market infrastructure. Qualitative interviews are useful where the purpose is to understand meanings, experiences and processes in their social and institutional context (Creswell & Poth, 2016).

Although focus group discussions were considered as a possible supplementary method, the final primary data collection relied on individual semi-structured interviews. Individual interviews were considered more appropriate because some questions concerned prices, profits, relationships with intermediaries, business practices and perceived weaknesses in the supply chain, which participants might have been less willing to discuss openly in a group setting.

3.3 Study Area

The research took place in Port Moresby, PNG's capital, focusing on three major urban markets: Gordons, Koki, and Boroko (Figure 6.0). These markets provided access to a range of stakeholders including vendors, wholesalers, consumers and informal traders. Port Moresby was selected because it is a major urban consumption centre and an important destination for sweet potato transported from production areas in the

Highlands. The study therefore focused on the downstream urban part of the supply chain while also collecting information from selected upstream and transport actors involved in supplying Port Moresby. Due to funding and logistical limitations, field engagement was concentrated in Port Moresby. Farmers from the Highlands were also included in the primary research, while transport and logistics companies located outside Port Moresby were interviewed by telephone.

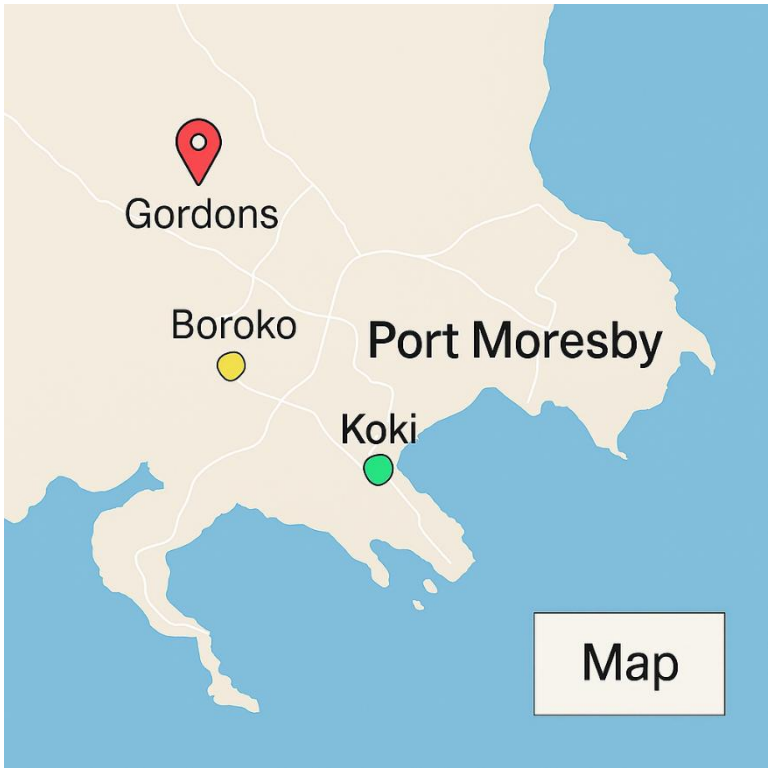

Figure 6.0 Map showing the three main markets in Port Moresby where the study was conducted. (Source: Satellite map of Port Moresby).

3.4 Target Population

Participants were selected from across the sweet potato supply/value chain, including smallholder farmers, transporters, wholesalers, market vendors, consumers, and government/NGO representatives involved in agriculture, market regulation and food safety. These groups were selected because each performs a different role in the movement, marketing or consumption of sweet potato and can therefore provide different perspectives on quality losses, transportation, storage, market access, informal trade and institutional constraints.

3.5 Sampling Strategy

A purposive sampling strategy was adopted to ensure that participants represented the main actors relevant to the research questions. Purposive sampling is appropriate in qualitative research when participants are selected because they possess direct experience or knowledge of the phenomenon being investigated (Palinkas et al., 2015). Snowball sampling was also used where initial participants helped identify other relevant actors, particularly wholesalers and transport agents who were not always easily accessible through public market locations.

The final sample comprised 68 participants. This included 15 farmers, 5 transporters, 15 wholesalers, 15 vendors, 15 consumers and 3 government/NGO representatives. In addition, five transport and logistics companies located outside Port Moresby were interviewed by telephone. [Note: the five transport/logistics interviews are included within the total of 68 and are not additional participants.] The participant codes and demographic information are provided in Appendix B, Tables 10–15.

Participants were recruited progressively and data collection continued until the researcher considered that sufficient information had been obtained to address the research questions and that additional interviews were largely confirming established patterns. In qualitative research, this principle is commonly discussed as data saturation, where additional data no longer contribute substantial new themes or insights (Guest et al., 2013). The study prioritised depth and diversity of stakeholder perspectives rather than statistical representativeness.

Because the sample was purposively selected, it may not capture every viewpoint in the wider sweet potato sector. In particular, very remote smallholders, large-scale retailers and actors in provinces outside the study's main supply corridor were not fully represented because of logistical, financial and time constraints. Consequently, the findings should be interpreted as context-specific qualitative evidence rather than statistically generalisable estimates for all sweet potato actors in PNG.

3.6 Data Collection Tools and Procedure

Primary data were collected using a semi-structured interview questionnaire/guide developed from the research objectives, research questions and issues identified in the literature review. The guide was designed to provide a common set of questions across interviews while allowing additional probing questions when participants raised relevant experiences or explanations. Separate question prompts were used where necessary to reflect the roles of different stakeholder groups, while maintaining common themes so that responses could be compared across groups.

The interview guide covered five broad areas: (1) participant and business/farming background; (2) harvesting and post-harvest handling practices, including sorting, packaging, storage and causes of physical damage or spoilage; (3) transport and logistics, including routes, delays, loading/unloading and transport-related costs or risks; (4) market access, pricing, relationships with intermediaries and informal trading practices; and (5) perceived solutions, institutional support and recommendations for improvi ng the supply chain. Questions were open-ended to encourage participants to describe practices and experiences in their own words, followed by probing questions where clarification or further detail was required.

Before the main data collection, the interview tool was pre-tested to assess the clarity, relevance and sequencing of the questions. Feedback from the pre-test was used to refine wording, remove ambiguity and ensure that the questions could be understood by participants with different levels of formal education and different roles in the supply chain. The final guide was administered in Tok Pisin or English according to participant preference.

Interviews were conducted face-to-face with farmers, wholesalers, vendors, consumers and government/NGO representatives in the study area. Interviews with transport and logistics companies located outside Port Moresby were conducted by telephone because travel to their locations was not feasible within the available resources. Interviews generally lasted approximately 20–40 minutes. With participants' consent, interviews were audio-recorded and supported by field notes. Audio recordings were subsequently transcribed, and interviews conducted in Tok Pisin were translated into English where necessary for analysis.

The use of semi-structured interviews enabled the researcher to maintain consistency across participants while still responding to information emerging during each interview. This flexibility was important because participants occupied different positions in the supply chain and therefore experienced different forms of post-harvest and distribution constraints. Ethical approval was obtained before data collection, informed consent was obtained from participants, participation was voluntary, and confidentiality and anonymity were maintained.

3.7 Data Analysis

The qualitative data were analysed using thematic analysis following the six-phase approach described by Braun and Clarke (2006): familiarisation with the data; generation of initial codes; searching for themes; reviewing themes; defining and naming themes; and producing the final report. Thematic analysis was selected because it provides a systematic but flexible way of identifying patterns across a large set of interview transcripts while retaining the contextual meaning of participants' accounts.

NVivo 15 software was used to support the organisation and management of the qualitative data. NVivo was selected because the study generated a relatively large number of interview transcripts from several stakeholder groups. The software enabled the researcher to store and organise transcripts in one project, assign and retrieve codes consistently, compare coded material across participants, group related codes into categories and themes, maintain coding notes and retrieve quotations efficiently. NVivo was therefore used as a data-management and coding tool; it did not replace the

researcher's interpretation or decision-making. The identification, refinement and interpretation of themes remained the responsibility of the researcher.

After transcription and translation, the interview transcripts were imported into NVivo and read repeatedly to become familiar with the data. Initial open codes were then assigned to meaningful segments of text relating to post-harvest handling, quality loss, storage, transport, market access, pricing, informal trade, actor relationships and other issues relevant to the research questions. Related codes were subsequently grouped into broader categories and themes. Coding was initially informed by the research questions and theoretical framework but remained sufficiently inductive to allow unexpected themes to emerge from participants' accounts.

The researcher repeatedly reviewed coded extracts and revised codes and themes where necessary. Where responses overlapped across categories, the segment was assigned to the theme that best represented its main meaning, and analytical notes were recorded to document the decision. Themes were then compared across stakeholder groups and interpreted in relation to the theoretical framework and relevant literature. This process helped identify similarities and differences in how farmers, transporters, wholesalers, vendors, consumers and institutional actors experienced the supply chain.

To enhance the credibility and consistency of the analysis, the researcher used repeated cycles of coding and re-coding, maintained reflexive notes, reviewed themes against the complete transcripts and used member checking for selected interpretations. The coding framework and NVivo outputs are provided in Appendix A. Frequency counts of coded responses were used descriptively to show how commonly particular issues were

mentioned; these counts were not treated as statistical estimates of the prevalence of the problem in the wider population.

3.8 Ethical Consideration

The researcher adhered to ethical requirements for qualitative fieldwork before and during data collection. Ethical approval was obtained from Massey University and/or the relevant research ethics process before participants were recruited. Participants were provided with information about the study and gave informed consent before interviews were conducted. Participation was voluntary, and participants were informed that they could decline to answer a question or withdraw from the study. Confidentiality and anonymity were maintained by removing identifying information from transcripts and using participant codes in the analysis and reporting of findings.

Audio recordings, transcripts and research notes were handled securely and were used only for the purposes of the research. Interviews were conducted in a manner intended to respect participants' cultural and social contexts. Where compensation or refreshments were provided for participants' time, this was done consistently with the approved research procedures and ethical requirements.

3.9 Limitations of the Methodology

Several limitations of the chosen methodology are acknowledged. First, the purposive qualitative sample was designed to provide depth and variation in stakeholder perspectives rather than statistical representation. The findings therefore cannot be generalised quantitatively to all sweet potato farmers, traders, consumers or markets in PNG. Second, access to some upstream and logistics actors was constrained by funding,

distance and time. Telephone interviews were therefore necessary for some transport and logistics companies, which may have limited the opportunity for direct observation of their operations.

Third, the study relied substantially on participants' self-reported experiences and recollections. Participants may have under-reported, over-reported or selectively described particular problems, especially when discussing prices, losses, business relationships or practices that they considered sensitive. Fourth, interviews conducted in Tok Pisin were translated into English for analysis. Although the researcher made efforts to preserve the original meaning and used familiar Tok Pisin expressions when checking interpretations, some minor linguistic or contextual nuances may have been lost during translation.

Fifth, the researcher was the sole primary coder, which creates a possibility of interpretive bias. This limitation was reduced through systematic coding, repeated review and re-coding, reflexive notes, comparison of themes across stakeholder groups and member checking. Finally, qualitative interviews provide detailed explanations but cannot by themselves quantify the exact volume or monetary value of post-harvest losses across the entire Port Moresby sweet potato supply chain. The study therefore interprets the findings as detailed contextual evidence of the mechanisms and experiences associated with post-harvest challenges and supply chain inefficiencies.

3.9 Methodological Limitations

Several methodological limitations should be considered when interpreting the findings. First, the study used purposive qualitative sampling, so the 68 participants were selected

for their relevance to the sweet potato chain rather than to provide a statistically representative sample of all actors in PNG. Second, the study focused on Port Moresby markets and selected supply sources in the Highlands, which limits transferability to other provinces and urban markets. Third, the study relied primarily on participant accounts rather than direct measurement of physical post-harvest losses at every stage; reported losses should therefore be interpreted as experienced or perceived losses rather than experimentally measured loss rates.

Fourth, some interviews were conducted in Tok Pisin and translated into English, creating a possibility of minor loss of meaning despite transcript checking. Fifth, the researcher was the sole primary coder. Systematic coding, repeated review, memoing and use of NVivo supported consistency, but qualitative interpretation remains influenced by researcher judgement. Finally, time and resource constraints limited prolonged observation of remote production areas, shipping operations and port handling. These limitations do not invalidate the findings; rather, they define the claims that can reasonably be made. The study provides contextual explanations of how supply-chain actors experience and respond to post-harvest, market and distribution constraints rather than population-level estimates of losses.

Chapter 4: Results

4.1 Introduction

This study utilized qualitative research methods to explore the post-harvest challenges and supply chain inefficiencies of sweet potato in Port Moresby, PNG. Data was collected through semi-structured interviews with a total of 68 participants, representing diverse actors across the sweet potato value chain. Supplementary results tables (Appendix B Tables 1–9) provide detailed coding references for each stakeholder group and theme, while Appendix B Tables 10–15 present participant demographics.

Interviews were conducted using individual face-to-face interviews, supplemented by a small number of phone interviews where in-person access was limited. Each interview lasted approximately 20–40 minutes and followed a semi-structured guide aligned with the research objectives. All interviews conducted for the small holder farmers, wholesalers, vendors, consumers and Government /NGO representatives were done in person, face to face. Interviews done with five transport and logistic companies were all conducted by phone as they were all located in other provinces (Lae and Mt. Hagen).

All interviews were conducted in Tok Pisin (PNG's local language) except for interviews done with the five logistic and transport companies were conducted in English. This was done depending on participant preference and was recorded on audio files. Interview recordings were later transcribed, translated where necessary, and uploaded for analysis.

The qualitative data analysis was conducted using NVivo 15 software. After all interviews were conducted, the audio-recorded responses were transcribed and translated into English. The translated transcripts were then imported into NVivo for systematic

coding. Coding was guided by both the research questions and emergent patterns in the data. Major themes and subthemes were created, ensuring that stakeholder voices were accurately represented. While there is a possibility of minor nuances being lost during the translation process, every effort was made to retain the original meaning by cross-checking translated transcripts and consulting familiar expressions in Tok Pisin where needed.

It is acknowledged that conducting the analysis in English rather than Tok Pisin was influenced by software limitations, NVivo does not support non-English natural language processing for functions such as auto coding, text frequency, or visualization. Therefore, English was used as the working language for both coding and analysis. Upon completion of coding, NVivo's "Code Summary" reports were exported into Microsoft Excel. This step was taken because the researcher had greater familiarity with Excel's graphing and visualization tools, which allowed for clearer presentation of frequency charts. The exported data were used to generate bar charts.

As the sole coder, all interview transcripts were imported into NVivo, and a systematic coding process was followed.

The coding was conducted in multiple stages:

Initial Open Coding: Each transcript was reviewed line-by-line to identify meaningful units of text related to post-harvest challenges, supply chain inefficiencies, and stakeholder perspectives.

Focused Coding: Initial codes were grouped and refined into broader categories and themes that captured recurring patterns and significant issues within the sweet potato value chain.

Theme Development: Themes were iteratively reviewed and adjusted to ensure they comprehensively represented the data and answered the research questions.

This chapter presents these themes with accompanying quotes, frequency tables, and illustrative graphs to support narrative interpretation.

4.2 Participant Overview

Relevance of each group and their role in the supply chain.

The sixty-eight (68) participants (Table2.0) in this study were drawn from six key stakeholder groups involved in the sweet potato supply chain in PNG, each having vital roles which are important, and are linked. Smallholder farmers, based in Goroka in the Eastern Highlands province of PNG, are the start of the sweet potato supply chain as they are primary producers. These farmers prepare the soil for cultivation, cultivate the crop, and harvest it all throughout the year and have them ready for sales. They play a distinct role in the supply chain as their decisions around crop variety, harvest timing, and post-harvest handling significantly influence the quality and quantity of sweet potatoes that enter the supply chain. Production areas with urban markets. Sweet Potatoes are transported from the sweet potatoes growing areas of PNG, which are the highlands region and transported down to Lae via trucking companies like Traisa and Mapai trucking companies. They manage the logistics of moving produce over long distances,

often facing infrastructure challenges such as poor road conditions and lack of cold storage. The way transporters handle and store sweet potatoes during transit can impact the final market quality and contribute to post-harvest losses. Transporters also influence the pricing and availability of produce in urban areas.

Wholesalers in Port Moresby function as intermediaries who purchase sweet potatoes in bulk from transporters or directly from producers. They perform a distinct role in the supply chain which includes sorting, grading, and repacking the produce before reselling it to vendors or other retailers. They also function as a market link between the rural producers in the highlands of PNG and the vendors in urban markets of Port Moresby. As such, wholesalers have a strong influence on price formation, market supply, and the distribution of sweet potatoes within the city. Their decisions affect which varieties and qualities reach urban consumers.

Vendors, located at key urban markets such as Gordon, Tokorara, and Boroko, are the direct interface between the supply chain and the consumer. Sweet potato vendors buy sweet potatoes from wholesalers or sometimes directly from the producers themselves and sell them at the main urban markets in Port Moresby. They often manage issues like pricing competition, limited storage facilities, and spoilage. Vendors are highly responsive to consumer preferences and are well positioned to observe and respond to market demand and feedback.

Consumers in Port Moresby are the end users of the supply chain. Their purchasing behavior, quality perceptions, and price sensitivity drive demand and ultimately shape the flow of sweet potatoes through the market. Consumer preferences influence vendor

practices and, indirectly, upstream decisions about which sweet potato types are grown, how they are transported, and how they are presented at the market.

Finally, government and NGO officers represent a small but significant group of stakeholders involved in regulating and supporting the sweet potato value chain. These participants, drawn from national agencies and development organizations, play a policy and facilitation role. They contribute to the development of agricultural standards, market infrastructure, training programs, and broader efforts to improve the efficiency and sustainability of the supply chain. Although fewer in number, their impact is far-reaching, influencing long-term changes in how the sweet potato sector is structured and supported in PNG.

The participant distribution provides coverage of multiple stages of the chain. Farmers and transporters describe upstream production and movement constraints, while wholesalers and vendors describe aggregation, storage, pricing and market conditions. Consumers provide the downstream perspective on price, appearance and food-safety concerns. The sample is therefore analytically diverse, but the numbers in each group should not be interpreted as proportional to the population of stakeholders.

Table 2.0 Stakeholder Overview.

Participant Code	Role in Supply Chain	Region/Market	No. of Interviews	Key Focus Area
F1 – F15	Farmer	Goroka (EHP)	15	Harvest, storage, loading

T1 – T5	Transporter	Highlands–Pom	5	Road access, delivery delay
W1 – W15	Wholesaler	Gordons Market	15	Storage, pricing
V1 – V15	Vendor	Gordons/Borko/Tokarara	15	Quality, spoilage
C1 – C15	Consumer	Port Moresby urban	15	Price, spoilage, food safety
G1-G3	Government/ NGO organizations	Port Moresby	3	

Table 3.0 presents the initial codes generated from interviews with 68 participants involved in the sweet potato supply chain. It shows each code, the number of participants who mentioned it, the number of excerpts linked to it, and a sample quote that illustrates the idea. The number of participants contributing to a code indicates how widely that issue appeared across the interview dataset, while the number of excerpts indicates how much coded material was associated with the issue. These figures are descriptive indicators of the qualitative dataset, not statistical estimates of prevalence. For example, the relatively high number of participants contributing to 'No Proper Storage' indicates that storage limitations were repeatedly raised across stakeholder accounts. The initial codes were subsequently consolidated into broader themes in Table 4.

Table 3.0 Initial Codes extracted from participant's interviews.

