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ANALYSE SOCIO-ECONOMIC FACTORS INFLUENCING COLD CHAIN LOGISTICS ADOPTION BY SMALL-HOLDER FARMERS IN DOMBOSHAVA, ZIMBABWE.

BY

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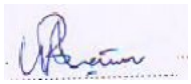
SIGNED: ……  ……..

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DECLARATION

I WEBSTER BHAIRA, proclaim that this research project is of my own work which has not been copied or picked up from any other source which is not acknowledged in this project. All information from other sources and literatures are highlighted in this project. The contribution from the supervisor and others was in-line with the Bindura University of Science Education guidelines.

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Signed

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DEDICATION

Firstly I would like to thank the Almighty God for giving me the strength and wisdom to make

this dissertation a success. Then I would want to extend my gratitude to my supervisor Mr.

Bindu for his tireless guidance throughout my dissertation formulation, my friends and my own
efforts. I'm thankful.

THANK YOU.

ABSTRACT

This study looks on an analysis on the socio-economic factors affect the adoption of cold chain

logistics among smallholder farmers in Zimbabwe which is a case study of Domboshava area.

A simple random sampling method was utilized where a sample size of 30 farmers was taken.

Information was gathered through questionnaires. The analysis list the different socio-

economic factors which includes, high upfront investments for cold storage equipment,

unreliable energy infrastructure, reduced finance availability, a lack of technical expertise,

including gender differences in decision-making and resource access. This study’s objectives

are, to examine smallholder farmers' awareness and understanding of cold chain logistics in

Domboshava, to investigate the infrastructure and cost issues impeding cold chain logistics

adoption, to make policy recommendations that might boost smallholder farmers' adoption of

cold chain logistics, to determine the impact that farmers' views of CCL and level of expertise

they have on their readiness to implement such systems. Tables, graphs are produced using

information gathered. The study ends with suggestions that the research underscores that

visual, vernacular, and hands-on communication models are urgently needed to boost

awareness, without public-private interventions to bridge this infrastructure gap, adoption will

remain low, farmers recommended the introduction of farmer-led policy forums, local

cooperatives equipped with shared cold rooms, and training incentives tied to infrastructure

investment, farmer’s education and technology acceptance, and also women inclusion in

agriculture technology systems. As a result, this study advances on, impact of mobile cold

chain units on postharvest loss reduction and market price stability in peri-urban settings

evaluating operational sustainability and gender-disaggregated benefits, effectiveness of peer-

led demonstration models in increasing technology adoption especially among low-literacy

farmers in similar peri-urban and rural contexts, intersection of cold chain logistics with digital

agriculture platforms, including apps and SMS systems, to enhance cold storage scheduling,

maintenance alerts, and market coordination, longitudinal study on policy engagement

outcomes from farmer-led advocacy in agricultural logistics, examining whether bottom-up

governance improves technology integration and trust.