Initial Code	**n of Participants Contributing (N=68)**	**n of Excerpts Assigned**	**Sample Quote**
Delays in transport	4	4	"Our kaukau can stay on the road for two or three days before reaching the market. Sometimes the truck breaks down, or we get stuck because of landslides or police checks. By the time we unload in Port Moresby, most of the tubers are already soft or rotting. It's frustrating because we work hard, but by the time we sell, we've already lost money"-T3
Extreme weather	11	16	"When it rains too much, we can't even use the truck; we just wait or carry the kaukau by foot." – F6
Bruised during harvest	7	7	"When we harvest, the kaukau gets bruised because we throw them into sacks. We don't have proper crates or bags that protect them, so the quality gets affected before they even leave the farm." – F9
No Post Harvest Training	9	9	"I've never been taught the right way to handle kaukau after harvesting, we just do what Our parents used to do, which is to dig them up and pack them into feed bags. No one government or agriculture organizations have come to show us how to do it

			Properly. May be if we had some training we'd lose less along the way." – F2
No Proper Storage	31	36	"We don't have any storage houses or proper stalls. Most of the time we just keep our kaukau under canvas or on wooden crates in the sun. When it rains or too hot, the tubers start to get shrink, rot, or get dirty that makes it hard to sell and sometimes customers walk away because of the condition." – V4
Improper packaging	3	3	"Some people pile them into plastic bags and they rot quickly. I try to leave mine in a basket, but space is limited and we just do what we can." – C3
Bad road condition	7	9	"The road is full of potholes, and trucks break down easily. Some areas don't even have proper bridges. We lose time and money just trying to reach the market."-T1
No Networks	5	5	"We don't have connections to big buyers or market vendors. It's hard for us small farmers to sell directly because we don't know who to talk to." -F7
High Transport Cost	6	7	I had to pay K400 just for one trip to town, that's not including food or loading costs. The price is too high. After Selling, sometimes I only make back what I spent or even less. There are weeks I just leave my kaukau at home to rot Because I can't afford a truck fare."-F3

Bad Weather Condition	4	4	"The rain destroys the road and delays delivery. During the wet season, it's almost impossible to move produce.
			We lose a lot just trying to get to town." – T4
Long Transit Time	3	3	"By the time we arrive, the kaukau is not fresh. Long travel times make it worse, especially when the vehicle has no ventilation.
			The vendors complain a lot "-F12

Poor Infrastructure	3	6	"Bridges are broken & some roads are not sealed. Even if we have a vehicle, sometimes we just turn back or take a longer route."-T2
Inconsistent Supply	16	19	"Some weeks we get supplies, or we don't. There's no consistency, & I lose customers when I can't meet their expectations." – V5
Lack of Customer Trust	3	3	"Customers don't trust roadside sellers anymore. They think the quality is bad or that we're cheating them,but really, we don't have Proper packaging." -C8
No Access to Standards	18	20	"We don't know the quality standards the buyers want. Sometimes they reject our produce without explanation. If we knew the standards, we could improve." – W1
Middleman Control	10	13	"Middlemen take most of the money and we get little. They decide the price & we have no say. But we depend on them to get access to the city markets." – F11
Cold Chain Infrastructure	16	16	"There's no cold storage here, we just stack the kaukau under shades or throw leaves over them. By afternoon they're already Soft or starting to spoil. If we had even one cold room or proper shelter,

			we could have fresh longer and maybe avoid throwing them away.”-V2
Food Safety Regulations	2	2	“There should be rules about food safety for all vendors. Sometimes people sell from dirty places or use unclean bags.It affects all of us.” V10
Fast Port Clearance	3	3	“Delays at the port cause our shipment to go bad. Even after harvest, we wait days just forclearance and by then, some of its already spoilt.”-L3
Need Proper Training	4	4	“I’ve never received any training on post-harvest handling. We just learn from others. A proper training would help me improve how I packed and store.”-F5
Proper Sales Equipment	13	13	“We need proper tables, scales, and shade. Right now, we sell on the ground or old wood planks. It doesn’t look good and makes the produce dirty.” – V7
Proper Storage Facilities	8	10	“If we had a good storage shed, we could sell more. People don’t like buying dirty or shriveled kaukau (sweet Potato) and the sun makes them spoil faster.” – W3

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Themes were developed by grouping initial NVivo codes with similar meanings or patterns. Each theme was validated through frequency analysis and cross-referencing with research objectives.Table 4.0 summarizes the main themes identified from interviews with 68 participants in the sweet potato supply chain and the initial codes that were grouped to form each theme. For each theme, it shows how many participants raised related points and how many excerpts were assigned during analysis. Together, the themes capture a range of challenges from harvest practices and transport issues to market dynamics, consumer concerns, and wider system gaps. Vendor Judgement and Repackaging has the largest number of participant mentions (60) and excerpts (65), followed by Price Volatility and Spoilage Losses (41 participants; 49 excerpts) and Informal Sourcing and Supply Uncertainty (31 participants; 37 excerpts). These patterns indicate that downstream quality judgement, economic consequences of deterioration and uncertainty in supply were prominent in participants' accounts. The themes are interconnected: handling and transport damage can increase spoilage; spoilage can create price pressure; and price pressure can influence vendor sorting, repackaging and sales decisions. The table therefore supports the study's value-chain perspective by showing how constraints at one stage can affect outcomes at subsequent stages.

Table 4.0 Final Themes Developed from Grouped Initial Codes.

Theme	Initial codes grouped to form theme	n of participants contributing (N=68)
Quality Perception, Harvest and Packing Practices	Sweet potato packed, Need Proper Training, Bruised during harvest, No Post Harvest Training,	23
Road Conditions and Travel Time	Bad road condition, Long Transit Time, Extreme weather	21
Damage During Transport	Delays in transport, Poor Infrastructure, High Transport Cost	14
Informal Sourcing and Supply Uncertainty	No Networks, Inconsistent Supply, Middleman Control	31
Price Volatility and Spoilage Losses	High Transport Cost, Poor Infrastructure, Improper Storage	41
Vendor Judgement and Repackaging	Proper Sales Equipment, Improper packaging, Cold Chain Infrastructure	60
Consumer Buying Behaviour and Safety Concerns	Lack of Customer Trust, No Access to Standards	21
System-wide Informality and Traceability Gaps	Middleman Control, No Networks, Lack of Customer Trust	18
Environmental Stress and Perishability	Extreme weather, Long Transit Time, Heat/Humidity	25
Coordination and Capability Gaps	No coordination, Lack of Standards, Capacity Gaps	17

Transporters, operating along the Lae to Port Moresby corridor, are crucial for linking rural

Table 5.0 maps each research question (RQ) to the themes (S) identified during analysis, showing how the findings address different aspects of the sweet potato supply chain. The Table provides the analytical audit trail linking the final themes to the research questions. RQ1 is addressed through themes concerning harvest and packing, transport damage, vendor judgement and environmental perishability. RQ2 is addressed through road and travel constraints, informal sourcing and consumer-related market conditions. RQ3 is addressed through transport, damage and coordination themes. RQ4 is addressed through informal sourcing, price and spoilage dynamics, system-wide informality and consumer concerns. RQ5 is addressed in the recommendations by drawing on these themes to identify practical interventions. This mapping demonstrates how the themes collectively answer the study's research questions.

Table 5.0 Themes Mapped to Research Questions.

Research Question (RQ)	**Theme (S)**
RQ1: Quality Losses in Post-Harvest Handling	Harvest and Packing Practices
	Damage During Transport
	Vendor Judgement and Repackaging
	Environmental Stress and Perishability
RQ2: Market Access Barriers	Road Conditions and Travel Time
	Informal Sourcing and Supply Uncertainty
	Consumer Buying Behavior and Safety Concerns
RQ3: Distribution Bottlenecks	Road Conditions and Travel Time
	Damage During Transport
	Coordination and Capability Gaps
RQ4: Informal Trade Impacts	Informal Sourcing and Supply Uncertainty
	Price Volatility and Spoilage Losses
	System-wide Informality and Traceability Gaps

	Consumer Buying Behaviour and Safety Concerns
RQ5: Best Practice Interventions	Harvest and Packing Practices
	Environmental Stress and Perishability
	Coordination and Capability Gaps

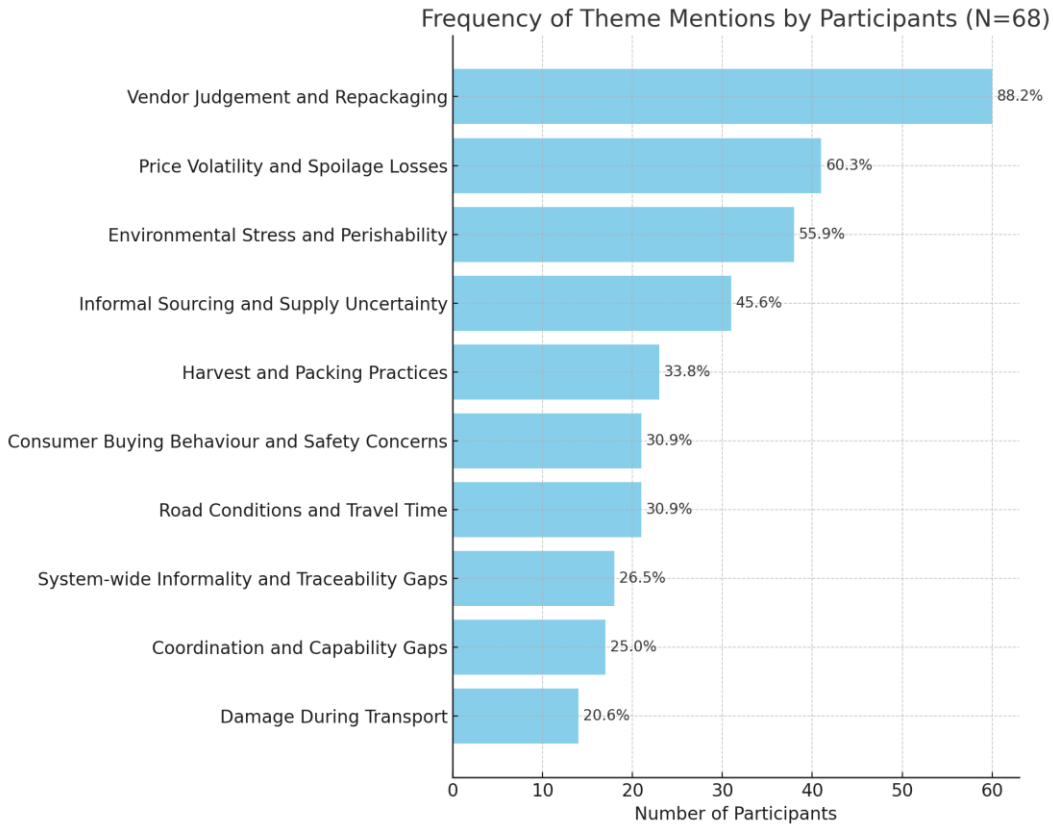


Figure 7.0 Frequency of themes mentioned by participants.

The graph (figure 8.0) illustrates the percentage of mentions for different supply chain themes by various stakeholder groups involved in the study. Farmers primarily emphasize issues related to Harvest and Packing Practices and Damage During Transport. Transporters focus heavily on Road Conditions and Travel Time, as well as Damage During Transport. Vendors are notably concerned with Vendor Judgment and Repackaging, Price Volatility, and Informal Sourcing. Consumers mentioned Consumer Buying Behavior and Safety Concerns the most, while Wholesalers and Organisations have more balanced mentions across themes, with

some emphasis on System-wide Informality and Traceability Gaps. Overall, each stakeholder group prioritizes themes relevant to their role in the supply chain, reflecting diverse perspectives on key challenges.

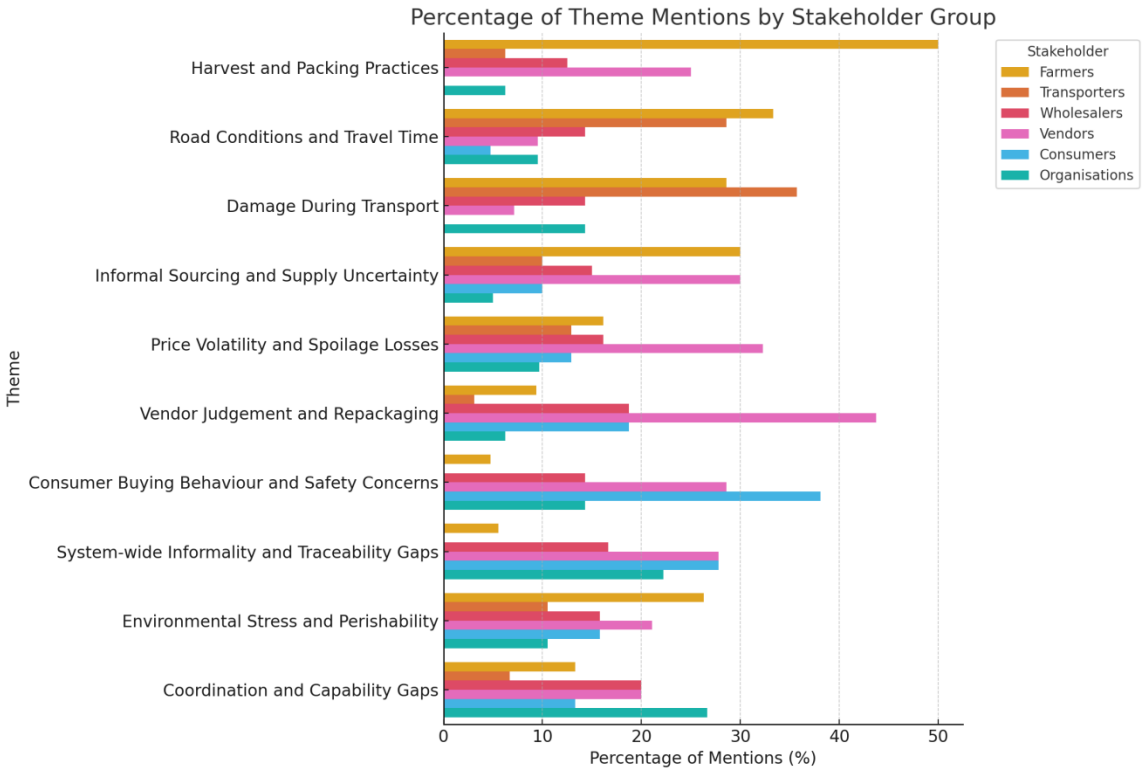


Figure 8.0 Percentage of themes mentioned by various stakeholder groups.

4.3 Production Level: Farmers' Perspectives

This section presents insights from smallholder sweet potato farmers in the Eastern Highlands who are at the start of the supply chain. The findings shows how farmers perceive and manage sweet potato quality, including their grading practices and post-harvest handling methods. These practices play a critical role in determining the condition of produce that eventually reaches urban markets like Port Moresby.

The data directly supports Research Objective 1, by identifying factors at the production level that contribute to quality deterioration, such as rough handling and lack of standardized grading. It also supports Objective 2, by revealing structural barriers farmers face in accessing urban markets, including limited understanding of buyer expectations. Lastly, it contributes to Objective 3 by exposing initial bottlenecks, such as delayed harvesting or improper packing, that weaken the entire downstream distribution chain Figure 9.0 illustrates the key issues

raised by farmers regarding post-harvest practices at the production level. Among the 15 farmers interviewed, the most frequently mentioned problem was bruising during harvest, indicating that multiple farmers shared several examples of this recurring issue. This was followed by using feed bags for packing, which many farmers acknowledged as contributing to damage and poor aeration during transport. A significant number also talked about the lack of post-harvest training, reflecting a gap in knowledge around improved handling techniques. Other concerns included poor handling practices and limited awareness of quality standards. These findings suggest that most of the quality deterioration begins immediately after harvesting due to inappropriate practices and inadequate knowledge among farmers. The visual representation quantifies these concerns, with percentages calculated based on the number of farmer participants (N=15), further emphasizing that these challenges are widely experienced across the farmer cohort. Detailed raw data on quality losses reported by farmers are provided in Appendix B Table 1**,** supporting the categories described below.

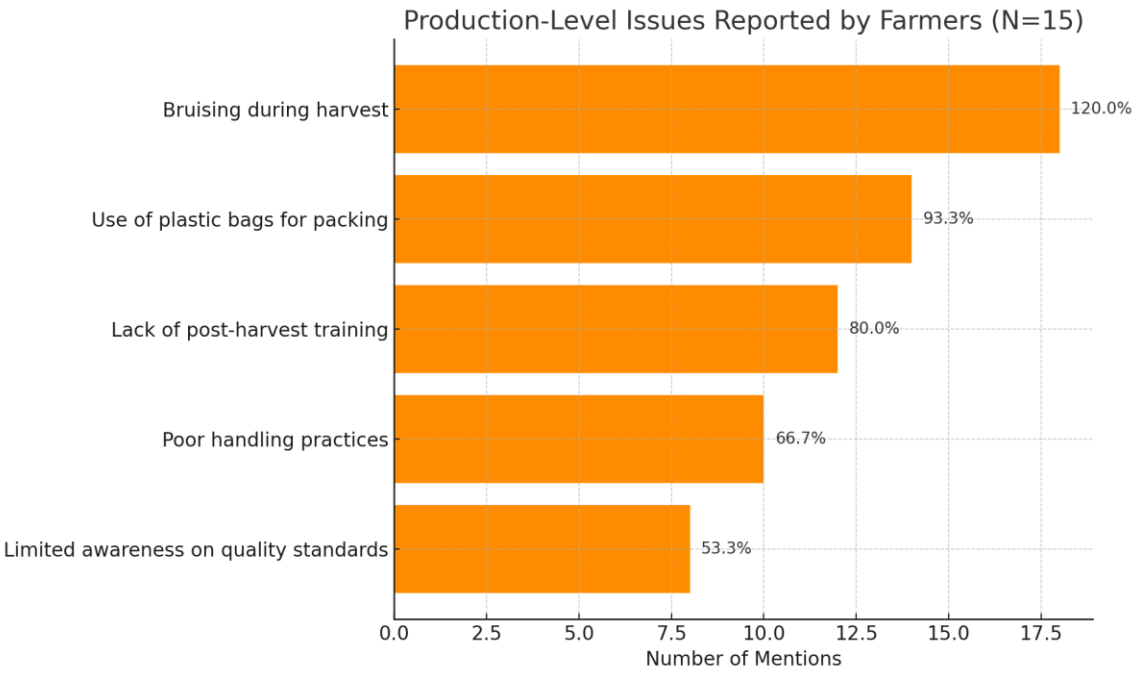


Figure 9.0 Production Level Issues mentioned by farmers during interview.

Farmers interviewed (refer to Appendix B Table10) reported between 3-25 years of experience in sweet potato production, cultivating farms ranging from 0.4 to 1.5 hectares. Most relied on PMVs (public motor vehicles) or hired trucks to move produce to Lae or Port Moresby markets.

A strong theme among farmers was the effect of poor road infrastructure on quality losses. One farmer (F3, 6 years farming, 0.5 -hectare farm) explained:

> *"By the time my kaukau (sweet potato) reaches Gordons Market, half of it is already bruised from the long truck ride on rough roads."*

Another (F11, 9 years farming, 0.7 hectares) added:

> *"Sometimes we don't even bother sending big loads because transport cost and losses are too high. It's better to sell in Goroka for a lower price than risk sending to Moresby."*

However, not all farmers shared this view. A minority noted that while transport was costly, market oversupply in Port Moresby was a bigger problem. Farmer F14, who owned a small truck, explained:

> *"Transport is not so hard for me because I have my own vehicle. The problem is at the market, too many sellers, price goes down quickly, and I can't make profit."*

Storage was another recurring issue. Most farmers lacked proper storage facilities, leading to rapid spoilage. As one farmer (F7, 5 years, 0.8 ha) explained:

> *"If I harvest today, I must sell quickly. If I keep kaukau for one week, it starts to rot."*

Others described improvising:

"We dig pits and cover the kaukau with grass, but that only works for short time." (F2, 12 years farming, 1.5 ha).

4.3.1 Quality Perception and Grading

The way smallholder farmers in Goroka identify and handle sweet potato quality is strongly associated with downstream supply chain expectations yet remains largely informal and inconsistent. Farmers' emphasis on size, appearance, and freshness as indicators of quality reflects their sensitivity to urban market preferences, particularly in Port Moresby, where larger, visually appealing tubers get better prices. However, this market-driven perception is not supported by structured or standardized grading systems. Instead, farmers rely on manual size-based sorting immediately after harvest, which, while practical, introduces variability and undermines uniform quality presentation. Furthermore, these grading practices occur together with poor harvesting and packing methods, such as using overfilled 50kg bags without cushioning and delaying dispatch that worsen bruising and spoilage even before the producer enters the transport stage. The disconnection between quality perception and the physical processes meant to preserve that quality reveals a critical gap: while farmers understand what the market values, they lack the training, tools, and infrastructure to protect those qualities post-harvest. This weakens not only the shelf life and appearance of sweet potatoes by the time they reach vendors, but also farmers' potential income and market credibility. Ultimately, the findings suggest that solutions targeting both technical training in grading and improvements in post-harvest handling are essential to close the gap between perceived quality and delivered quality along the supply chain.

4.3.2 Harvesting and Packing Practices

Harvested sweet potatoes are packed manually, usually in reused 50kg feed bags, without cushioning. Delays before dispatch and exposure to rain or sun were common issues. These practices, while rooted in tradition and

convenience, contribute greatly towards physical damage such as bruising, skin breaks, and microbial spoilage. Farmers typically harvest in the early morning and pack immediately to prepare for transport, yet without any protective lining or ventilation, the packed produce is highly vulnerable to injuries and heat stress, especially when stored under direct sunlight or in humid conditions. While the farmers' grading decisions are influenced by urban demand, their limited access to proper post-harvest tools and knowledge weakens their ability to preserve the quality they aim to deliver. This disconnects between perceived market standards and on-farm handling practices results in a form of “invisible loss,” where the degradation of quality begins before transport even occurs. Such deterioration not only reduces the market value of sweet potatoes but further worsens inefficiencies further along the supply chain. While quality begins on farm, its preservation depends heavily on how produce is transported. The next section focuses on how these harvesting and packing limitations interact with transport conditions to further accelerate post-harvest losses.

At the farm level, sweet potato quality is primarily defined by visual and physical characteristics such as size, appearance, and freshness. These perceptions guide harvesting and grading practices, but they are not matched by protective handling methods. Farmers harvest early to meet demand, compromising tuber maturity, and pack in reused 50kg bags.



Figure 10.0 Sweet potato harvested, packed and ready to be transported to Port Moresby's Urban markets. The 50kg bags of sweet potato packed manually by farmers in the Highlands of PNG.

While this traditional method of packing sweet supports local labor, the heavy bags (figure 10.0) and manual transport can contribute to bruise and damage, leading to quality loss during post-harvest handling and reducing market value.

without cushioning creating conditions for damage during transit. While farmers intend to meet market expectations, their limited access to post-harvest training or tools results in inconsistencies. The consequences of these upstream decisions is seen down the supply chain, particularly in transport, where improperly handled tubers are more likely to spoil.

4.4 Transport and Handling

Transporting sweet Potato comes with a lot of challenges such as poor infrastructure, transport delays, and inadequate handling practices. In this section it reveals how physical damage and spoilage often happen during this stage due to rough roads, extended transit times, and improper loading/unloading techniques.

The findings link closely to Research Objective 1, by showing how poor post-harvest handling during transit contributes to significant quality loss. They also address Objective 3, by identifying key distribution bottlenecks in logistics and infrastructure that hinder efficient movement of produce from rural to urban markets.

Figure 11.0 presents key transport-related issues raised by the five transporters interviewed. The most prominent concern was poor road conditions, reflecting widespread challenges in rural infrastructure that

directly affect timely delivery and quality preservation. Long transit times and exposure to heat and rain were also mentioned by many, indicating that both distance and lack of protective measures contribute to spoilage and deterioration of sweet potatoes during transport. Other frequently raised issues included vehicle breakdowns and delays, high fuel and transport costs, and damage during loading or unloading. Percentages shown in the chart are based on the total number of transporters (N=5) but calculated using total mentions, which means a single transporter may have raised the same issue more than once. These results indicate how logistical constraints during the transport stage create major vulnerabilities in maintaining sweet potato quality.

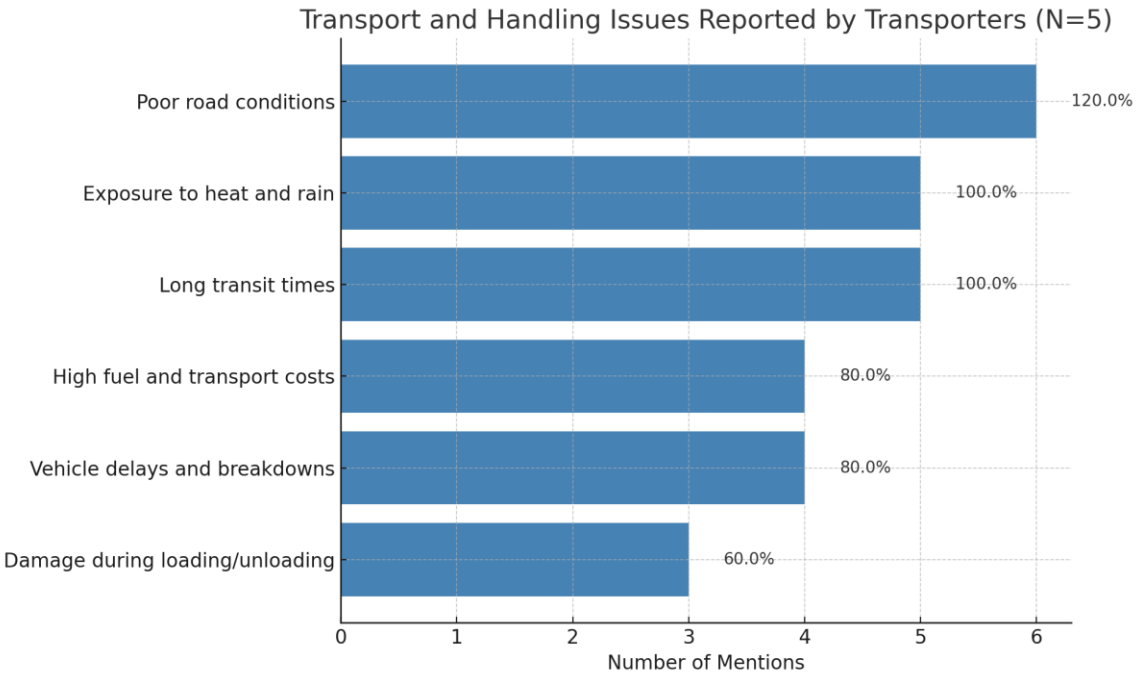


Figure 11.0 Transport and handling issues in the sweet potato supply chain.

4.4.1 Road Conditions and Travel Time

Logistical constraints caused by poor infrastructure were a dominant concern among farmers and transporters. Many roads connecting sweet potato farms in the highlands to urban centres like Lae are unsealed, narrow, and deteriorate further during the rainy season. Inaccessibility often delays the collection and dispatch of

produce, particularly when bridges are washed out or vehicles break down. Farmers and transporters alike reported frequent disruptions and extended travel times due to impassable roads, sometimes requiring farmers to carry produce on foot to roadside collection points.

While these conditions are well-known, the implications for the supply chain go beyond delayed delivery. Poor road access translates into fewer transporters willing to service remote areas, driving up the cost per bag for each trip. These rising transport costs reduces farmers profits, reducing incentives for surplus production or market participation. It also limits the ability of traders to negotiate better bulk prices or maintain supply consistency. Road conditions act as both a physical and economic bottleneck, constraining both the flow of goods and the distribution of value along the supply chain.

The five transport operators (T1–T5) interviewed were based in Lae and Goroka, moving sweet potatoes from the Highlands to Lae and Port Moresby by road and sea. They had between 7–20 years of experience in freight and logistics, operating with different capacities, from small PMV truck 79 ɜ 10–15 bags to commercial trucking and container shipping of 200–300 bags per trip.

A common theme across transporters was the poor road conditions in the Highlands and along the Goroka to Lae supply route. They described how this contributed to long delays and quality deterioration. For example:

> *"The Highlands Highway is full of potholes. Sometimes we get stuck for hours, and kaukau starts to spoil before even reaching Lae"* (T3, 7 years transport experience, medium fleet operator).

Another transporter emphasized the impact of landslides and roadblocks:

> *"When there is a landslide, we can't move for days. The kaukau rots inside the truck, and we are blamed by the farmers"* (T5, 20 years in transport, large vessel operator).

Transporters also highlighted the high cost of fuel and maintenance, which they said directly influenced freight rates:

> *"Fuel prices are too high. If we don't charge more, we make no profit. But when we increase fares, farmers complain" (T2, 18 years' experience, truck driver*).

There was some variation in perspectives on responsibility for losses. Some transporters felt strongly that farmers should bear the risk once produce was loaded:

> *"Our job is only to move it. If it spoils, it's not our fault. We don't control the road or weather"* (T1, *12 years' experience, truck driver*).

Others acknowledged shared responsibility, particularly when handling practices were poor:

> *"If we overload or don't use proper ventilation, then yes, it's partly our fault. We need better cooling system for fresh produce"* (*T4, 9 years' experience, vessel operator*).

Finally, several transporters stressed the lack of cold chain facilities during long hauls and shipping:

> *"There are no refrigerated containers for kaukau. We put them in normal containers, and the heat destroys them on the way to Moresby"* (T5, large fleet operator).

4.4.2 Damage During Transport

Even when transport is secured, poor handling practices, long transit times, and lack of protective infrastructure result in great post-harvest damage. Sweet potatoes are typically packed in large 50kg feed bags with no padding and are stacked in open-back trucks or small public motor vehicles (PMVs). Without ventilation or temperature control, the tubers are exposed to fluctuating heat and humidity, which leads to bruising, softening,

and early spoilage. The longer the distance and the more delays encountered, the greater the deterioration, especially if produce sits in the sun during transit or at depots.

This kind of damage has huge effects downstream. Spoiled or softened tubers reduce the volume of marketable product and compromise farmers' reputations with urban buyers. Transporters and vendors often absorb these losses, creating distrust and reinforcing informal, short-term trading relationships. Moreover, the absence of cold chain infrastructure, no refrigerated trucks, no temporary storage further worsens this vulnerability. What emerges is a clear mismatch between the quality farmers attempt to produce and the logistical systems meant to deliver it: the supply chain lacks the physical capacity to preserve quality, thereby weakening both food security and economic returns.

With quality compromised during transport, urban wholesalers face yet another layer of difficulty, unpredictable supply volumes, inconsistent quality, and volatile prices. The next section explores how these transport-induced challenges manifest at the wholesale level, where informal sourcing practices and market access barriers further constrain the efficiency of the sweet potato supply chain.

Transport and handling are directly influenced by the quality of packing and grading decisions made at the farm level. While poor roads and long travel times are often viewed as infrastructure problems, these are compounded by how the produce is prepared. Bags overstuffed with unprotected tubers, combined with lack of cooling or ventilation, make sweet potatoes more vulnerable to damage. Transporters operate with little coordination from producers, often prioritizing speed and capacity over produce care. “Challenges experienced by transporters are detailed in Appendix B Table 9. As a result, the physical stress during travel,such as bouncing on rough roads or heat exposure, leads to spoilage before arrival at market.

4.5 Wholesaling and Market Access

The role of wholesalers in the urban supply chain, is specifically to receive, pricing, and distributing sweet potatoes sourced from multiple rural suppliers. The analysis reveals informal sourcing relationships, unpredictable supply volumes, and a lack of formal contracts or quality control systems.

These findings address Objective 2, by exposing the market access challenges created by the absence of structured trade relationships. They also contribute to Objective 3, by identifying supply inconsistencies and inefficiencies. In addition, Objective 4 is addressed through the discussion of informal trade practices that affect pricing fairness, product traceability, and food safety.

Figure 12.0 shows the key market access and distribution challenges faced by wholesalers in Port Moresby's urban markets. Themes raised by wholesalers regarding market access are outlined in Appendix B Table 6**.** Among the 15 wholesalers interviewed, inconsistent supply from farmers was the most frequently raised issue, followed closely by reliance on informal sourcing channels. These practices introduce unpredictability in both supply volumes and quality. Lack of cold storage facilities was also a common concern, as wholesalers reported difficulties in preserving sweet potatoes after delivery. The full set of codes on distribution bottlenecks is shown in Appendix B Table 3.

Other notable issues included the short shelf life upon arrival, difficulty in price negotiation with farmers and middlemen, and market congestion or intense competition. These findings show the need for better storage, formal supply agreements, and improved market coordination mechanisms to support wholesalers. Supplementary evidence on market access barriers is summarised in Appendix B Table 2**.**

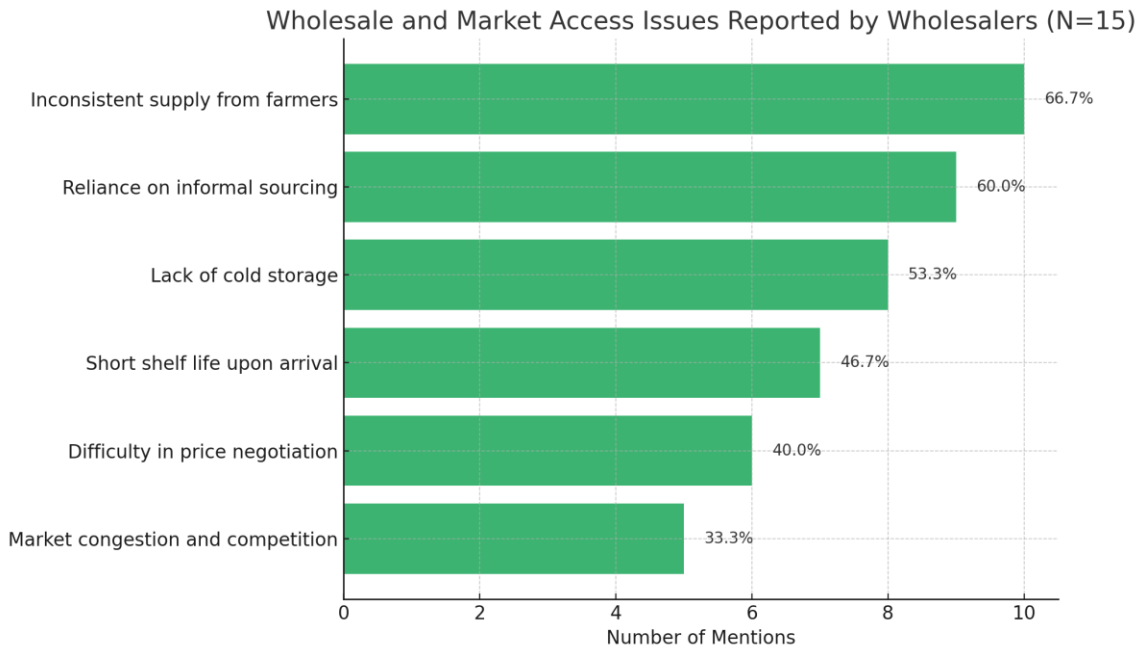


Figure 12.0 Wholesale and market access issues.

The 15 wholesalers (W1–W15) (refer to Appendix B Table 7 for wholesaler's demographic) interviewed were mainly operating in Gordons Market and Six-Mile Market in Port Moresby. Most had been in the business for 5–15 years, purchasing large volumes of sweet potatoes from transporters arriving from the Highlands and then redistributing to vendors or smaller retailers. Their scale of operations varied, with some handling 5–10 bags per week**,** while others managed truckloads of up to 50 bags**.**

A dominant issue raised by wholesalers was post-harvest damage during transport. Many complained that by the time produce arrived in Port Moresby, a significant portion was already unsellable. As one wholesaler explained:

> *"Sometimes nearly one-quarter of the bag is rotten when we open it. We must throw it away or sell very cheap"* (W6, 11 years in wholesaling, handles 60-75 bags weekly).

Another noted the lack of proper handling methods during shipping:

> *"The kaukau comes in hot containers, no air, so it sweats and spoils. We lose a lot"* (W2, 15 years wholesaling, mid-scale operator).

Pricing volatility was another recurring concern. Wholesalers described difficulty setting consistent prices because of changing supply levels and costs:

> *"One week the truck brings plenty, so the price drops. Next week nothing comes, and customers complain when we raise prices again"* (W9, 10 years wholesaling, 65-80 bags weekly).

However, perspectives varied, some wholesalers saw this fluctuation as part of doing business, while others felt it weaken trust with customers.

Storage limitations were also emphasized. Without cool storage, wholesalers had to sell quickly or face losses:

> *"We can't keep kaukau more than three days. If it doesn't sell, we lose. There is no cold room here"* (W4, 10 years wholesaling).

Despite these challenges, a few wholesalers mentioned strategies they used to cope. For instance, some resold damaged sweet potatoes cheaply to food vendors, while others diversified by selling other produce alongside sweet potatoes. As one wholesaler put it:

> *"We don't only rely on kaukau. If it goes bad, we still have banana or taro to cover the loss"* (W12, 6 years wholesaling).

4.5.1 Informal Sourcing and Supply Uncertainty

Informal sourcing through middlemen is a major weakness in Port Moresby's sweet potato supply chain. While useful for wholesalers without direct farmer links, these unregulated, non-contractual arrangements cause

inconsistent supply, delivery delays, and poor product quality. Additional data illustrating informal trade dynamics appears in Appendix B Table 4.

The lack of traceability reduces accountability, hampers quality control, and undermines food safety. Environmental disruptions such as heavy rain and poor roads further expose the fragility of the system, forcing wholesalers to react to unstable conditions. This instability discourages long-term investment and weakens market connectivity, efficiency, and consumer trust, highlighting deeper structural issues in the chain. The findings point to a deeper structural issue: informal sourcing practices may provide short-term access but introduce long-term vulnerabilities that reduce the efficiency and equity of market access for both producers and wholesalers. This aligns directly with Objectives 2, 3, and 4, revealing how weak institutional links and informal trade dynamics impair supply reliability, market connectivity, and consumer trust.

4.5.2 Price Volatility and Spoilage Losses

Price volatility and spoilage are two closely linked challenges that wholesalers in Port Moresby face because of inconsistent supply chains and limited storage options. The informal nature of sourcing, combined with unpredictable transport and weather conditions, often results in either oversupply or severe shortages. When large volumes arrive unexpectedly, wholesalers may struggle to sell perishable sweet potatoes in time, especially if the quality has already deteriorated during transit. In the absence of cold storage or inventory management systems, much of the unsold produce spoils quickly, becoming a direct financial loss. On the other hand, during periods of low supply, caused by fuel shortages, poor roads, or weather disruptions, prices increase. While this temporarily benefits some sellers, it isolates low-income consumers and destabilizes market demand. These pricing fluctuations and spoilage risks not only reduce profit margins but also undermine the predictability that both wholesalers and urban consumers rely on. Moreover, the lack of coordinated supply planning makes it difficult for wholesalers to maintain consistent pricing strategies, develop

business relationships, or support longer-term food system improvements. The findings here show how fragile logistics, informal trade arrangements, and environmental uncertainties converge to create a cycle of economic inefficiency and food loss, directly contributing to Objectives 2, 3, and 4 by emphasizing the downstream consequences of upstream weaknesses.