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Contents

LIST OF TABLES

LIST OF FIGURES

ABREVIATIONS

CCL- Cold Chain Logistics

PHL- Post-Harvest Losses

DIT- Diffusion of Innovations Theory

AVC- Agriculture Value Chain model

TAM- Technology Acceptance Model theory

SADC – Southern African Development Committee

SPSS – Statistical Package for Social Sciences

NGO's – Non Governmental Organisation

CHAPTER 1

INTRODUCTION

1.0 Introduction

With substantial contributions to GDP, employment, and food security, the agriculture industry is essential to Zimbabwe's economy,contributing immensely to improving the rural livelihoods (Han et al., 2021). However, due to inappropriate managing the storage and transportation, post-harvest losses remain a significant problem, with an estimated 30% of fresh produce being lost annually (Mujeyi et al., 2021), especially for smallholder farmers. One practical way to lower post-harvest losses and increase farmers' income is through managing cold chain logistics, which ensures the temperature-controlled preservation of perishable items from harvesting to market.Due to several socio-economic limitations, cold chain logistics adoption among smallholder farmers in Zimbabwe is still limited, despite its potential advantages (Nyamushamba et al., 2020). Smallholder farmers in Domboshava, a peri-urban region prominent for horticultural output, poultry e.g. chickens encounter obstacles like limited access to cold storage facilities, high operational expenses, and insufficient infrastructure and equipment (Mupeti et al., 2022). According to (Kilelu et al., 2024), implementing cold chain practices is further limited by disintegrated supply chains, minimal overall understanding, and low financial literacy. It is crucial to comprehend these socio-economic obstacles to create focused interventions that can increase cold chain adoption and boost farmers' profits. This study seeks to examine the social and economic factors influencing smallholder farmers' adoption of cold chain logistics in the Domboshava area. Through the analysis of important hurdles like price, awareness, infrastructure, and limited market connections, the study seeks to offer policy suggestions that can help smallholder farmers become part of effective cold chain systems. The results will advance the body of knowledge on agricultural logistics and guide tactics to lower post-harvest losses in Zimbabwe's small-scale farming industry.

1.1 Background of the study

Over 60% of the workforce is employed in agriculture, and a 12-15% GDP contribution forms the backbone of Zimbabwe's economy (FAO, 2022; World Bank, 2021). The agricultural industry is dominated by smallholder farmers, who are essential to rural lives and food security. Nonetheless, post-harvest losses continues to be a major problem, estimates indicate that insufficient storage and transportation conditions cause 30-40% of perishable products to be

lost (Mujeyi et al., 2021). A crucial way to reduce these losses is through managing cold chain logistics, a temperature-controlled supply chain system that maintains the quality and shelf life of agricultural products (Kitinoja, 2020).

Cold chain logistics (CCL) is an established means of lowering post-harvest losses (PHL), increasing shelf life, and improving market accessibility by maintaining regulated temperatures from harvest to market. Globally, the implementation of CCL has revolutionized the agricultural sectors in nations like Kenya and India, where smallholders have seen increases in income of up to 50% due to decreased spoilage. In Zimbabwe, CCL adoption is still low despite its promise, particularly among smallholders. Although localized data is still lacking, the first studies relate this discrepancy to socioeconomic hurdles such as high upfront expenses, restricted access to technology, and inadequate infrastructure.

The semi-arid Domboshava Area, which is located 30 kilometres northeast of Harare, is a prime example of these difficulties. Over 2,000 small-scale farmers raise mostly extremely perishable leafy greens, tomatoes, and poultry. Despite being situated near metropolitan markets, farmers continue to experience PHL because of less effective transportation, storage facilities, and a shortage of reasonably priced cold storage systems. CCL measures have been launched by the government and NGOs, but adoption is still limited, indicating deeper socio-economic restrictions. A 2022 survey by (Mafirakurewa et al., 2023), revealed that only 12% of Domboshava farmers used refrigeration of any kind, citing financial constraints and a lack of technical expertise.

The socio-economic aspects of CCL in Africa are frequently overlooked in favour of technical or institutional variables in the research that is currently available. In Zimbabwe, research emphasizes issues at the macro level, such as policy instability and inflation, but ignores local obstacles, such as the impact of social networks in technology adoption or gender differences in resource access. This study closes these gaps by examining how infrastructure, gender, income levels, education, and credit availability influence the adoption of CCL in Domboshava. A mixed-methods approach is used to capture the complex experiences of farmers.

The research intends to provide insight into these issues to inform specific policies that will increase the uptake of CCL, such as gender-inclusive training programs or subsidized cold

storage cooperatives. In addition to supporting SDGs 2 (Zero Hunger) and 9 (Industry, Innovation, and Infrastructure), its conclusions may help Zimbabwe's National Development Strategy 1 (2021–2025), which places a high priority on agricultural modernization. Smallholder empowerment through CCL has the potential to revolutionize rural economies by converting subsistence farming into sustainable agribusiness.

Smallholder farmers in Zimbabwe, particularly in regions like Domboshava, are critical to national food security and rural livelihoods. However, their agricultural productivity and income remain constrained by significant post-harvest losses (PHL), estimated at 30-40% for perishable crops, due to inadequate storage and transportation systems. Cold chain logistics (CCL) presents a viable solution to mitigate these losses by preserving crop quality, extending shelf life, and connecting farmers to lucrative markets. Despite its proven effectiveness in other developing contexts, CCL adoption among smallholder farmers in Zimbabwe and Domboshava specifically remains alarmingly low, with only 12% of farmers utilizing basic refrigeration technologies.

Socio-economic reasons are frequently blamed for the difficulties related to CCL adoption, but limited research explains how these aspects specifically interact in Zimbabwe. Smallholders in Domboshava, for example, deal with issues like high upfront investments for cold storage equipment, unreliable energy infrastructure, reduced finance availability, and a lack of technical expertise. Adoption may also be hampered by social and cultural variables, including gender differences in decision-making and resource access. Existing research focuses on macro-level problems, including policy gaps and inflation, but it doesn't sufficiently address local socioeconomic barriers that have a direct impact on farmers' ability to implement CCL.

This knowledge gap makes inefficient solutions more likely to occur. Subsidized storage facilities or training programs are examples of government and non-governmental organization initiatives that promote CCL, but they frequently overlook the complex circumstances faced by smallholder farmers, which results in limited uptake and sustainability. Customized solutions cannot be created without a thorough examination of the socioeconomic elements, including socioeconomic status, education, gender roles, infrastructure, and financial accessibility. Food insecurity, poverty, and dependence on subsistence farming in Domboshava are thus made worse by farmers' ongoing avoidable losses.

Therefore, the purpose of this study is to look at social and economic variables that either help or hinder smallholder farmers in Domboshava from adopting CCL. By identifying these variables, the study hopes to give stakeholders, development organizations, and policy-makers useful information for creating context-specific strategies that increase CCL uptake, lower post-harvest losses, and strengthen the socioeconomic resilience of smallholder farming communities in Zimbabwe.

1.3 Purpose of the study

This study's goal is to examine the social and economic factors that affect smallholder farmers in Zimbabwe's adoption of cold chain logistics, with a particular focus on the Domboshava region. A system for preserving perishable agricultural products through temperature-controlled storage and transportation, known as cold chain logistics, has the potential to improve market accessibility, lower post-harvest losses, and increase smallholder farmers' income stability. Nonetheless, adoption rates are still low in Zimbabwe, especially among farmers with little resources.

1.4 Research objectives

1. To examine smallholder farmers' awareness and understanding of cold chain logistics in Domboshava.
2. To investigate the infrastructure and cost issues impeding cold chain logistics adoption.
3. To make policy recommendations that might boost smallholder farmers' adoption of cold chain logistics.
4. To determine the impact that farmers' views of CCL and level of expertise they have on their readiness to implement such systems.

1.5 Research questions

1. To what extent are smallholder farmers in Domboshava aware of and knowledgeable about cold chain logistics?
2. What infrastructure and financial constraints limit cold chain logistics from being widely used?

3. What policies might inspire smallholder farmers to support cold chain logistics?
4. What role does education and technical knowledge play in shaping farmers' perceptions of CCL?

1.6 Significance of the study

Many stakeholders may find great value in this report on "An analysis of the socio-economic factors affecting the adoption of cold chain logistics among smallholder farmers in Domboshava, Zimbabwe":

1. Smallholder Farmers - The study assists farmers in understanding how to lower post-harvest losses and enhance market access by identifying the main obstacles (such as cost, understanding, and infrastructure) that limit the implementation of cold chain logistics.
2. Government & Policymakers - In order to encourage cold chain adoption and improve food security and rural livelihoods, this research will guide policy on agricultural assistance programs, infrastructure development, and financial incentives.
3. Economic Development - Smallholder farmers may boost incomes, access premium markets, and maintain shelf life by enhancing cold chain logistics, which will contribute to Zimbabwe's overall agricultural and economic development.
4. Providers of Agribusiness & Logistics - Private sector investments in scalable and reasonably priced cold storage solutions for smallholders might be guided by knowledge of the socioeconomic limitations faced by farmers.