As sweet potatoes make their way from wholesalers into urban retail markets, the pressures of inconsistent supply, price swings, and variable quality are passed on to vendors and ultimately to consumers. The next section explores how these final actors in the supply chain, vendors and buyers, respond to these challenges through repackaging, selective purchasing, and perceptions of food safety and trust.

4.6 Vendor and Consumer Preferences

Vendors are responsible for sorting, repackaging, and selling sweet potatoes under conditions that vary in cleanliness and transparency. Consumers see quality primarily by appearance, but concerns about food safety, trust, and origin also play a role in purchase decisions.

Findings in this section align with Objective 1, by showing how poor-quality produce reaches the final consumer. They are linked to Objective 2, by reflecting urban demand expectations and access conditions. They also address Objective 4, through consumer responses to informal handling and vendor strategies that may compromise safety and fairness. “Key vendor challenges are presented in Appendix B Table 7.

4.6.1 Vendor Judgement and Repackaging

In the absence of standardized quality controls or cold storage at the retail end of the supply chain, vendors in Port Moresby markets act as the final quality gatekeepers. They rely heavily on visual, texture, and olfactory cues to assess the marketability of sweet potatoes, emphasizing indicators such as firmness, skin integrity, size, shape, and freshness. However, these evaluations are not totally based on visual appeal but serve as adaptive

strategies to manage losses and preserve customer trust. Vendors often sort produce upon arrival, repacking damaged or deteriorated tubers into smaller bundles to maintain sales volume and minimize wastage. This form of sorting reflects both a survival mechanism and a quality control system, shaped by limited infrastructure and competitive market conditions. In this way, vendors play a dual role: preserving product appeal for customers while also absorbing upstream inefficiencies caused by poor transport and inconsistent supply. Their sorting practices not only influence pricing and turnover but also directly shape consumer perceptions of food quality and safety at the point of sale, linking back to Objective 1 on post-harvest quality and Objective 4 on informal trade impacts.

Figure 13.0 illustrates key challenges and practices by vendors in Port Moresby's urban markets. Out of 15 vendors interviewed, the most cited issue was that quality is judged primarily by appearance with vendors relying heavily on visual appearance such as skin colour, firmness, and size to determine market value. Repackaging of sweet potatoes was another frequent practice, often done to present mixed-quality tubers more attractively and improve sales, but it also contributed to customer complaints about spoilage. Additionally, several vendors acknowledged that they rely solely on visual inspection, lacking formal training or tools to assess internal quality. Lack of proper storage facilities at market stalls was also a concern, leading to faster deterioration of the product. The percentages shown are based on the number of vendor participants (N=15), and reflect total mentions and not unique individuals, allowing for multiple responses per vendor (refer to Appendix B,Table 13 for vendors demographic).

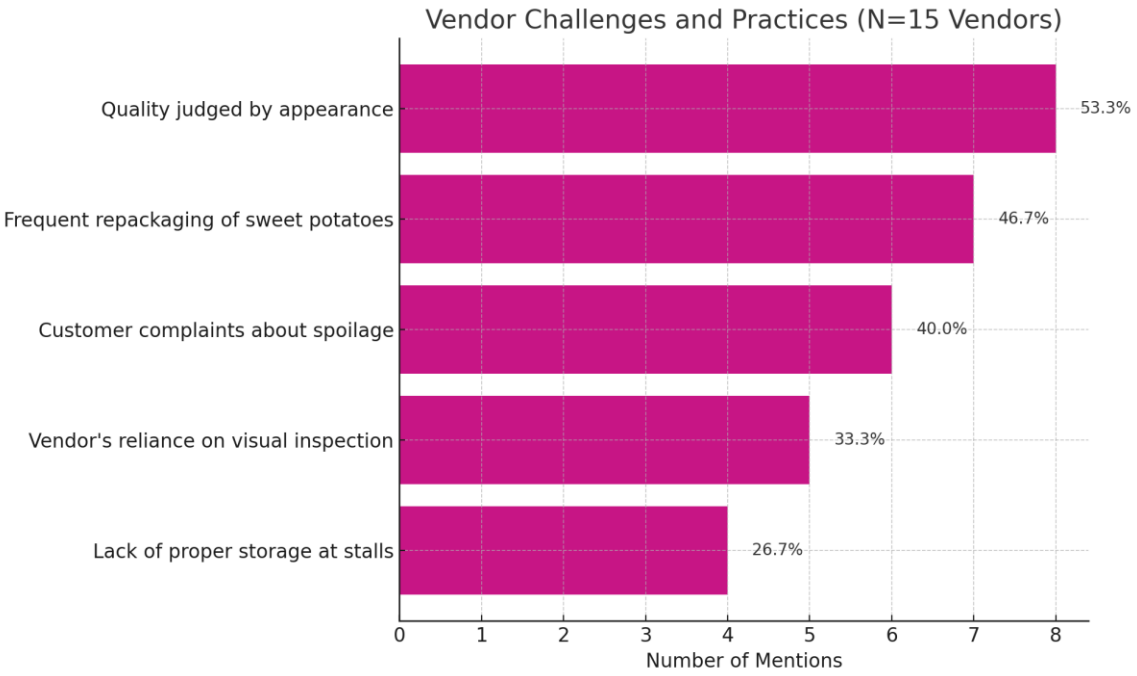


Figure 13.0 Vendor challenges and practices.

A dominant concern was spoilage and quality loss during the marketing period. Many vendors explained that sweet potatoes often arrived already damaged and continued to deteriorate quickly without proper facilities:

> *"Sometimes the kaukau comes already soft and rotten from the truck. We still try to sell, but customers don't want it"* (V4).

> *"If it rains and the kaukau is wet, by the next day it starts to smell, and we lose money"* (V11).

In terms of consumer preferences, vendors highlighted mixed experiences. Some observed that customers preferred larger tubers for value:

> *"Big kaukau sells faster because people feel it's worth the K10"* (V3).

Others argued the opposite, noting that smaller, cheaper bundles moved more quickly:

"Mothers want small bundles for K2 or K5 , those sell out first" (V8).

This contrast illustrates the variation in market demand, influenced by consumers' purchasing power and household needs.

Competition among vendors was also raised as a challenge. Several participants described how oversupply in markets like Gordons and Boroko forced them to drop prices:

"Too many of us are selling the same kaukau. We end up cutting prices and still cannot finish" (V6).

A few vendors linked this competition to middlemen practices:

"The wholesalers bring in big loads, and we small sellers struggle to keep up" (V14).

Finally, vendors repeatedly emphasized the lack of proper storage and market infrastructure as a constraint. With no cool storage or covered spaces, they relied on makeshift methods:

"We just put kaukau under canvas. If the sun is hot, it cooks them, and they spoil" (V1).

4.6.2 Consumer Buying Behavior and Safety Concerns

Consumer preferences in Port Moresby reflect both economic constraints and evolving expectations around food quality and safety. While price sensitivity remains high, driven by fluctuating supply and market conditions, buyers consistently prioritize visual freshness, firmness, and color when selecting sweet potatoes. These preferences are closely aligned with vendor practices, indicating that consumers are highly responsive to the way produce is displayed and presented. However, deeper factors such as trust and familiarity with specific vendors also strongly influence purchasing decisions. Many consumers rely on long-standing relationships with

sellers, using personal rapport as a stand-in for product safety and quality assurance in a market where there is no traceability. When prices increase, buyers often reduce quantities, shift to more affordable markets, or delay purchases entirely, demonstrating how disruptions in supply directly affect dietary habits and food access. These findings address Objectives 2 and 4, showing how limited consumer protections and informal vendor-consumer relationships serve as coping mechanisms within a poorly enforced food environment. Consumer perspectives are summarized in Appendix B Table 8.

Key concerns raised by consumers (Figure 14.0) regarding sweet potato quality and market experiences in Port Moresby's urban markets. Of the 15 consumers interviewed, the most frequently mentioned issue was high sensitivity to price fluctuations, with many expressing frustrations over inconsistent pricing that limited their buying options. Concerns about food safety and hygiene were also prevalent, particularly in relation to the handling and storage of produce in open markets. An equal number of participants noted a lack of trust in vendor claims about quality and freshness, as there were no labels or transparency regarding the origin or handling of the produce. Spoilage after purchase was a common complaint, suggesting poor post-harvest management prior to retail. Additionally, some consumers admitted they had no awareness of where the sweet potatoes were sourced, indicating a broader traceability gap. These insights demonstrate the importance of transparency, traceability, and better vendor-consumer communication to restore trust and improve consumer satisfaction.

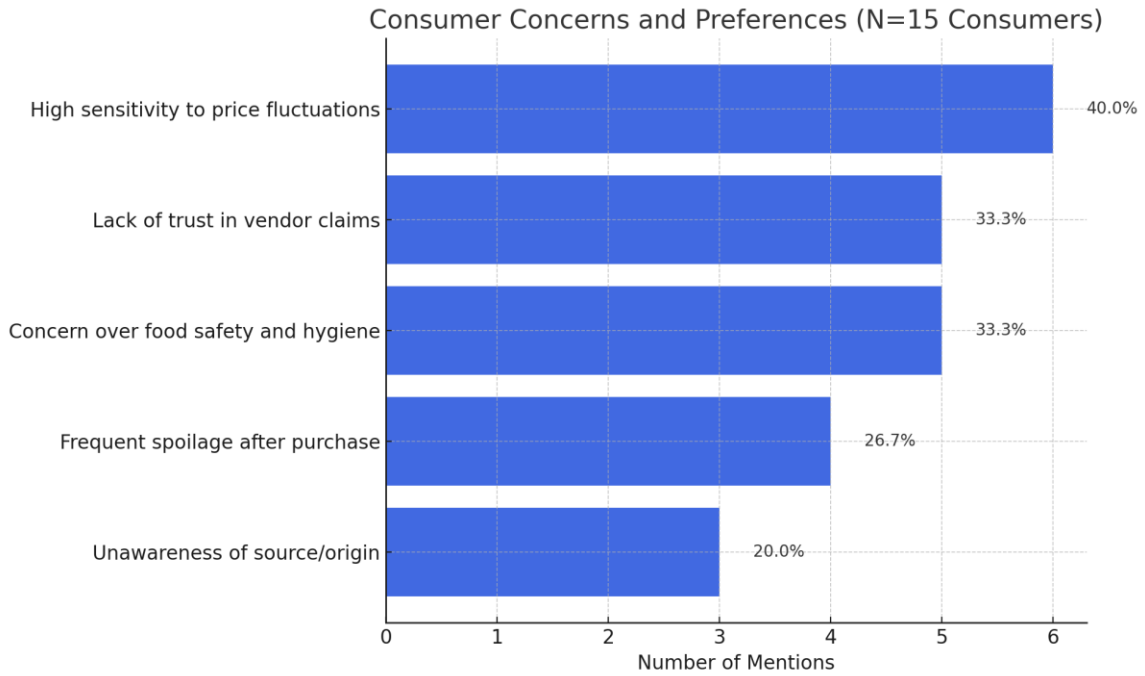


Figure 14.0 Consumer concern and preferences

The 15 consumers interviewed (C1–C15) were based in Port Moresby and represented a mix of household buyers, working parents, and informal food vendors who purchased sweet potatoes for resale or home consumption. Their ages ranged from 25 to 55 years, with household sizes typically between 5–8 members (refere Appendix B, Table 24 for consumers demographic)**.** Most reported buying sweet potatoes at least twice a week**,** making them regular customers in the urban markets.

A common theme across consumers was concern about fluctuating prices**.** Many said that the cost of sweet potatoes had increased significantly compared to previous years, putting pressure on household budgets. One consumer explained:

> *"Sometimes the price is K10 for a small pile. Before, that same pile was only K5. It's too much now, especially for big families"* (C5, mother of 6).

Another consumer linked high prices to fuel costs and transport:

"When fuel goes up, the kaukau price also goes up. We don't know what the real price should be" (C12, 42 years, employed father).

In terms of quality, consumers expressed frustration with spoilage and inconsistency. Several said they often encountered rotten tubers hidden in market piles:

"When I get home and open the pile, half of it is rotten. We feel cheated" (C2, 29 years, food vendor).

Others emphasized appearance as an indicator of quality:

"I look for the ones that are clean and not bruised. If the skin is broken, it won't last even one day" (C7, 35 years, household buyer).

There was some variation in consumer preferences**.** While some preferred large tubers for value, others said smaller ones were easier to cook and portion:

"Big kaukau is good for sharing, but I like the small ones because they cook fast and don't waste" (C9, 27 years, working mother).

A few consumers even expressed willingness to pay a higher price for better quality and freshness**:**

"If it is fresh and clean, I don't mind paying extra. At least I know it will last until tomorrow" (C14, 50 years, office worker).

Vendors and consumers, positioned at the end of the supply chain, compensate for upstream deficiencies. Vendors often receive mixed-quality produce and mitigate spoilage by sorting, discarding, or repackaging damaged tubers. These strategies are not a solution but a reflection of failures earlier in the chain, especially in

harvesting, packing, and transport. Consumers, in turn, assess quality through physical appearance, firmness, and freshness, relying on trust rather than certification or traceability. This reinforces a market system where trust replaces standards, and repeat purchases depend more on individual vendor reputation than verified quality. In effect, vendors and consumers carry the burden of quality assurance, even though they have the least control over production or logistics. This imbalance illustrates how informal coping mechanisms mask systemic inefficiencies, allowing deeper problems in production and transport to persist unchecked.

Across every level of the sweet potato supply chain from production and transport to retail and consumption, certain recurring structural issues continue to affect quality, efficiency, and trust. The following section explores these cross-cutting challenges, such as the dominance of informal trade, environmental vulnerabilities, and weak institutional coordination, which compound the inefficiencies and losses observed at each stage.

4.7 Cross-Cutting Issues

This final section identifies broader systemic challenges that affect all actors in the sweet potato supply chain. These include widespread informality, lack of training or support services, absence of regulation, and environmental factors such as heat and humidity that worsen spoilage.

The data here reinforces Objective 1, by showing the cumulative impact of uncoordinated practices on quality loss. It supports Objective 3, by highlighting inefficiencies across multiple distribution points. Objective 4 is evident in the widespread reliance on informal trade, and Objective 5 is supported through identifying critical gaps were targeted solutions, such as training, storage infrastructure, or coordination mechanisms could strengthen the entire supply chain.

Figure 15.0 summarizes the extensive issues that cut across all stages of the sweet potato supply chain, as reported by stakeholders from production to consumption (N=68). The most prominent concern was the lack of standards and quality grading mechanisms, which hinders consistency and value assessment in markets.

Closely related was system-wide informality, where transactions occur without proper records, agreements, or accountability, creating vulnerabilities for both sellers and buyers. Traceability gaps were also noted as a key limitation, particularly by government and retail stakeholders, who noted the absence of clear information about origin, handling, and quality assurance. Environmental stressors such as heat and rain were frequently cited as uncontrollable but critical factors affecting post-harvest losses. Other persistent concerns included coordination breakdowns among actors and a lack of training and capacity-building efforts. These cross-cutting issues point to systemic weaknesses that require multi-level interventions to build a more resilient and efficient sweet potato supply chain.

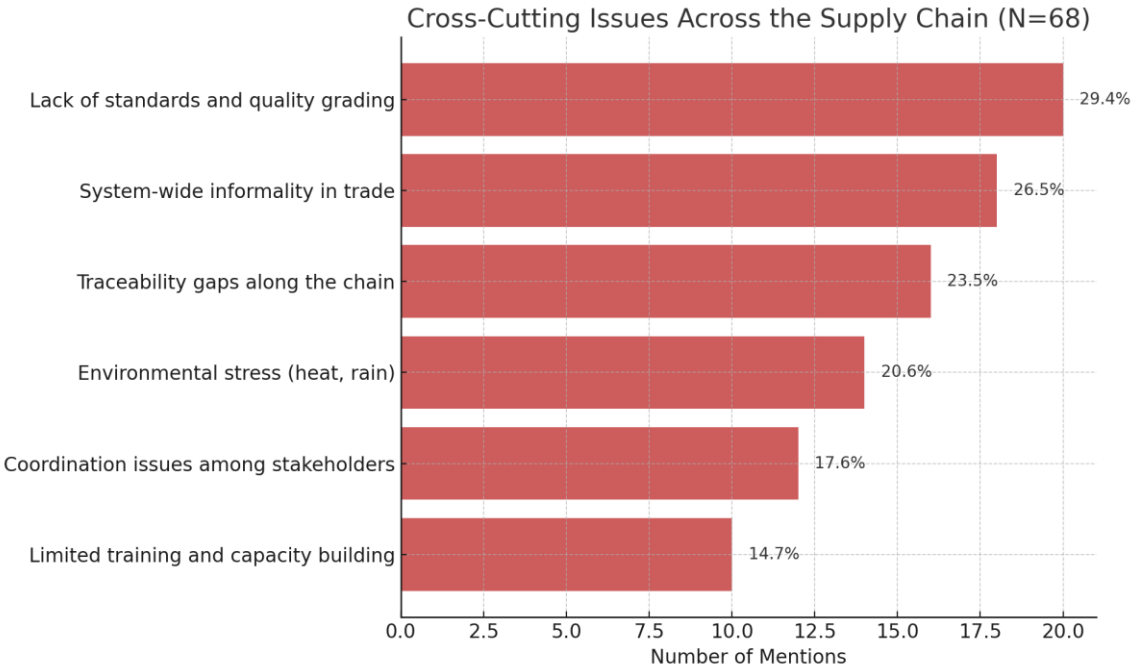


Figure 15.0 Cross cutting issues across supply chain.

4.7.1 System-wide Informality and Traceability Gaps

Across the chain, trade is dominated by informal arrangements, no contracts, receipts, or shared quality standards, which create problems about origin, handling, and liability. This informality lowers transaction costs

in the short term but carries risk: when quality problems emerge (bruising, rot, contamination), neither cause nor remedy can be reliably identified. The result is a pattern of reactive behaviour, wholesalers avoid with opportunistic buying, vendors prioritize produce at stalls, and consumers rely on personal trust rather than product information. This system weakens incentives to invest in better post-harvest practices (Objective 1), establishes distribution bottlenecks by preventing coordinated scheduling (Objective 3), elevates pricing opacity and food-safety risk (Objective 4), and signals were targeted formalization, basic record-keeping, simple grading tickets, or source labeling, could produce out-sized improvements (Objective 5).

4.7.2 Environmental Stress and Perishability

Heat, humidity, and extended time in transit magnify the crop's perishability. Without shade, ventilation, or temperature moderation, tubers experience compression injury and rapid physiological breakdown, especially when packed tightly in 50 kg bags. These conditions convert minor handling defects at harvest into visible decay by the time produce reaches urban markets. Because exposure points occur at multiple nodes (farm, roadside loading, wharf, market), losses compound non-linearly rather than additively. This explains why stakeholders report sharp quality deterioration even when individual steps seem "manageable." The finding directly addresses Objective 1 (mapping drivers of quality loss) and motivates Objective 5 (practical mitigation such as low-cost liners).

4.7.3 Coordination and Capability Gaps

Interview evidence indicates limited shared routines such as no agreed loading times, inconsistent bag weights, ad-hoc pricing, and minimal feedback loops on rejected stock. Absent simple coordination mechanisms (e.g., weekly run schedules, basic size/defect grades), actors optimize locally: farmers prioritize size/appearance; transporters maximize load; wholesalers chase immediate availability; vendors repackage to recover value. These misaligned incentives create a problem where system efficiency remains low despite high individual

effort. Capability gaps, particularly in post-harvest handling, basic quality assurance, and business record-keeping, further constrain improvement. Addressing these gaps tackles Objective 3 and Objective 5 .

Taking together, these cross-cutting issues reveal reinforcing feedback: informality, weak traceability, low accountability, limited investment; environmental stressors, accelerated loss , defensive sorting/repacking ,consumer distrust; coordination gaps , volatile volumes/prices, short-term tactics . This system's view clarifies why quality deteriorates despite farmers' awareness of market preferences and why downstream actors shoulder spoilage and price risk. It also indicates leverage points: minimal formalization (source labels, simple grade bands), micro-infrastructure (shade, ventilation,), and routine coordination that collectively improve quality, predictability, and fairness across the chain.

4.8 Summary of Findings

This chapter has mapped the flow of sweet potatoes through the Port Moresby supply chain, from rural production to urban consumption, identifying critical points of quality loss, access challenges, and inefficiencies. Using a supply chain framework, the results demonstrate that while stakeholders at each stage play a role in maintaining value, systemic weaknesses, especially in coordination, infrastructure, and formalization, undermine overall performance.

Chapter 5: Discussion

5.1 Introduction

This chapter interprets the findings in relation to the five research questions, the literature reviewed in Chapter 2, and the agricultural value-chain framework adopted for the study. The purpose of the discussion is to move beyond description of what participants reported and explain what the findings mean for the performance of the sweet potato supply chain in Port Moresby. The findings indicate that post-harvest loss, market access constraints, distribution bottlenecks and informal trading practices are not independent problems. Rather, they interact across the chain, so a weakness at one stage can increase the likelihood or cost of failure at another stage.

The value-chain perspective is particularly useful for interpreting this pattern because value is created, transferred and lost through a sequence of interconnected activities and relationships (Porter, 1985; Kaplinsky & Morris, 2001). In this study, quality begins with harvesting and packing, but its preservation depends on transport, storage, wholesale handling, retail practices and consumer acceptance. The findings therefore support a systems interpretation in which the condition of the product at the market is the accumulated outcome of decisions and constraints experienced along the route from the Highlands to Port Moresby.

The discussion is organised around the major findings rather than simply repeating the order of the Results chapter. Section 5.2 interprets post-harvest quality loss and explains why damage accumulates across stages. Section 5.3 examines market access and the interaction between transport costs, information, credit and intermediaries. Section 5.4 considers distribution bottlenecks, including road, maritime, port and urban-market constraints. Section 5.5 discusses informal trade as both an enabling mechanism and a source of weak accountability. Section 5.6 examines how consumer perceptions and price sensitivity transmit market pressure upstream. Section 5.7 then considers gender, climate and socio-economic conditions as cross-cutting factors that shape exposure to these constraints.

A central contribution of the study is therefore not simply the identification of individual constraints, many of which are already documented in PNG, but the explanation of how they interact in the Port Moresby-bound supply chain. The findings suggest that interventions focused on only one node are unlikely to deliver sustained improvements if the constraints at connected nodes remain unchanged.

5.2 Post-Harvest Quality Loss

The study found that post-harvest quality loss is a cumulative process rather than a single event. Farmers reported bruising and damage during harvesting and packing; transporters described physical stress, heat exposure and delays; wholesalers reported receiving produce with reduced shelf life; and vendors described further deterioration before sale. This finding is consistent with the wider literature showing that sweet potato losses are strongly associated with handling, storage and transport conditions (Chang & Spriggs, 2007; Parmar et al., 2017; Shee et al., 2019). The important implication is that the quality observed by consumers in Port Moresby is partly determined long before the produce reaches the retail stall.

The use of reused 50 kg feed bags without cushioning illustrates how an apparently low-cost practice can create costs later in the chain. Heavy loading and limited protection increase the likelihood of mechanical injury, while prolonged exposure to heat and humidity can accelerate deterioration. Previous research has identified mechanical damage and inadequate post-harvest management as important causes of sweet potato losses in PNG and other developing-country settings (Chang et al., 2007; Parmar et al., 2017). The present findings extend this understanding by showing how small injuries can become economically significant when the product subsequently experiences additional handling and long transit times.

An important interpretation concerns the role of farmer knowledge. The findings do not support a simple conclusion that losses occur because farmers are unaware of good practices. Some participants understood the importance of careful handling and curing but lacked suitable materials, storage space, labour or sufficiently

predictable transport schedules to implement these practices consistently. This distinction is important because a training-only intervention may have limited effect where the physical and economic conditions required to apply the training are absent. Shee et al. (2019) similarly demonstrate that post-harvest losses are associated with socio-economic and handling conditions, while Stathers et al. (2024) show that storage interventions can improve the period for which sweet potato remains suitable, although handling and environmental conditions continue to matter.

The study also demonstrates that quality loss is partly market-defined. Vendors reported that consumers reject roots with visible bruising, cracking or other defects, even where the damage may not necessarily make the product unsafe or nutritionally worthless. This is consistent with Villano et al. (2016), who found that consumer willingness to pay in PNG is influenced by quality attributes. Thus, a physical defect becomes an economic loss when it reduces the price or makes the product unsaleable. The finding links post-harvest management directly to market behaviour: preserving appearance is not merely a technical objective but an important condition for maintaining value.

The combination of road and maritime transport is particularly significant in the Port Moresby case. The supply route described by participants involves repeated loading, unloading, storage and exposure to environmental conditions. Consequently, a bruise sustained during the first transport leg can deteriorate further during subsequent handling. This provides a more integrated explanation of the high loss perceptions reported by participants than treating each transport stage separately. It also explains why improving farm-level handling alone would be insufficient if the subsequent logistics system continues to expose produce to heat, compression and delay.

Overall, the findings answer Research Question 1 by showing that the principal sources of quality deterioration occur across several linked stages: harvesting and packing, transport, storage and retail handling. The practical

implication is that loss reduction should combine improved harvesting and packing practices with affordable protective materials, shaded or ventilated storage, better transport coordination and appropriate consumer information. This is more consistent with a value-chain approach than a narrow focus on farmer behaviour alone.

5.3 Market Access Constraints

The findings show that market access is not simply the ability to reach a physical market. For the farmers interviewed, meaningful market access also depended on whether they could transport produce at a cost that left a reasonable return, obtain timely information about prices and demand, and negotiate with buyers from a position of reasonable bargaining power. This interpretation is consistent with the literature showing that infrastructure, collective action and market relationships shape smallholder participation in agricultural markets (Mutai et al., 2013; Candemir et al., 2021).

Transport costs were particularly important because they operate in two ways. First, high freight costs reduce the net price received by farmers. Second, unreliable transport increases the risk that produce will deteriorate before sale. Farmers may therefore face a choice between selling earlier at a lower local price or paying to reach Port Moresby while accepting a greater risk of loss. The findings consequently suggest that distance is not only a geographical problem; it is an economic risk that influences farmers' decisions about whether to participate in the urban market at all. This helps explain why some participants preferred local sales despite recognising that Port Moresby could offer higher prices.

The role of intermediaries requires a more balanced interpretation. Previous literature often identifies middlemen as a source of reduced farmer bargaining power (Chang et al., 2013a; De Bock et al., 2019). The present study supports the concern about bargaining power but also shows why intermediaries remain important. Participants described intermediaries as actors who may arrange transport, provide advance payments, connect farmers with urban buyers and assume some risk when produce deteriorates. In a supply chain where formal market institutions

are limited, these services have real economic value. The issue is therefore not that intermediaries exist, but that the functions they perform are largely informal and may not be accompanied by transparent pricing, quality standards or clear accountability.

This interpretation also helps explain the limited development of collective marketing arrangements. Literature from other developing-country settings indicates that collective action and cooperatives can strengthen bargaining power and reduce transaction costs (Mutai et al., 2013; Candemir et al., 2021). However, collective structures cannot simply be transferred into PNG without considering existing social relationships and trust networks. A more realistic approach may be to strengthen producer groups around specific functions such as bulk transport, shared packaging, market information and negotiated sales while retaining flexibility for farmers who already depend on informal networks.

Access to market information and finance further compounds the problem. Participants indicated that they often lacked reliable, timely information about Port Moresby prices and demand. The literature similarly identifies information visibility as important for decision-making (Nguyen, 2021). However, the findings indicate that information alone cannot solve the problem. A farmer may know the Port Moresby price but still be unable to benefit from it if transport is too expensive, storage is unavailable, or the produce cannot survive the journey. Market information therefore needs to be considered as one component of a wider market-access system rather than as a stand-alone intervention.

The findings answer Research Question 2 by demonstrating that market access is constrained by interacting physical, financial, informational and relational barriers. These barriers reduce farmers' ability to choose among buyers and markets and can shift more value and risk toward downstream actors. Improving market access therefore requires a combination of reliable transport, appropriate financial services, timely market information

and stronger forms of collective bargaining or coordination, rather than simply creating additional outlets for selling produce.

5.4 Distribution Bottlenecks

The interviews made it clear that distribution problems sit at the centre of many losses in the sweet potato supply chain. People involved at every stage, farmers, transport operators, wholesalers, and vendors, spoke about delays and disruptions that they had come to expect. Some mentioned shipping schedules that changed without warning; others talked about rural roads that had deteriorated to the point where trucks crawled for hours. Port congestion and inconsistent handling practices added another layer of uncertainty. By the time sweet potatoes reached Port Moresby, they often showed signs of bruising or early decay, which shortened their shelf life and forced vendors to sell at reduced prices.

These observations echo earlier research in PNG that shows transport and logistics weaknesses as long-standing barriers to maintaining produce quality (Chang, 2018; Wera, 2017a). What this study adds, however, is a clearer sense of how these problems accumulate. Farmers described tubers being damaged on the rough trip from the Highlands to Lae. Transporters then spoke about delays at the port or heat exposure during shipping. Vendors, at the final stage, dealt with additional handling damage when containers were offloaded. When these small issues stack up, the result is a cascading deterioration process: a bruise from the first leg of the journey becomes full spoilage by the time the produce reaches the market.

In many developing countries, post-harvest losses are usually blamed on poor rural roads or the absence of cold storage. PNG's situation is different. The supply chain depends on a combination of long road travel and maritime transport, and the two systems do not always align. Sweet potatoes must survive both modes, each with its own stressors, and there is little coordination between them. This dual-transport reliance creates a

sequence of risks that amplify one another. The finding challenges the assumption, common in value chain literature, that transport networks operate in a linear and predictable way.

Institutional bottlenecks appeared as another major source of disruption. Vendors and transporters repeatedly mentioned delays linked to port procedures, unclear offloading schedules, and inconsistent enforcement of inspection rules. The National Research Institute (2023) has noted the regulatory burden placed on small-scale agricultural traders, but the interviews here show how these delays translate directly into spoilage. Several vendors described situations where containers sat idle in the heat because paperwork had not been cleared, and by the time they gained access, the tubers had already deteriorated.

A closer look suggests that these institutional issues stem from deeper structural constraints. Regulatory agencies often operate with limited staff, outdated or partially digitised scheduling systems, and overlapping responsibilities between inspection and clearance authorities. This fragmentation creates uncertainty and inconsistent enforcement across ports. In that sense, poor coordination is both a cause and a symptom: it causes delays, but it also reflects broader resource limitations that make systematic improvement difficult. Addressing these problems will require more than procedural tweaks. It will involve building capacity, clearer protocols between agencies, investment in digital tracking systems, and stronger accountability mechanisms.

The findings also mention tensions that are not always acknowledged in the literature. While infrastructure problems are frequently blamed for distribution failures, transporters in this study argued that coordination breakdowns between supply chain actors were just as damaging. They described farmers arriving late with produce, shipping schedules being miscommunicated, and wholesalers failing to prepare storage areas in time. These examples point to governance and communication weaknesses within the supply chain, not just physical constraints.

Urban distribution challenges added yet another layer. Vendors in Port Moresby spoke about congestion at market entry points, competition for shaded selling spaces, and the lack of secure temporary storage. Similar issues appear in some Pacific studies (e.g., Sharma et al., 2021), but Port Moresby's rapid growth seems to intensify them. The study therefore identifies a gap between rising urban demand and limited investment in market infrastructure, an issue that receives relatively little attention in PNG-focused research.

Overall, the findings show that distribution bottlenecks in PNG are not isolated logistical problems. They arise from the interaction of infrastructure weaknesses, coordination failures, and regulatory constraints. The country's reliance on both road and maritime transport, combined with fragmented relationships among supply chain actors, creates compounding vulnerabilities. Improving distribution will require integrated planning, better coordination, and stronger port and market management systems, not just more roads or more storage facilities.

5.5 Informal Trade and Market Dynamics

Informal trade is central to the functioning of the sweet potato supply chain in Port Moresby. The findings show that verbal agreements, personal relationships and intermediary networks allow produce to move despite limited formal contracts, weak market information and limited access to finance. This is consistent with literature describing the importance of informal intermediaries in agricultural markets in developing countries (Chang et al., 2013a; De Bock et al., 2019). Informality should therefore not automatically be interpreted as market failure; in this context it performs important coordination and risk-sharing functions.

At the same time, the same characteristics that make informal trade flexible can create weaknesses. Without written records, standardised grades or clear responsibilities, it becomes difficult to determine where damage occurred, who should bear the loss, or whether the price paid reflects differences in quality. Schanbacher et al. (2021) and related PNG value-chain literature show the implications of weak accountability and informal market structures. The present findings show how this lack of formalisation is experienced in everyday transactions: damaged produce may be accepted because of a personal relationship, while disputes over quality or payment have few formal mechanisms for resolution.

Earlier studies in PNG have already noted the dominance of informal intermediaries and the lack of standardised quality controls (Chang et al., 2013a; De Bock et al., 2019). What this study adds is a clearer sense of why informality persists. It is not simply because formal systems are absent; it is because the formal options that do exist, credit services, wholesale markets, regulated logistics, are either too costly, too slow, or too inaccessible for most smallholders. Farmers repeatedly said that intermediaries were the only actors willing to offer advance payments, cover freight costs, or take on the risk of spoilage. These are not small contributions. They help explain why intermediaries remain central, even when their practices are uneven or sometimes exploitative.

Quality variation emerged as a major issue tied to informality. Without grading standards, sweet potatoes from different farms are often mixed and packed without sorting. Vendors said this regularly led to complaints from customers, especially when damaged tubers were sold alongside better ones. Schanbacher et al. (2021) argue that informality weakens traceability and quality assurance, and the findings here support that. But the study also shows that Port Moresby's consumers are particularly sensitive to appearance, which means even small defects can lead to large revenue losses. Vendors described situations where a few bruised tubers in a bag caused buyers to reject the entire lot.

Competition within informal markets adds another layer of pressure. Vendors talked about rushing to secure good stall spaces, lowering prices to keep up with neighbours, and selling quickly before spoilage set in. These situations are common in many low-income urban markets, but Port Moresby has its own twist: access to physical market space is often socially negotiated. Getting a shaded stall or a high-traffic spot sometimes depends on personal relationships, informal payments, or long-standing arrangements with market managers. In this way, informality shapes not only transactions but also who gets access to the physical infrastructure that protects product quality.

One of the most striking themes in the interviews was the tension between social obligation and economic logic. Trade in Port Moresby is deeply tied to wantok networks, where kinship and clan relationships guide commercial decisions. Several vendors said they bought sweet potatoes only from relatives or clan-linked middlemen, even when other suppliers offered better quality or lower prices. One vendor explained that changing suppliers would be seen as disrespectful and could damage family relationships. In this case, loyalty outweighed profit, even though the vendor repeatedly absorbed losses from poor-quality produce.

These social obligations can stabilise trade by reducing transaction costs and providing informal safety nets, credit, delayed payments, or help during difficult periods. But they can also trap people in arrangements that are inefficient or unfair. Vendors described accepting losses rather than confronting a relative about poor-quality produce, because doing so risked long-term social tension. This shows that informality is not only flexible; it also shifts risk downward, often onto the smallest actors in the chain.

The study also mentions structural weaknesses within the informal model. Without documentation or enforceable agreements, disputes rarely go anywhere. Vendors who received damaged produce often lacked the

leverage to demand compensation. Farmers, on the other hand, expressed frustration when intermediaries delayed payments or changed agreed prices without explanation. Over time, these unresolved issues reduce trust and make the supply chain more volatile.

The findings show that informal trade in Port Moresby is both essential and problematic. It keeps the supply chain functioning in the absence of strong formal systems, but it also produces unstable prices, inconsistent quality, and limited accountability. Importantly, informality is not just a technical issue,it is a socially embedded system shaped by cultural expectations and power imbalances. This suggests that policy interventions should aim to strengthen, rather than replace, informal systems. Structured market spaces, voluntary grading schemes, simple micro-contracts, or vendor cooperatives could help introduce more predictability while preserving the flexibility and social foundations that make informality workable for smallholders.

5.6 Consumer Perceptions and Pricing

Consumer behavior is an important mechanism through which supply-chain problems become economic outcomes. The study found that consumers commonly assessed sweet potato using visible characteristics such as freshness, firmness, size, colour and absence of bruising, while also responding strongly to price. This supports Villano et al. (2016), who found that quality attributes influence willingness to pay for sweet potato in PNG. Vendors repeatedly explained that customers focus on freshness, shape, uniformity, and the absence of blemishes. Even small cracks, bruises, or early signs of rot often lead buyers to reject a tuber altogether. This strong focus on appearance shapes how vendors judge quality and influence the way farmers and middlemen sort, package, and prepare sweet potatoes before they reach the market.

The finding is significant because it demonstrates that quality loss is not complete when a tuber is physically damaged; its economic effect depends on how buyers respond to that damage.

The findings show a clear connection between upstream handling and downstream purchasing. Bruising that occurs during harvesting or transport may appear minor at the point of origin but can become a major loss when the consumer rejects the product. Vendors therefore respond by sorting, repackaging or discounting. This creates a transmission mechanism through which physical losses are converted into price losses and, ultimately, lower returns for farmers and sellers. The consumer is therefore not simply the final recipient of the supply chain but an actor whose preferences influence decisions at earlier stages.

The findings show that people buying sweet potatoes in Port Moresby are strongly influenced by how the produce looks and how much it costs.

These observations align with earlier studies describing PNG consumers as highly appearance-driven with little tolerance for imperfections. What this study adds is a clearer picture of how these preferences interact with challenges earlier in the supply chain. Sweet potatoes travel long distances by road and sea, and small injuries picked up along the way often worsen by the time they reach Port Moresby. As a result, consumer behaviour amplifies problems that begin much earlier in the chain, turning minor damage into significant economic losses. This connection between consumer expectations and upstream vulnerabilities is rarely talked about in existing literature, yet it plays a major role in how the supply chain performs.

From the study, it was seen that Port Moresby consumers are extremely price-sensitive. Vendors described how even small price increases can cause buyers to cut back, switch to rice, or buy only a few pieces. While previous research already notes strong price elasticity in PNG sweet potato markets, this study reveals an important interaction: price sensitivity becomes even stronger when quality drops. If produce arrives looking tired or damaged due to delays or rough handling, consumers are even less willing to pay normal prices, forcing

vendors to discount heavily. This creates a cycle where poor supply chain performance fuels market instability, hitting small vendors hardest because they have little room to absorb losses.

Another emerging trend is the growing interest in orange-fleshed sweet potatoes (OFSP). Vendors reported that more customers are asking for these varieties because they believe they offer better health benefits. Although similar patterns have been noted elsewhere in the Pacific, this study shows a key challenge in PNG: farmers and intermediaries often lack the information or capacity to respond to changing consumer tastes. Without reliable market information, many farmers remain unaware of rising urban demand for higher-value varieties, missing opportunities to supply what the market increasingly wants.

The findings also reveal a strong contradiction. While consumers are quick to reject sweet potatoes with visible blemishes, many do not realise that these imperfections rarely affect nutritional value. Vendors noted that tubers with minor marks, still perfectly healthy to eat, were routinely rejected, even at discounted prices. This shows that cosmetic standards, rather than nutritional considerations, drive purchasing decisions. As a result, nutritious food is wasted, and farmers and vendors bear unnecessary financial losses. This points to a need for consumer education that challenges misconceptions about external defects.