All things considered, this study offers practical suggestions to improve the use of cold chain logistics, which will help farmers, agricultural businesses, as well as the national economy.

1.7 Assumptions

The study makes the assumption that socioeconomic factors such as income, education, credit availability, infrastructure, and market connections have a greater impact on adoption than political unpredictability or climatic change, which are considered contextual background. Responses from farmers during surveys and interviews are assumed to be truthful and reflective of their actual practices, perceptions, and constraints.

1.8 Scope of the study

This study focuses on smallholder farmers in Domboshava, a poultry and horticulturally productive peri-urban area. The study examines the socio-economic aspects of cold chain adoption, including infrastructure, awareness, market connections, and financial constraints. Farmers, agricultural extension agents, and supply chain participants will collectively provide data.

1.9 Delimitations of the study

Delimitations specify the conditions of the investigation and make it clear which will and won't be covered. The following are the delimitations for this study geographic scope, the study solely looks at smallholder farmers in Zimbabwe's Domboshava region results might not apply to other areas. Time frame, long-term trends in cold chain adoption are not evaluated, and data collection and analysis are strictly limited to a particular time frame. Socio-economic factors throughout the study ignores other potential variables like political or cultural impacts in support of focusing on infrastructure, education, income levels, and credit availability. The adoption of cold chain logistics in agriculture is the study's primary focus while other industries like medicines and fisheries are not included.

1.10 Limitations of the study

Limitations refer to potential shortcomings in the study that may affect the results but are beyond the researcher's control. These consist of challenges with data collection: Farmers' answers could be distorted by inaccurate memory recall or a reluctance to disclose operational and financial issues. Limited secondary data, comparative analysis may be constrained by the absence of current research on cold chain logistics in Zimbabwe, particularly around Domboshava. External factors, while not fully taken into account in the study, unpredictable factors like inflation, climate change, and policy changes may have an impact on the adoption of cold chains.

1.11 Definition of terms

Adoption refers to the choice and procedure that people or organizations make in order to adopt, incorporate, and use a new technology, system, or innovation into their current routines in a sustainable manner.

Socio-economic refers to the associated social and economic elements that influence the opportunities, practices, and quality of life of people, households, or societies. These elements affect decision-making, resource accessibility, and the ability to engage in economic activity.

1.11 Summary

The investigation is composed of five parts. Part one covers the presentation, foundation of the investigation, articulation of the issue, motivation behind the examination, inquire about destinations, look into inquiries, significance of the examination, scope of the examination, delimitations of the investigation, impediments of the investigation, and association of the investigation. Literature review is covered by chapter two, chapter three covers methodology, chapter four data analysis, interpretation, and presentation, and in conclusion, part five presents a synopsis of the discoveries, exchanges, ends, and suggestions.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

With an emphasis on the Domboshava region of Zimbabwe, this chapter of the dissertation examines the research on the socio-economic factors influencing smallholder farmers' adoption of cold chain logistics. The system of cold chain logistics, which is essential for maintaining perishable agricultural products through temperature-controlled transition and storage, is essential for reducing post-harvest losses, boosting market competitiveness, and strengthening livelihood resilience. In environments with limited resources, such as Zimbabwe, where smallholder farmers have structural socio-economic obstacles, its uptake is still low. This chapter establishes the obstacles and drivers of cold chain adoption while emphasizing the gaps that this study aims to fill by synthesizing regional and international literature, theoretical frameworks, and practical studies.

2.1 The concept of Cold Chain Logistics Adoption

The process by which smallholder farmers incorporate temperature-controlled systems (such as solar powered refrigeration, cooled storage, and improved transportation conditions e.g. transporting during the early or late hours of the day) into their post-harvest procedures in order to preserve perishable agricultural products, lower losses, and increase market value is known as cold chain logistics (CCL) adoption(Kilelu et al., 2024) .Adoption of CCL in Zimbabwe, especially among smallholders in Domboshava, is a socioeconomic choice impacted by a number of interdependent variables, including infrastructural availability, institutional support, financial capability, and cultural standards (Han et al., 2021). CCL is a vital instrument for sustainable agriculture-based development since post-harvest losses, which are estimated to be between 30 and 40 percent for perishables in sub-saharan Africa, seriously jeopardise food security and economic stability (Pandeya et al., 2025).

2.1.1 Cool to cold storage

These are facilities that maintain particular temperature zones, such as solar powered refrigeration systems, shades for storage, which serve the purpose of preventing deterioration during bulk storage. (Ndlovhu, Senamiso L. 2022) highlights post-harvest losses and the cold chain's role in reducing food waste, particularly in developing nations like Zimbabwe. One example is storerooms with thatched grass which is locally available materials grass and wood, which can provide a cool storage for fresh produces like tomatoes and vegetables.

2.1.2 Managed transportation time

Trucks, can be loaded during the earlier or late hours of the day, the goal assures steady conditions while in transit since the temperatures will be cooler than during the day. The importance of temperature managed transportation in lowering post-harvest losses in underdeveloped nations is highlighted by (Kilelu et al., 2024) . The concept behind enables the timely managed transportation system of produces in transit dynamically modifying their temperatures in response to outside conditions.

2.1.3 Customized Packaging

Materials and preservative containers that act as a safeguard against produces like tomatoes to have bruises, these includes crates, trays, and cooler boxes for last-mile deliveries.These help inpreserving the produces not to succumb scratches which might make them susceptible to temperatures and also cutting waste. Packaging, such as cooling boxes, is highlighted by (Ndlovhu et al., 2022) as a means of lowering losses in disrupted supply chains. Investing in customized solutions gives businesses a competitive advantage by guaranteeing that consumers will receive fresher, longer-lasting products.

2.2 Theoretical review

This theoretical analysis looks at the conceptual frameworks that clarify how socio-economic issues affect smallholder farmers in Domboshava, Zimbabwe, as they embrace cold chain logistics. A detailed understanding of the adoption challenges and drivers in this setting is provided by the analysis, which draws on related theories.

2.2.1 Diffusion of Innovations Theory (DIT)

The diffusion of innovations concept developed by Rogers (2003), describes how new technologies like solar powered refrigeration, spread among users based on factors such as testing, observation, complexity, reliability, and potential benefits. Domboshava smallholder farmers may be reluctant to adopt cold chains due to their high complexity (requiring technical knowledge) and limited success narratives. According to research conducted in Africa, technologies that have definite economic advantages, like lower post-harvest losses, are embraced more quickly (Han et al., 2021).

2.2.2 Institutional theory

Institutional theories offer a critical perspective for comprehending how corporate structures, legal and informal regulations, and norms influence the implementation of cold chain logistics. The regulatory framework, social norms, and financial structures that govern agricultural systems all have a significant impact on technology adoption, according to these ideas (Issn & No, 2025). Affordability is also influenced by these formal institutions, government policies (such as power access and refrigeration systems subsidies) (Nyamangara et al., 2020). Adoption may be compelled or encouraged by regulatory frameworks (such as food safety regulations). Low compliance has resulted from Zimbabwe's post-harvest policies being poorly enforced (Mutambara et al., 2020). Upon adoption, they are slowed by unofficial institutions, i.e., smallholder farmers' social norms, such as mistrust of new technologies (A. Srivastava et al 2025), women's access to cold chain resources may be limited by gender roles (Ndlovu et al., 2021).

2.2.3 Technology acceptance model (TAM)

Davis (1989) developed the technology acceptance model (TAM). According to the TAM framework, technology adoption is influenced by two main factors, perceived utility, which is an assumption that cold chains will increase output or revenue, and perceived ease of use, which is an estimate of the complexity of implementation. According to studies conducted in comparable African contexts, smallholder farmers frequently view post-harvest technologies as too costly in comparison to the anticipated advantages (Mujeyi and others, 2021), too difficult without adequate guidance , and unsuitable for current agricultural practices.