A further tension emerges in the gap between what consumers expect and what they are willing to pay for. Buyers want high-quality produce but are reluctant to pay prices that would support better storage, packaging, or transport systems. This mismatch places ongoing pressure on farmers and vendors, who struggle to meet expectations without the financial support needed to improve supply chain conditions.

Overall, the findings show that consumer perceptions and pricing behaviour are not just end-point issues,they shape the entire sweet potato supply chain. Appearance-driven demand and strong price sensitivity interact with weaknesses in handling, transport, and coordination, magnifying losses and creating instability in Port

Moresby's markets. Compared with other developing contexts, PNG's urban consumers place unusually high value on visual quality without equivalent investment in the systems required to maintain it. Strengthening consumer awareness, introducing clearer quality standards, and improving supply consistency could help stabilise the market and better align farmer incentives with what buyers want.

5.7 Intersecting Vulnerabilities (Gender, Climate Change, Socio-Economic Factors)

The findings indicate that gender, climate and socio-economic conditions do not operate as separate background variables. They influence who can access transport, market space, finance, information and quality-preserving infrastructure, and therefore shape the extent to which different actors can respond to supply-chain constraints. This interpretation is consistent with value-chain research that emphasises the importance of power, access to resources and institutional relationships in determining who benefits from agricultural markets (Kaplinsky & Morris, 2001; Kosec et al., 2022).

The significance of these factors is that the same supply-chain disruption can have different consequences for different actors. A farmer with access to a vehicle may respond to a transport disruption differently from a farmer dependent on hired transport. A vendor with secure shaded space may protect produce more effectively than one selling in an exposed location. Similarly, actors with access to credit can absorb a temporary loss more easily than those operating with very limited working capital. Vulnerability is therefore produced by the interaction between the physical supply chain and the resources available to cope with disruption.

5.7.1 Gender and Market Participation

Women play central roles in sweet potato production, trading, and retailing in Port Moresby's markets, yet the findings show that they face disproportionate barriers compared to men. Female vendors reported difficulties

securing safe transport, accessing capital, and obtaining shaded or permanent selling spaces. These constraints directly affect post-harvest quality: women who cannot travel at night due to safety concerns often arrive later at the market, when storage space is limited and heat exposure is higher. This increases spoilage and reduces selling time.

Existing literature confirms that women in PNG face structural disadvantages linked to land access, mobility restrictions and market insecurity (Chang et al., 2010; Koczberski, 2012; Kosec et al., 2022). However, this study provides new insight into how these disadvantages translate into product loss. For example, women described being pushed into open-air stalls without shade, accelerating tuber dehydration and rot. This intersection of gender and quality loss is not emphasized in prior value chain research, which often treats gender as a separate social concern rather than a factor directly affecting product outcomes.

These findings suggest that interventions improving post-harvest handling will be ineffective unless gender disparities in market access, safety, and resource control are simultaneously addressed.

5.7.2 Climate Change Impacts Across the Chain

Climate variability intensifies the supply chain challenges documented earlier. Farmers and transporters explained that heavy rainfall worsened road conditions, slowed transport, and increased tuber bruising during overland travel. High temperatures in Port Moresby markets accelerated sprouting and microbial decay due to the absence of cold storage. Vendors described that during prolonged wet seasons, sweet potatoes arrived already softened or cracked, resulting in faster rejection by consumers.

These findings support research identifying climate change as a major threat to root crop systems in PNG (Stice & McGregor, 2016; Bourke, 2018). However, this study adds depth by showing how climate impacts accumulate across multiple nodes. In PNG's dual-mode transport system, rainfall-induced road damage in the

Highlands delays shipping schedules in Lae; in turn, shipping delays expose tubers to heat and humidity on the wharf, compounding early-stage deterioration. This links climatic shocks to the transport and distribution inefficiencies identified in Sections 5.2 and 5.4.

In contrast to many landlocked countries where alternative routes may exist, PNG's geographic isolation means that disruptions at any point of the road–sea pathway create unavoidable bottlenecks. This makes climate adaptation strategies particularly urgent and context specific.

5.7.3 Socio-Economic Constraints and Supply Chain Performance

Socio-economic factors include lack of credit, low income, and limited infrastructure investment also reinforce inefficiencies. Farmers explained that without access to affordable credit, they could not purchase packaging materials, hire reliable transport, or invest in improved curing structures. Vendors similarly noted that limited capital prevented them from buying larger quantities or investing in temporary shading or storage.

While previous studies argue that financial exclusion restricts smallholder participation (Benny et al., 2022), this study shows a more complex relationship: poverty shapes physical quality outcomes. For example, farmers who cannot afford proper bags or crates rely on cheaper, rougher packaging, which increases tuber damage during transport. Vendors without financial buffers cannot absorb losses, pushing them to sell damaged produce at reduced prices or discard it entirely.

Socio-economic constraints also interact with informality. Because many actors lack financial stability, they depend heavily on trust-based networks for credit, transport, and market access. This reliance on informal systems reinforces price variability and reduces incentives to adopt improved technologies.

5.7.4 The Compounding Effect of Intersecting Vulnerabilities

Taken together, gender inequalities, climate pressures, and socio-economic constraints form a reinforcing system of vulnerability.

- Gender barriers reduce access to safe, quality-preserving market spaces.
- Climate variability intensifies transport delays and accelerates spoilage.
- Poverty limits investment in technologies and practices that could reduce losses

These vulnerabilities converge at multiple nodes of the supply chain, making sweet potato deterioration not merely a technical problem but a socially and environmentally embedded one. Compared with other developing contexts, PNG's combination of cultural norms, geographic isolation, and infrastructure deficits makes these intersections particularly acute.

Chapter 6: Conclusion

6.1 Introduction

This chapter concludes the study by synthesizing its major findings, outlining the key contributions to theory and practice, discussing the study's limitations, and identifying future directions for research. The study

examined the post-harvest challenges and supply chain inefficiencies affecting sweet potato in Port Moresby's urban markets, drawing on qualitative interviews with farmers, transporters, wholesalers, vendors, and consumers. Through a value chain lens, the study traced how losses accumulate and how market dynamics, social structures, and infrastructural constraints interact to shape product quality and livelihoods. The following sections bring together these insights and talk about their broader significance for PNG's agricultural sector.

6.2 Summary of Key Findings

This study largely addressed the research questions by providing a holistic understanding of post-harvest challenges and supply chain inefficiencies affecting sweet potato in Port Moresby.

Firstly, the research identified key post-harvest challenges across multiple supply chain stages, demonstrating that quality deterioration is cumulative from farm to market rather than occurring at a single point. This confirms that losses are systemic and embedded within handling, transport, and market practices.

Secondly, the study showed that supply chain inefficiencies and informal market structures significantly influence losses and market access. Informal intermediaries were found to be both a source of inefficiency and a critical enabling mechanism for farmers and vendors, highlighting the need for context-sensitive interventions rather than full formalization.

Thirdly, the research demonstrated that urban consumer preferences strongly influence upstream decisions, particularly through appearance-based rejection and price sensitivity, which shape vendor purchasing behavior and farmer incentives.

Overall, the findings answered the research questions to a substantial extent. However, the qualitative scope and focus on Port Moresby limit generalizability. Future research should incorporate quantitative loss measurements and comparative studies across regions to strengthen policy relevance.

6.3 Integrated Significance of These Findings

These three insights collectively show that the sweet potato supply chain in PNG operates within a web of structural constraints, not simply logistical or behavioral issues.

The study demonstrates that technical solutions (better storage, improved packaging) are insufficient without addressing social and economic barriers. Also, value chain analysis must account for dual transportation modes, multiple risk points, and informal governance structures. And finally urban consumer dynamics have a stronger influence on supply chain performance than previously recognized.

By revealing how these forces interact, the study contributes to the understanding of why sweet potato losses remain persistently high in Port Moresby despite years of sectoral interventions.

6.4 Contributions of the Study

This study provides important contributions to the understanding of sweet potato value chains in PNG, particularly by examining how post-harvest and market inefficiencies manifest within an urban setting. Its contributions can be summarized across three domains: theoretical, empirical, and practical.

6.4.1 Theoretical Contributions

Firstly**,** most agricultural value chain frameworks assume single-mode or linear transport systems. This study demonstrates that PNG's dual reliance on long-distance road transport and maritime shipping introduces compounding, non-linear deterioration patterns. Damage incurred during the first mode intensifies during the

second, revealing that standard models understate risk in geographically isolated contexts. This provides a new understanding for analyzing post-harvest loss in other Pacific- island and remote regions.

Secondly**,** existing literature often attributes losses to limited farmer knowledge or poor handling practices. The findings challenge this assumption by showing that farmers frequently understand good post-harvest practices but are restricted by labor shortages, transport schedules, and lack of affordable technologies. This shifts theoretical emphasis from farmer deficits to systemic constraints, advancing debates about the real drivers of post-harvest loss.

Finally, while informal intermediaries are often portrayed as extractive, this study shows that they also perform essential functions, coordinating transport, providing credit, assuming spoilage risk, and enabling rural participation in distant markets. This duality contributes to broader theoretical debates on informal governance by demonstrating that informality can be both functional and inefficient, depending on the context.

6.4.2 Empirical Contributions

This research traces deterioration from farm to market more comprehensively than previous PNG studies. It identifies how damage accumulates, how delays worsen spoilage, and how consumer rejection reflects earlier weaknesses in transport, packaging, and handling.

Most prior studies focus on rural production systems. By capturing the experiences of Port Moresby vendors and consumers, this study provides new insights into urban market dynamics, appearance-based rejection, and price-driven behavior which are the factors previously underexplored in PNG literature.The study show how these cross-cutting issues interact with specific supply chain nodes, offering new empirical evidence of how vulnerabilities converge to produce losses.

6.4.3 Practical Contributions

This study outlines actionable strategies such as simple curing techniques, coordinated transport scheduling, low-cost market storage solutions, and basic voluntary grading systems. These are feasible for PNG's current capacity given the less resources we have. Also, the results provide a comprehensive picture of how inefficiencies arise, enabling government agencies, NGOs, and development partners to design interventions that address root causes rather than symptoms. Insights into informal trade networks can help guide realistic policies that complement existing market structures rather than weaken them.

The study also demonstrates that improving sweet potato supply chains requires integrated action across infrastructure, social systems, market governance, and consumer behavior. This offers a practical roadmap for designing multi-sectoral programs aimed at enhancing food security and farmer incomes.

6.5 Limitations of the Study

While this study provides important perceptions into the sweet potato supply chain in PNG, several limitations should be acknowledged. These limitations do not undermine the study's main findings but help clarify the context in which the research was conducted.

6.5.1 Geographic Scope

The study focused primarily on Port Moresby's urban markets and a selected group of smallholder farmers supplying the city. This may limit generalizability to other urban centers such as Lae, Mt Hagen, or Goroka, where market structures and transport networks differ.

Port Moresby was selected because it is PNG's largest and most influential urban market, handling a significant share of sweet potato arriving from the Highlands.

Given Port Moresby's central role in shaping national demand, pricing, and transport patterns, the findings remain strategically relevant and provide insights applicable to broader policy and market reform discussions in PNG.

6.5.2 Sample Diversity and Representation

Although the study included 68 participants across five stakeholder groups, some actor categories, such as remote farmers, large-scale retailers, and major shipping companies, were less represented due to time and resource constraints.

The sample prioritized actors were most directly involved in handling and exchanging sweet potato, ensuring rich qualitative details about the processes where losses occur.

Even without full representation, strong thematic saturation across interviews indicates that the key challenges identified are widely experienced and structurally embedded in the supply chain.

6.5.3 Translation and Interpretation Challenges

Several interviews required translation from Tok Pisin or local languages into English. This introduced the possibility of subtle meaning loss or interpretive influence from translators.

Transcripts were cross-checked with bilingual assistants, and ambiguous statements were clarified through follow-up conversations where possible. Core patterns, such as transport delays, spoilage causes, vendor rejection, and informal trade dynamics were seen consistently across interviews, suggesting that the findings remain robust despite minor linguistic limitations.

6.5.4 Resource and Time Constraints

Limited funding restricted the number of extended field visits, especially to distant rural communities and maritime freight sites. This reduced the opportunity to observe physical handling practices directly across all transport stages.

The study compensated for this by conducting in-depth interviews with multiple actors who had firsthand experience at these stages, providing detailed descriptions of processes and challenges.

Even without extensive site visits, the convergence of accounts from farmers, transporters, vendors, and consumers strengthens confidence in the validity of the findings.

6.6 Future Research Directions

To support implementation of the recommendations in Section 6.5, future research should prioritise two key areas. First, a controlled study on consumer willingness-to-pay and acceptance of cosmetic imperfections is needed to inform realistic grading systems and market education strategies, as consumer preferences were shown to strongly influence upstream handling and wastage. Second, pilot intervention trials on low-cost post-harvest technologies, such as improved packaging, shading, and simple storage solutions, should be conducted to assess cost-effectiveness, adoption barriers, and scalability in PNG's context. Evidence from these studies would directly guide immediate and medium-term policy and investment decisions aimed at reducing post-harvest losses and improving market efficiency.

REFERENCES

Australian Centre for International Agricultural Research. (2013). Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea (Final report ASEM/2006/035). ACIAR.

Australian Centre for International Agricultural Research. (2017). An integrated approach for systemic change and sustained development of the Papua New Guinea sweetpotato value chain (Final report ASEM/2011/048). ACIAR.

Australian Centre for International Agricultural Research. (2020). New farming practices boost PNG sweetpotato production. ACIAR.

Australian Centre for International Agricultural Research. (2024). Supporting commercial sweetpotato production and marketing in the Papua New Guinea Highlands. ACIAR.

Abong, G., Ndanyi, V., Kaaya, A., Shibairo, S., Okoth, M., Obimbo, P., Odongo, N., Wanjekeche, E., Mulindwa, J., & Sopade, P. (2016). A review of production, post-harvest handling and marketing of sweetpotatoes in Kenya and Uganda. *Current Research in Nutrition and Food Science Journal*, *4*(3), 162-181.

Abong, G. O., Ndanyi, V. C., Kaaya, A., Shibairo, S., Okoth, M. W., Lamuka, P. O., Odongo, N. O., Wanjekeche, E., Mulindwa, J., & Sopade, P. (2016). A review of production, post-harvest handling and marketing of sweetpotatoes in Kenya and Uganda.

Abrham, T., Beshir, H. M., & Haile, A. (2021). Sweetpotato production practices, constraints, and variety evaluation under different storage types. *Food and Energy Security*, *10*(1), e263.

Allen, B. (2009). Agricultural development, policies and governance. *Food and Agriculture in Papua New Guinea*, 425-488.

Allen, B., Bourke, R. M., & Gibson, J. (2005). Poor rural places in Papua New Guinea. *Asia Pacific Viewpoint*, *46*(2), 201-217.

Amherst, U. o. M. (2013). *Sweet potato harvest and storage*. Center for Agriculture, Food, and the Environment. Retrieved April 14 from https://ag.umass.edu/vegetable/fact-sheets/sweet-potato-harvest-storage

Benny, D., Benson, T., Ivekolia, M., Kedir Jemal, M., & Ovah, R. (2022). *Improving agricultural productivity in Papua New Guinea: Strategic and policy considerations* (Vol. 1). Intl Food Policy Res Inst.

Boliko, M. C. (2019). FAO and the situation of food security and nutrition in the world. *Journal of nutritional science and vitaminology*, *65*(Supplement), S4-S8.

Bonney, L., Shantapriyan, P., Muscat, P., & Worinu, M. (2014). A feasibility study for a new wholesale fresh produce market in Port Moresby. XXIX International Horticultural Congress on Horticulture: Sustaining Lives, Livelihoods and Landscapes (IHC2014): XVII 1103,

Bourke, R. M. (2005). Sweet potato in Papua New Guinea: the plant and people. *The sweet potato in Oceania: a reappraisal. Ethnology Monographs*, *19*, 15-24.

Bourke, R. M. (2010). Altitudinal limits of 230 economic crop species in Papua New Guinea. *Altered Ecologies: Fire, Climate and Human Influence on Terrestrial Landscapes. Terra Australia*, *32*, 473-512.

Bourke, R. M. (2018). Impact of climate change on agriculture in Papua New Guinea. *Climate Change: Our Environment, Livelihoods, and Sustainabilit*, 35-50.

Bourke, R. M., & Harwood, T. (2009). *Food and agriculture in papua new guinea*. ANU E Press.

Bourke, R. M., & Vlassak, V. (2004). *Estimates of food crop production in Papua New Guinea*. Land Management Group, Department of Human Geography, Research School of ….

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.

Cai, H., Cai, R., & Zhang, L. (2025). Meta-Analysis of Sweet Potato Storage Methods and Their Impact on Quality. *Bioscience Methods*, *16*.

Cerio, C. (2021). Value chain of sweet potato: a sociological analysis. IOP Conference Series: Earth and Environmental Science,

Chakraborty, C., Roychowdhury, R., Chakraborty, S., Chakravorty, P., & Ghosh, D. (2017). A review on post-harvest profile of sweet potato. *International Journal of Current Microbiology and Applied Sciences*, *6*(5), 1894-1903.

Chang, H.-S. C. (2014). Future Prospects for Sweetpotato Processing in Papua New Guinea.

Chang, H.-S. C., Be'Soer, L., Wali, C., Anjan, J., & Ramita, I. (2010). Women in sweet potato marketing in Papua New Guinea.

Chang, H.-S. C., Spriggs, J., Anjen, J., Dowa, E., Kewa, J., & Hehona, D. (2016). Improving sweetpotato marketing in Papua New Guinea: Results from a value chain analysis. *Australasian Agribusiness Review*, *24*, 1-27.

Chang, H., Irving, D., Lutulele, R., Komolong, B., & Be'Soer, L. (2013a). Improving marketing efficiency, postharvest management and value addition of sweetpotato in Papua New Guinea. *Final Report to ACIAR*.

Chang, H., Irving, D., Lutulele, R., Komolong, B., & Be'Soer, L. (2013b). Improving marketing efficiency, postharvest management and value addition of sweetpotato in PNG. *ACIAR Final Report FR2013-02 for ASEM/2006/035, ACIAR, Canberra*.

Chang, H., & Kewa, J. (2014). Sweet potato value chain analysis in Papua New Guinea. Conference paper presented to the 8th ASAE Conference, Savar, Bangladesh,

Chang, H., & Spriggs, J. (2007). Sweet potato marketing in PNG highlands. *University of New England Working Paper Series in Agricultural and Resource Economics*, *3*.

Chang, H., Spriggs, J., & Newman, S. (2007). Improving sweet potato marketing in the Papua New Guinea Highlands. II International Symposium on Improving the Performance of Supply Chains in the Transitional Economies 794,

Connell, J., Lowitt, K., Saint Ville, A., & Hickey, G. (2020). *Food security in small island states*. Springer.

Connell, J., Lowitt, K., Saint Ville, A., & Hickey, G. M. (2019). Food security and sovereignty in Small Island developing states: Contemporary crises and challenges. In *Food security in small island states* (pp. 1-23). Springer.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Cuddeford, V. (2014). Introduction to agricultural value chains.

Culas, R. J., & Pombre, C. (2023). Assessing socioeconomic impact of pathogen tested and conventional practice sweet potato production in the highlands of Papua New Guinea. *Journal of Agriculture and Food Research*, *14*, 100701.

Curry, G. N., Koczberski, G., Lummani, J., Ryan, S., & Bue, V. (2012). Earning a living in PNG: From subsistence to a cash economy. In *Schooling for sustainable development: A focus on Australia, New Zealand, and the Oceanic Region* (pp. 159-184). Springer.

Ezin, V., Quenum, F., Bodjrenou, R. H., Kpanougo, C. M., Kochoni, E. M., Chabi, B. I., & Ahanchede, A. (2018). Assessment of production and marketing constraints and value chain of sweet potato in the municipalities of Dangbo and Bonou. *Agriculture & Food Security*, *7*(1), 15.

FAO. (2023). *Sweet potato production*. Retrieved 17/09/2025 from https://ourworldindata.org/grapher/sweet-potato-production

Fujinuma, R., Kirchhof, G., Ramakrishna, A., Sirabis, W., Yapo, J., Woruba, D., Gurr, G., & Menzies, N. (2018). Intensified sweetpotato production in Papua New Guinea drives plant nutrient decline over the last decade. *Agriculture, Ecosystems & Environment*, *254*, 10-19.

Georgeou, N., Hawksley, C., Wali, N., Lountain, S., Rowe, E., West, C., & Barratt, L. (2022). Food security and small holder farming in Pacific Island countries and territories: a scoping review. *PLOS Sustainability and Transformation*, *1*(4), e0000009.

Gibson, J. (2001). The economic and nutritional importance of household food production in PNG. *Food Security for Papua New Guinea'eds. Bourke, RM, Allen, MG and Salisbury, JG ACIAR Proceeding*, *99*, 37-44.

Given, L. M. (2008). *The Sage encyclopedia of qualitative research methods*. Sage publications.

Grace, D. (2023). Burden of foodborne disease in low-income and middle-income countries and opportunities for scaling food safety interventions. *Food Security*, *15*(6), 1475-1488.

Guest, D., & Walton, M. (2016). Developing the cocoa value chain in Bougainville. *Bougainville, Australian Centre for International Agricultural Research*.

Guest, G., Namey, E. E., & Mitchell, M. L. (2013). Qualitative research: Defining and designing. *Collecting qualitative data: A field manual for applied research*, 1-40.

Hainzer, K. (2023). *Capacity building for value chain development: A multimethod study of culturally responsive agricultural extension in Papua New Guinea* CQUniversity].

Hamilton, A. J., Burry, K., Mok, H.-F., Barker, S. F., Grove, J. R., & Williamson, V. G. (2014). Give peas a chance? Urban agriculture in developing countries. A review. *Agronomy for sustainable development*, *34*(1), 45-73.

Hartemink, A. E., Johnston, M., O'sullivan, J., & Poloma, S. (2000). Nitrogen use efficiency of taro and sweet potato in the humid lowlands of Papua New Guinea. *Agriculture, ecosystems & environment*, *79*(2-3), 271-280.

Hu, W., & Tanaka, S. I. (2007). Effects of heat treatment on the quality and storage life of sweet potato. *Journal of the Science of Food and Agriculture*, *87*(2), 313-319.

Joseph, J., Hayoge, G., Sikas-Iha, H., Dorosh, P. A., Schmidt, E., & Kedir Jemal, M. (2025). *Potential impacts of an El Niño related drought on sweet potato consumption and prices in Papua New Guinea*. Intl Food Policy Res Inst.

Khan, A. A., Siddiqui, Y., Siddique, K. H., Bobo, J. A., & Ali, A. (2024). Minimizing postharvest food losses: a vital strategy to alleviate food insecurity and malnutrition in developing nations: a review. *Discover Food*, *4*(1), 145.

Kosec, K., Schmidt, E., Carrillo, L., Fang, P., Ivekolia, M., & Ovah, R. (2022). Improving agricultural value chain coordination and gender inclusiveness in PNG.

Krueger, R. A. (2014). *Focus groups: A practical guide for applied research*. Sage publications.

Kvale, S., & Brinkmann, S. (2015). *Interviews*. Sage.

Lankes, H. P. (2002). Market access for developing countries. *Finance and Development*, *39*(3), 8-15.

Martin, S. K., & Jagadish, A. (2006). Agricultural marketing and agribusiness supply chain issues in developing economies: the case of fresh produce in Papua New Guinea.

Mbela, D. E. N., Peter, N. L., Kariathi, V., Mtunguja, M., Mwana, E., & Wandella, M. (2021). Imparting Nutrition Knowledge to School Children and Communities: The Role of Orange Fleshed Sweet Potato in Nutrition. *European Journal of Applied Sciences–Vol*, *9*(3).

McGregor, A., & Stice, K. (2014a). Agricultural Value Chain Guide for the Pacific Islands. *Technical Centre for Agricultural and Rural Cooperation (CTA)*.

McGregor, A., & Stice, K. (2014b). Agricultural Value Chain Guide for the Pacific Islands: Making value chain analysis a useful tool in the hands of farmers, traders and policy makers.

Mukundi, E., Mathenge, M. K., & Ngigi, M. (2013). Sweet potato marketing among smallholder farmers: The role of collective action.

Munyaka, J.-C. B., Gallay, O., Hlal, M., Mutandwa, E., & Chenal, J. (2024). Optimizing the sweet potato supply chain in Zimbabwe using discrete event simulation: A focus on production, distribution, and market dynamics. *Sustainability*, *16*(21), 9166.

Mutai, B. K., Agunda, E. N., Muluvi, A. S., Kibet, L. K., & Maina, M. C. (2013). Determinants of smallholder sweet potato farmers' participation in different market options: The case of Vihiga County, Kenya. *Journal of Development and Agricultural Economics*, *5*(8), 314-320.

Nguyen, T. T. H. (2021). *Supply chain information visibility and its impact on decision-making: an integrated model in the pharmaceutical industry: a dissertation presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Management at Massey University, Albany, Auckland, New Zealand* Massey University].

Nhanala, S. E., & Yencho, G. C. (2021). Assessment of the potential of wild Ipomoea spp. for the improvement of drought tolerance in cultivated sweetpotato Ipomoea batatas (L.) Lam. *Crop Science*, *61*(1), 234-249.

NRI. (2023). *THE CHALLENGES FACED BY INFORMAL FRESH PRODUCE VENDORS IN PORT MORESBY*

Retrieved 17/09/2025 from https://pngnri.org/images/Publications/Spotlight_Vol16_Iss08_The_challenges_faced_by_informal_fresh_produce_vendors_in_Port_Moresby_by_Evelyn_MalalaJan23.pdf?utm_source=chatgpt.com

Okrupa, M., Aku, R., Sar, S., Ovah, R., & Hati, H. (2017). Identifying Value Chain Constraints for Sweet potato, Irish potato and bulb onion in the Highlands of Papua New Guinea. Proceeding of International

Conference on Agricultural Extension Addressing Farmer's Needs. University of Fresh Produce Development Agency, Goroka,

Omot, N., Spriggs, J., & Chang, H.-S. C. (2010). Long-distance marketing of sweet potato from the Highlands of Papua New Guinea: An analysis of consumer preferences and supplier responsiveness.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health and mental health services research*, *42*, 533-544.

Parmar, A., Hensel, O., & Sturm, B. (2017). Post-harvest handling practices and associated food losses and limitations in the sweetpotato value chain of southern Ethiopia. *NJAS-Wageningen Journal of Life Sciences*, *80*, 65-74.

Paul, N. C., Park, S., Liu, H., Lee, J. G., Han, G. H., Kim, H., & Sang, H. (2021). Fungi associated with postharvest diseases of sweet potato storage roots and in vitro antagonistic assay of Trichoderma harzianum against the diseases. *Journal of Fungi*, *7*(11), 927.

Ray, R. C., & Tomlins, K. I. (2010). Sweet potato: post harvest aspects in food, feed and industry. *(No Title)*.

Rubagumya, I., Komakech, A. J., Menya, E., Kizito, S., Zziwa, A., & Kabenge, I. (2023). Postharvest losses of fruits and vegetables along their urban supply chain in Eastern Africa: A case study of Uganda towards sustainable management. *Journal of Biosystems Engineering*, *48*(2), 105-114.

Rundquist, J. (2020). *Identifying the optimum storage and handling conditions for sweetpotato slips* Kansas State University].

Schmit, T. M., Wall, G. L., Newbold, E. J., & Bihn, E. A. (2020). Assessing the costs and returns of on-farm food safety improvements: A survey of Good Agricultural Practices (GAPs) training participants. *PloS one*, *15*(7), e0235507.

Sharma, S., Singh, K., & Arya, V. (2021). Innovation and employee turnover in biotechnology companies: rethinking the role of strategic human resource management. *World Review of Entrepreneurship, Management and Sustainable Development*, *17*(2-3), 291-305.

Sharp, T. L. (2021). Intermediary trading and the transformation of marketplaces in Papua New Guinea. *Journal of Agrarian Change*, *21*(3), 522-544.

Stice, K., & McGregor, A. (2016). Vulnerability of high-value horticultural crops to climate change. *ofPaci c Island agriculture and forestry to climate change*, 295.

Tavva, S., & Nedunchezhiyan, M. (2012). Global status of sweet potato cultivation. *Fruit Veg. Cereal Sci. Biotechnol*, *6*, 143-147.

Villano, R., Chang, H.-S. C., Kewa, J., & Irving, D. (2016). Factors affecting consumers' willingness to pay for good quality sweetpotato in Papúa New Guinea. *Australasian Agribusiness Review*, *24*, 1-17.

Wang, A., Li, R., Ren, L., Gao, X., Zhang, Y., Ma, Z., Ma, D., & Luo, Y. (2018). A comparative metabolomics study of flavonoids in sweet potato with different flesh colors (Ipomoea batatas (L.) Lam). *Food chemistry*, *260*, 124-134.

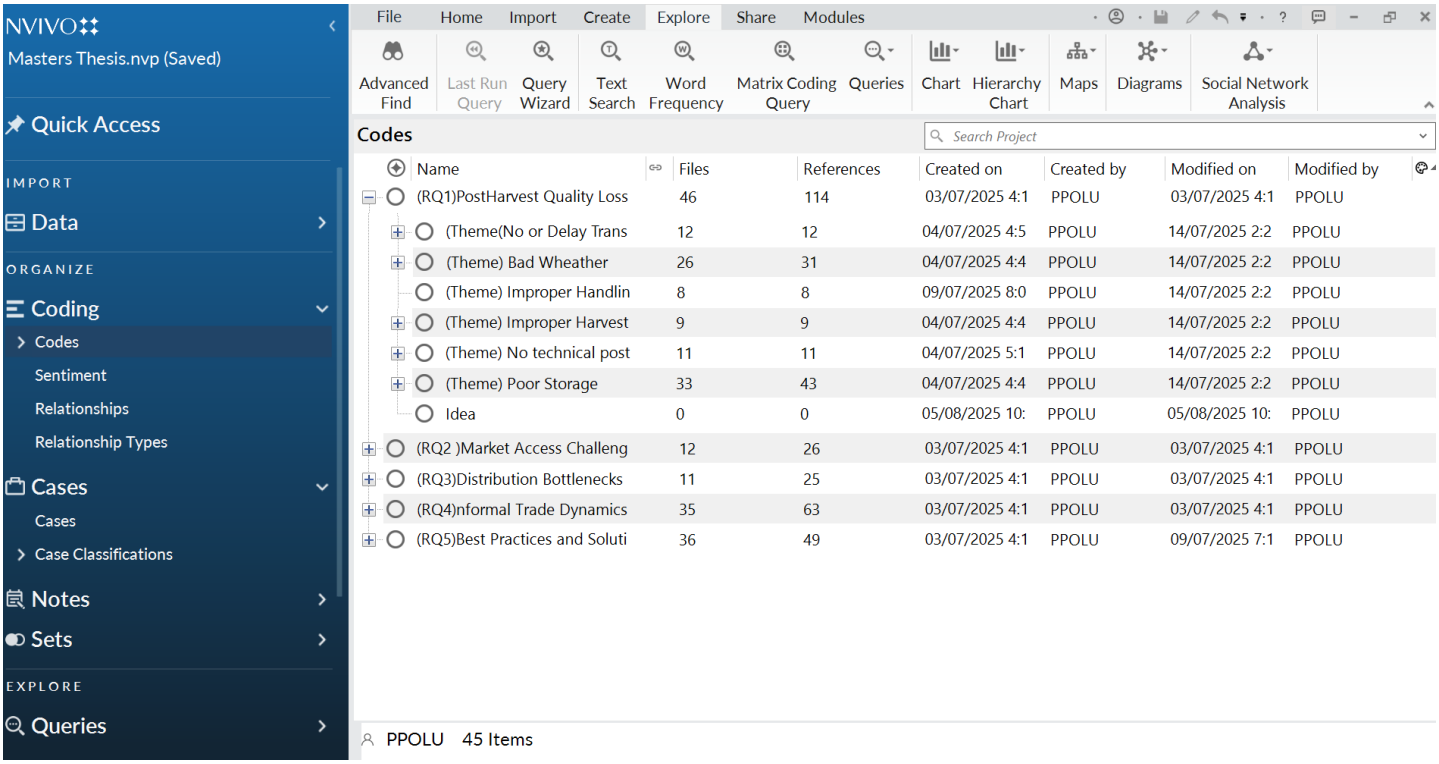
Wera, B. (2017). Roots and tubers value chain development and food and nutrition security-PNG: Lessons for Papua New Guinea from the World Congress on Roots and Tuber Crops, China, 18–22 January 2016.

Wiessner, P. (2005). *Social, symbolic and ritual roles of the sweet potato in Enga, from its introduction until first contact*.

Wilson, L., Averre, C., & Covington, H. (1977). Sweet potato production, handling, curing, storage, and marketing in North Carolina.

APPENDICES

Appendix A – Supplementary Methods



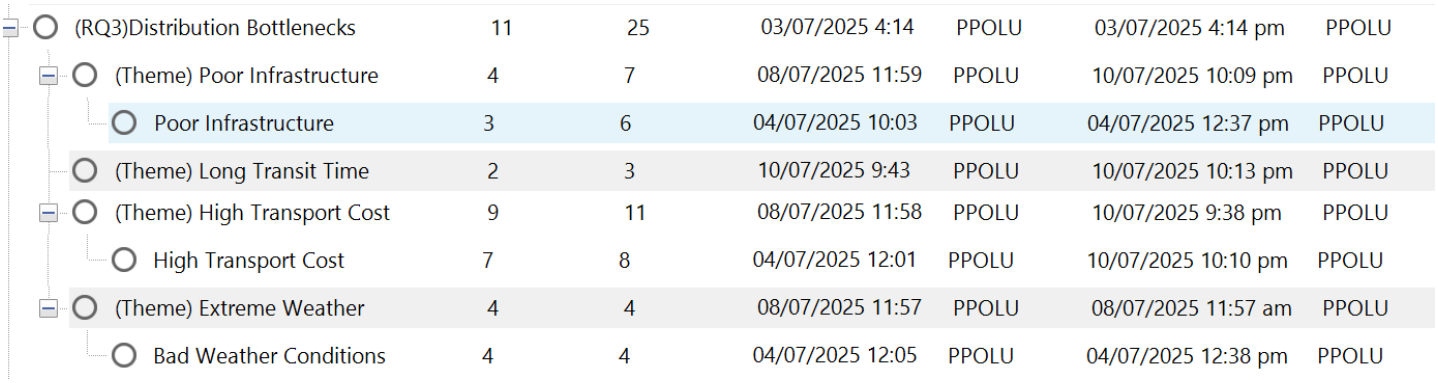
Appendix A Figure 1: Screenshot of Themes under the five Research Questions.

(RQ1)PostHarvest Quality Losses	46	114	03/07/2025 4:11	PPOLU	03/07/2025 4:11 pm	PPOLU
(Theme) Poor Storage	33	43	04/07/2025 4:43	PPOLU	14/07/2025 2:24 pm	PPOLU
Sweet potato packed too ti	3	3	03/07/2025 4:55	PPOLU	04/07/2025 12:18 p	PPOLU
No Proper Storage	31	36	04/07/2025 12:50	PPOLU	10/07/2025 10:13 p	PPOLU
(Theme) No technical post harv	11	11	04/07/2025 5:10	PPOLU	14/07/2025 2:24 pm	PPOLU
No Post Harvest Training	9	9	04/07/2025 11:25	PPOLU	10/07/2025 12:17 p	PPOLU
(Theme) Improper Harvest Tech	9	9	04/07/2025 4:44	PPOLU	14/07/2025 2:24 pm	PPOLU
Bruised during harvest	7	7	04/07/2025 10:15	PPOLU	10/07/2025 9:44 am	PPOLU
(Theme) Improper Handling	8	8	09/07/2025 8:04	PPOLU	14/07/2025 2:24 pm	PPOLU
(Theme) Bad Wheather	26	31	04/07/2025 4:41	PPOLU	14/07/2025 2:24 pm	PPOLU
Extreme weather	11	16	03/07/2025 4:57	PPOLU	09/07/2025 7:47 pm	PPOLU
(Theme(No or Delay Transport)	12	12	04/07/2025 4:54	PPOLU	14/07/2025 2:24 pm	PPOLU
Delays in transport	4	4	03/07/2025 4:44	PPOLU	09/07/2025 7:30 pm	PPOLU

Appendix A Figure 2: Themes under Research Question one(RQ1).

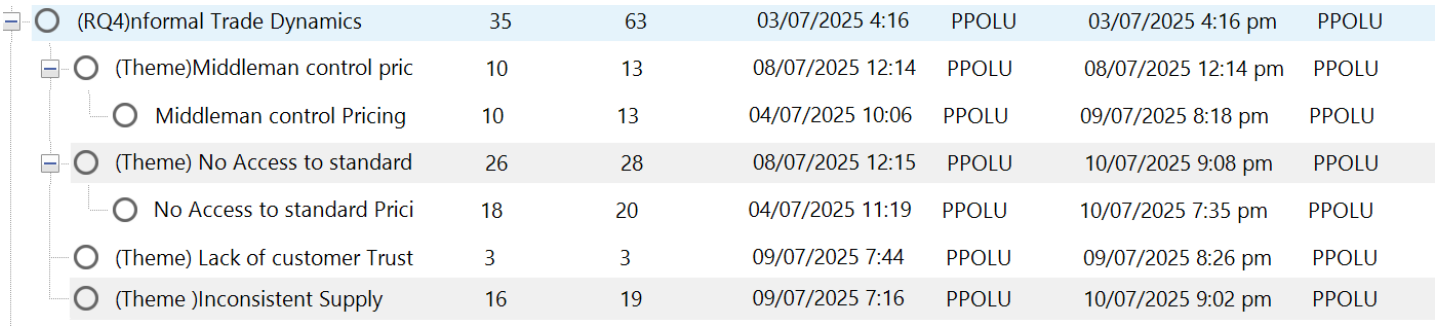
(RQ2)Market Access Challenges	12	26	03/07/2025 4:13	PPOLU	03/07/2025 4:13 pm	PPOLU
Code (Theme) Transportation Issue	7	10	08/07/2025 11:51	PPOLU	10/07/2025 7:24 pm	PPOLU
High Transport Cost	6	7	04/07/2025 9:52 a	PPOLU	04/07/2025 12:41 pm	PPOLU
Delays in transport	2	2	04/07/2025 9:50 a	PPOLU	04/07/2025 11:28 am	PPOLU
(Theme) Lack of Market Linkage	5	5	08/07/2025 11:56	PPOLU	08/07/2025 11:56 am	PPOLU
No Networks	5	5	04/07/2025 11:33	PPOLU	04/07/2025 12:42 pm	PPOLU
(Theme) Bad Road Condition	9	11	04/07/2025 5:23	PPOLU	10/07/2025 9:04 pm	PPOLU
Bad road condition due to	7	9	04/07/2025 9:51 a	PPOLU	10/07/2025 7:40 pm	PPOLU

Appendix A Figure 3:Themes under Research Question Two(RQ2).