2.2.4 Agricultural value chain theory

From farm to consumer, value is added at every stage of production, according to the Agricultural Value Chain (AVC) theory. This theory clarifies these aspects of cold chain adoption, which include value addition mechanisms, value chain upgrading and cold chains, transaction cost in value chains, government structures, and cold chain adoption (Kilelu et al., 2024). According to this theoretical framework, cold chain adoption needs to be viewed as an aspect of larger value chain dynamics, where adoption patterns are determined by a combination of governance frameworks, coordination mechanisms, and financial incentives. This framework will be used in the study to examine the unique value chain context of Domboshava.

2.3 Awareness and understanding of cold chain logistics

A key factor in adoption is smallholder farmers' understanding and appreciation of cold chain logistics (CCL), which influences their attitudes, willingness to make investments, and ability to efficiently use temperature-controlled storage and transportation. According to recent studies, there are still knowledge gaps, with many farmers only connecting CCL to large-scale commercial operations or export-oriented agriculture, ignorant to its relevance for preserving local markets and minimizing losses (Mutambara et al., 2020). Domboshava farmers were surveyed in 2023, and the results showed that although 62% of them understood the basic concepts of refrigeration, only 12% were aware of the full extent of CCL, which includes energy-efficient cooling solutions, crating packaging, and timely managed transportation (Agritex, 2023). Limited access to agricultural extension services, which results in only 35% of farmers receiving formal training on post-harvest management, exacerbates this knowledge gap (ZimStat, 2022).

Many farmers overstate capital requirements and underestimate potential returns, such as the 20-30% price premiums achievable for chilled produce in Harare's high-value markets, due to incorrect assumptions about costs and technical complexity, which complicates adoption (World Bank, 2022). Targeted interventions, like mobile training units, community-based demonstration projects, and digital awareness campaigns, are crucial to removing these challenges and explaining CCL while showcasing its socioeconomic advantages, such as improved market access and a 40% decrease in post-harvest loss to less than 15% (FAO, 2023). Domboshava's agricultural ecosystem can create a more knowledgeable and open atmosphere

for cold chain adoption by incorporating CCL education into already-existing farmer outreach initiatives and utilizing peer-to-peer knowledge sharing.

2.3.1 Infrastructure and cost issues

Due to a lack of infrastructure and prohibitive costs, cold chain logistics adoption among smallholder farmers in Domboshava is severely limited. These factors combined create formidable implementation barriers. According to ZERA (2023), only 23 percent of rural households in the region have access to reliable energy power, making conventional refrigeration systems challenging and resulting in the use of costly alternatives like solar powered cooling units or diesel-powered generators, which come with an initial cost of about $2,500 per unit, which is significantly more than the average smallholder's yearly income (Mujeyi et al., 2023). This problem is made worse by the absence of centralized cold storage facilities in the area, where the closest temperature-controlled warehouses are more than 30 kilometers away in Harare, which raises transportation expenses and post-harvest losses during transit (Nyamangara et al., 2022).

Moreover, farmers are solely responsible for maintenance costs, such as fuel for generators and replacement parts for solar panels, which make up 40% of operating costs, due to the lack of coordinated value chain support (RBZ, 2023). Since only 15% of smallholders are eligible for formal loans and informal lenders charge unacceptable interest rates of up to 30%, these financial burdens are made worse by restricted access to credit (FAO, 2023). The economic feasibility of cold chain adoption is still out of reach for the majority of Domboshava farmers in the absence of focused measures, such as collaboration between the public and private sectors to increase rural electrification, cooperative-based financing models, and subsidized solar cold hubs. This will prolong cycles of post-harvest waste and reduce market competitiveness.