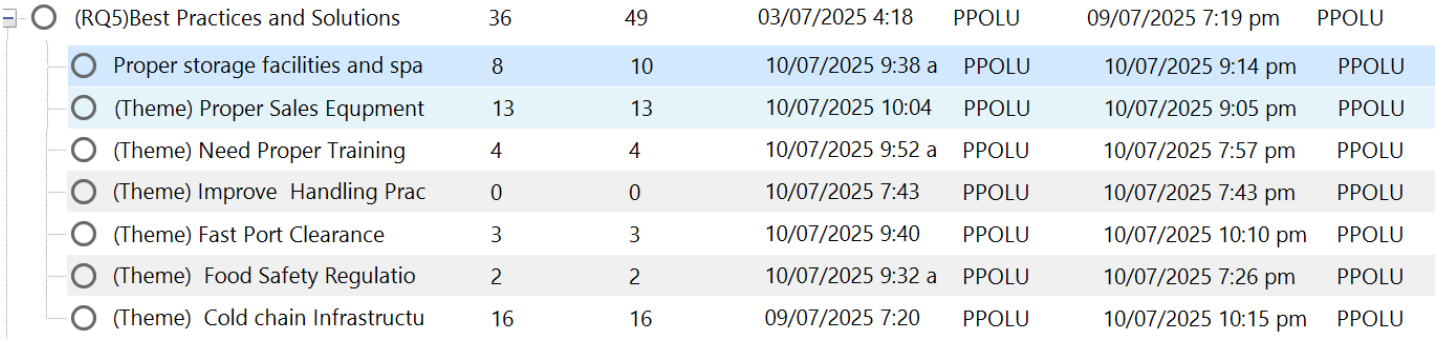
(RQ3)Distribution Bottlenecks	11	25	03/07/2025 4:14	PPOLU	03/07/2025 4:14 pm	PPOLU
(Theme) Poor Infrastructure	4	7	08/07/2025 11:59	PPOLU	10/07/2025 10:09 pm	PPOLU
Poor Infrastructure	3	6	04/07/2025 10:03	PPOLU	04/07/2025 12:37 pm	PPOLU
(Theme) Long Transit Time	2	3	10/07/2025 9:43	PPOLU	10/07/2025 10:13 pm	PPOLU
(Theme) High Transport Cost	9	11	08/07/2025 11:58	PPOLU	10/07/2025 9:38 pm	PPOLU
High Transport Cost	7	8	04/07/2025 12:01	PPOLU	10/07/2025 10:10 pm	PPOLU
(Theme) Extreme Weather	4	4	08/07/2025 11:57	PPOLU	08/07/2025 11:57 am	PPOLU
Bad Weather Conditions	4	4	04/07/2025 12:05	PPOLU	04/07/2025 12:38 pm	PPOLU

Appendix A Figure 4: Themes under Research Question three (RQ3).



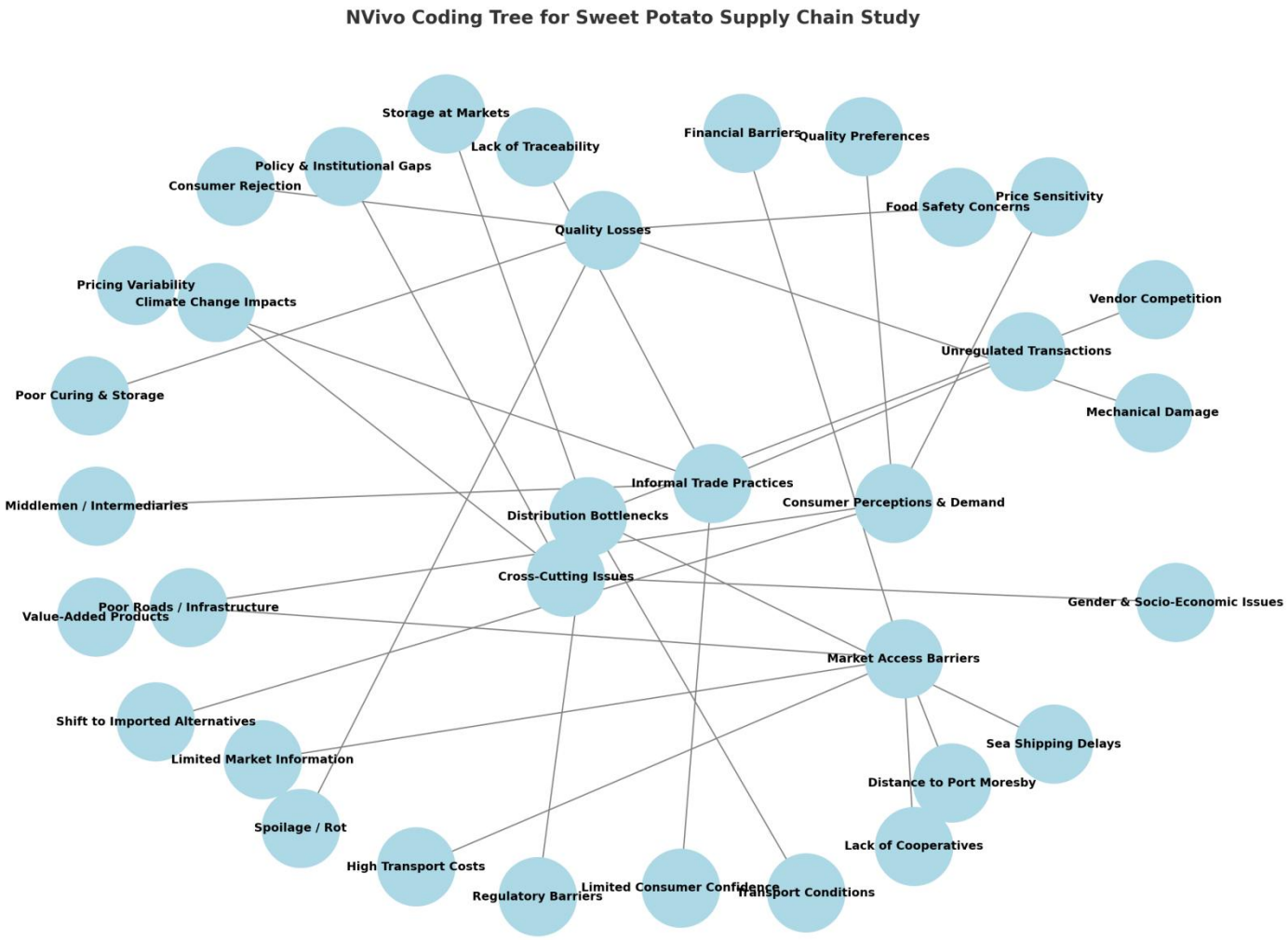
(RQ4)nformal Trade Dynamics	35	63	03/07/2025 4:16	PPOLU	03/07/2025 4:16 pm	PPOLU
(Theme)Middleman control pric	10	13	08/07/2025 12:14	PPOLU	08/07/2025 12:14 pm	PPOLU
Middleman control Pricing	10	13	04/07/2025 10:06	PPOLU	09/07/2025 8:18 pm	PPOLU
(Theme) No Access to standard	26	28	08/07/2025 12:15	PPOLU	10/07/2025 9:08 pm	PPOLU
No Access to standard Prici	18	20	04/07/2025 11:19	PPOLU	10/07/2025 7:35 pm	PPOLU
(Theme) Lack of customer Trust	3	3	09/07/2025 7:44	PPOLU	09/07/2025 8:26 pm	PPOLU
(Theme)Inconsistent Supply	16	19	09/07/2025 7:16	PPOLU	10/07/2025 9:02 pm	PPOLU

Appendix A Figure 5: Themes under Research Question four (RQ4).



(RQ5)Best Practices and Solutions	36	49	03/07/2025 4:18	PPOLU	09/07/2025 7:19 pm	PPOLU
Proper storage facilities and spa	8	10	10/07/2025 9:38 a	PPOLU	10/07/2025 9:14 pm	PPOLU
(Theme) Proper Sales Equpment	13	13	10/07/2025 10:04	PPOLU	10/07/2025 9:05 pm	PPOLU
(Theme) Need Proper Training	4	4	10/07/2025 9:52 a	PPOLU	10/07/2025 7:57 pm	PPOLU
(Theme) Improve Handling Prac	0	0	10/07/2025 7:43	PPOLU	10/07/2025 7:43 pm	PPOLU
(Theme) Fast Port Clearance	3	3	10/07/2025 9:40	PPOLU	10/07/2025 10:10 pm	PPOLU
(Theme) Food Safety Regulatio	2	2	10/07/2025 9:32 a	PPOLU	10/07/2025 7:26 pm	PPOLU
(Theme) Cold chain Infrastructu	16	16	09/07/2025 7:20	PPOLU	10/07/2025 10:15 pm	PPOLU

Appendix A Figure 6: Themes under Research Question five (RQ5).



Appendix A Figure 7: Example of Coding Tree / Framework. Presents a screenshot of the NVivo coding tree used to organize data during thematic analysis. This example shows how raw interview transcripts were coded into nodes and grouped into higher-order themes, illustrating the pathway from descriptive codes to analytic categories.

Reflexive Journal Excerpts

(Examples of notes kept during coding and analysis)

Date: 18 July 2025: Market spoilage and heat exposure

While coding "post-harvest loss"nodes, I noticed how strongly I empathised with vendors describing tuber spoilage in the sun. I risk over-emphasising loss and under-representing coping strategies (e.g., covering produce, rotating stock). I created a sub-node "Vendor coping practices" to keep both aspects visible. Planned to review later interviews to check balance.

World Bank. (2025). Papua New Guinea Economic Update: Economic growth ahead for Papua New Guinea, but agriculture reforms key to more jobs and sustained prosperity. World Bank.

Date: 25 July 2025 : Transport and shipping delays

Farmers from Goroka stressed road washouts and shipping queues. My own frustration with freight to Port Moresby made me interpret these stories mainly as "infrastructure" issues. On reflection, there were also relational aspects (trust in shipping agents) that deserved coding. Added "relationship with carriers" under "Distribution bottlenecks".

Date: 2 August 2025 :Women vendors' workload

Several women spoke about childcare while handling sweet potato sales. I initially saw this as "background," but realized it shapes how produce is stored and marketed. Inserted a memo on gendered constraints and linked it to "post-harvest handling". Will revisit transcripts to see if similar patterns appear in farmer data.

Date: 14 August 2025: Price sensitivity vs quality

Consumers prioritized freshness but quickly changed suppliers if prices rose. I felt tempted to treat this as a simple economics theme, yet some participants linked price swings to "trust in sellers." Added an analytic memo suggesting a combined "Price–trust" theme. Plan to check coding stripes across "Consumer behavior" to verify saturation.

Appendix A Figure 8: Examples of notes kept during coding and analysis

Appendix B – Supplementary Results

Appendix B Table 1: Quality losses reported by farmers.

Theme / Sub-theme	Files (n)	References (n)	% of Total References
Delays in Transport	4	12	10.50%
Extreme Weather	11	16	14.00%
Improper Handling (bruising)	8	8	7.00%
Improper Harvest (bruised)	9	9	7.90%
No Post-harvest Training	11	9	7.90%
Poor Storage	33	43	37.70%
Sweet Potato Packed (50kg bags)	3	3	2.60%
Total	**46**	**114**	**100%**

Appendix B Table 2: Market Access Challenges.

Theme / Sub-theme	Files (n)	References (n)	%
Bad Road Condition	9	11	42.30%
Lack of Market Linkage	5	5	19.20%
Transportation Issues	7	10	38.50%
Total	**12**	**26**	**100%**

Appendix B Table 3:Distribution Bottlenecks

Theme / Sub-theme	Files (n)	References (n)	% of Total References
Extreme Weather	4	4	16
High Transport Cost	9	11	44
Long Transit Time	2	3	12
Poor Infrastructure	4	7	28
Total	**11**	**25**	**100**

Appendix B Table 4: Informal Trade Dynamics.

Theme / Sub-theme	Files (n)	References (n)	% of Total References
Inconsistent Supply	16	19	30.2
Lack of Customers	3	3	4.8
No Access to Standards	26	28	44.4
Middleman Control	10	13	20.6
Total	**35**	**63**	**100**

Appendix B Table 5: Best Practices and Solutions

Theme / Sub-theme	Files (n)	References (n)	% of Total References
Training / Capacity Building	12	14	28.6
Infrastructure Improvement	10	12	24.5
Market Linkages	8	13	26.5
Policy/Regulation	6	10	20.4
Total	**36**	**49**	**100**

Appendix B Table 6: Wholesale and Market Access Issues Reported by Wholesalers

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Theme / Sub-theme	Files (n)	References (n)	% of Wholesalers (N=15)
Inconsistent supply from farmers	10	10	66.70%
Reliance on informal sourcing	9	9	60.00%
Lack of cold storage	8	8	53.30%
Short shelf life upon arrival	7	7	46.70%
Difficulty in price negotiation	6	6	40.00%
Market congestion & competition	5	5	33.30%

Appendix B Table 7: Vendor Challenges

Theme / Sub-theme	Files (n)	References (n)	% of Vendors (N=15)

Price volatility	12	14	80.00%
Spoilage losses	11	13	73.30%
Judgement & repackaging	10	12	66.70%
Market congestion	9	9	60.00%
Lack of storage	7	8	46.70%

Appendix B Table 8: Consumer Perspectives

Theme / Sub-theme	**Files (n)**	**References (n)**	**% of Consumers (N=15)**
High prices	11	13	73.30%
Poor quality / bruising	10	12	66.70%
Short shelf life	9	10	60.00%
Lack of trust in vendor practices	8	8	53.30%
Lack of consistency in supply	6	7	40.00%

Appendix B Table 9: Transporter Challenges

Theme / Sub-theme	Files (n)	References (n)	% of Transporters (N=5)
High fuel / transport costs	4	5	80.00%
Poor road conditions	4	4	80.00%
Delays due to weather	3	3	60.00%
Long transit times	2	2	40.00%
Vehicle breakdowns	2	2	40.00%

Appendix B Table 10: Demographics of Farmers (F1–F15).

Participant ID	Gender	Age Range	Years of Experience	Farm Size (ha)	Location (Highlands Region)
F1	Male	41	20 years	1.2 ha	Goroka - Eastern Highlands Province
F2	Female	31	8 years	0.6 ha	Goroka - Eastern

					Highlands Province
F3	Male	26	6 years	0.5 ha	Goroka - Eastern Highlands Province
F4	Female	36	12 years	0.8 ha	Goroka - Eastern Highlands Province
F5	Male	51	25 years	1.5 ha	Goroka - Eastern Highlands Province
F6	Female	21	4 years	0.4 ha	Goroka - Eastern Highlands Province
F7	Male	34	10 years	0.7 ha	Goroka - Eastern Highlands Province
F8	Female	44	18 years	1.0 ha	Goroka - Eastern Highlands Province
F9	Male	27	5 years	0.6 ha	Goroka - Eastern Highlands Province
F10	Female	36	15 years	0.9 ha	Goroka - Eastern Highlands Province

F11	Male	35	9 years	0.7 ha	Goroka - Eastern Highlands Province
F12	Female	41	17 years	1.1 ha	Goroka - Eastern Highlands Province
F13	Male	39	3 years	0.5 ha	Goroka - Eastern Highlands Province
F14	Female	37	11 years	0.8 ha	Goroka - Eastern Highlands Province
F15	Male	55	22 years	1.4 ha	Goroka - Eastern Highlands Province

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Participant ID	**Gender**	**Age Range**	**Years of Experience**	**Business Scale (bags/week)**	**Location (Distribution Point)**
W1	Male	36	12 years	80–100 bags/week	Gordons Wholesale Yard
W2	Female	43	15 years	60–80 bags/week	Gordons Wholesale Yard

W3	Male	24	9 years	70–90 bags/week	9 Mile Depot
W4	Female	26	6 years	50–70 bags/week	Gerehu Wholesale
W5	Male	57	22 years	100–120 bags/week	Gordons Wholesale Yard
W6	Female	36	11 years	60–75 bags/week	Gordons Wholesale Yard
W7	Male	31	8 years	55–70 bags/week	9 Mile Depot
W8	Male	60	17 years	90–110 bags/week	Gordons Wholesale Yard
W9	Female	65	10 years	65–80 bags/week	Gerehu Wholesale
W10	Male	38	5 years	50–60 bags/week	Gordons Wholesale Yard
W11	Female	36–45	13 years	80–95 bags/week	Gordons Wholesale Yard
W12	Male	47	18 years	100–120 bags/week	9 Mile Depot
W13	Female	20	4 years	40–55 bags/week	Gerehu Wholesale
W14	Male	32	7 years	60–70 bags/week	Gordons Wholesale Yard

W15	Female	46	20 years	85–100 bags/week	Gordons Wholesale Yard

Appendix B Table 12: Demographics of Transporters (T1–T5)

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Participant ID	Gender	Age Range	Years of Experience	Transport Capacity (trucks)	Main Route
T1 (Mapai Trucking Company)	Male	36	12 years	Around 100	Highlands → Lae
T2 (Traisa Trucking company)	Male	50	18 years	Over 100	Highlands → Lae
T3 (Consort Shipping Company)	Male	26	7 years	Over 20 ships	Lae → Port Moresby
T4(Bismark shipping companies)	Female	40	9 years	Over 20ships	Lae → Port Moresby
T5 (Express Freight Management)	Male	55	20 years	Over 15 ships	Lae → Port Moresby

Appendix A Table 13: Demographics of Vendors (V1–V15)

Participant ID	Gender	Age Range	Years of Experience	Business Scale (bags/day)	Location (Market)

V1	Female	40	8 years	10–15 bags/day	Gordons Market
V2	Male	26	6 years	5–10 bags/day	Gerehu Market
V3	Female	66	15 years	20–25 bags/day	Gordons Market
V4	Female	37	4 years	8–12 bags/day	Boroko Market
V5	Male	38	12 years	15–20 bags/day	Gordons Market
V6	Female	30	7 years	12–18 bags/day	Gerehu Market
V7	Male	53	14 years	20–30 bags/day	Gordons Market
V8	Female	32	5 years	6–10 bags/day	Waigani Market
V9	Female	29	10 years	15–20 bags/day	Gordons Market
V10	Male	25	3 years	5–8 bags/day	Boroko Market
V11	Female	67	18 years	25–30 bags/day	Gordons Market
V12	Male	43	9 years	12–15 bags/day	Gerehu Market
V13	Female	36	11 years	18–22 bags/day	Gordons Market
V14	Male	26	6 years	7–12 bags/day	Waigani Market
V15	Female	51	20 years	20–25 bags/day	Gordons Market

Appendix B Table 14: Demographics of Consumers (C1–C15)

Participant ID	Gender	Age Range	Household Size	Purchase Frequency	Usual Purchase Location
C1	Female	30	4	2–3 times/week	Gordons Market
C2	Male	32	6	Weekly	Gerehu Market
C3	Female	27	5	2 times/week	Boroko Market
C4	Male	19	3	Weekly	Waigani Market
C5	Female	45	7	3–4 times/week	Gordons Market
C6	Male	21	2	Weekly	Street Vendors
C7	Female	46	8	Weekly	Gordons Market
C8	Male	58	5	2 times/week	Gerehu Market
C9	Female	26	3	3 times/week	Gordons Market
C10	Male	36	6	Weekly	Boroko Market
C11	Female	50	4	2–3 times/week	Gordons Market

C12	Male	43	7	Weekly	Waigani Market
C13	Female	40	2	2 times/week	Gordons Market
C14	Male	37	5	Weekly	Gerehu Market
C15	Female	36	6	3 times/week	Gordons Market

Appendix B Table 15: Demographics of Government/NGO Participants (G1–G3)

Participant ID	**Gender**	**Age Range**	**Years of Experience**	**Role/Position**	**Organization Type**
G1	Male	50	15 years	Crop Production Specialist	National Agriculture Research Institution (NARI)
G2	Female	36	12 years	Program Manager – Food Security	Fresh Produce Development Agency (FPDA)
G3	Male	40	8 years	Market Development Specialist	

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