2.3.2 Policy recommendations that might boost smallholder farmers

In Domboshava, specific policy programs must address financial and infrastructure barriers while creating an enabling regulatory framework to increase smallholder farmers' adoption of cold chain logistics. Nigeria's successful ColdHubs project, which used inexpensive, pay-per-use cooling systems to cut post-harvest losses by 80%, should serve as the model for the

government's first sponsored solar-powered cold storage programs (IAPRI, 2023). Second, smallholders could reduce upfront costs by utilizing low-interest loan programs, such as Kenya's KCB Cold Chain Loan program, with credit lines supported by risk-sharing arrangements between banks, development organizations, and agribusinesses (World Bank, 2022).

Using farmer groups and mobile demonstration units to highlight advantages like the 30% income increases seen among Tanzanian horticulturists, third, incorporating cold chain training into national extension services would enhance technical literacy (FAO, 2023). Public-private partnerships should also encourage private investment in cold chain infrastructure in rural areas. For example, Zimbabwe and Innscor Africa have partnered to install shared cold rooms close to aggregation centres (ZimTrade, 2023). According to Nyamangara et al. (2022), policy harmonization is crucial. While tax exemptions on imported refrigeration equipment could reduce adoption costs, bringing food safety regulations into line with regional trade standards (such as the SADC Cold Chain Guidelines) would create market incentives for compliance. These steps would establish a sustainable path for cold chain integration, boosting Domboshava's agricultural output and competitiveness in the market, especially when combined with gender-inclusive financing to close the access gaps for women (Ndlovu et al., 2021).

2.3.3 The impact that farmers' views of CCL and level of expertise

Smallholder farmers' opinions of the technology's relevance and their degree of technical expertise have a significant impact on their adoption of cold chain logistics (CCL) in Domboshava. These factors both affect their ability to make decisions and carry them out. Only 18% of farmers acknowledge that CCL can help them lower their post-harvest losses, and many see it as complicated and financially unaffordable. Research indicates that 65% of farmers only associate it with large-scale commercial operations (Mutambara et al.,2023).The lack of practical experience less than 20% of farmers have had official training in temperature control, equipment operation, or maintenance exacerbates this perception gap (Agritex, 2022). Technical illusions, such as overestimating energy expenses or overlooking shelf-life extensions, further deter investment, even though there is proof that appropriate cold storage can boost tomato sales by as much as 40% (ZimTrade, 2023).

Due to unequal access to training, women farmers, who make up the majority of horticultural production, have 30% less confidence in using CCL technology, which exacerbates gender disparities (Ndlovu et al., 2022). However, pilot programs in Domboshava have shown that focused education, such as mobile cold chain demonstrations and peer-led workshops, can change attitudes and increase adoption intent by 50% when farmers see real benefits like less spoiling (FAO, 2023). To turn uncertainty into regular CCL use and eventually improve market competitiveness and income stability for Domboshava's smallholders, it will be essential to address these knowledge acquisition and skill-based constraints through regional training initiatives and farmer-to-farmer exchange of information.

2.4 Challenges in cold chain adoption

Regardless of its potential to improve market access, reduce post-harvest losses, and increase food security, cold chain logistics adoption among smallholder farmers in Zimbabwe is still extremely low. Cold chain systems, which involve temperature-controlled storage, managed transportation time, and handling of perishable goods, are especially important for horticultural producers dealing with highly perishable crops, but several socio-economic barriers have historically prevented widespread adoption, ranging from institutional weaknesses and knowledge gaps to financial constraints and infrastructural deficiencies.

2.4.1 Capital expenditure

Smallholder farmers' adoption of cold chain logistics has been slowed over time by a complex network of institutional, financial, infrastructural, and educational challenges. One significant obstacle in the past has been the large capital expenditure needed for cold chain infrastructure, such as refrigerated storage and transportation. Because of the high prices and narrow financing choices, early research in Zimbabwe (Kilelu et al., 2024) found that less than 5% of smallholder farmers had access to cold storage practices. Due to operating costs, such as fuel and maintenance, which took a significant portion of farmers' profits, adoption of mobile cold storage units and cooperative ownership models remained low even after their debut in the mid-2010s.

2.4.2 Insufficient infrastructure

Adoption difficulties have been worsened by insufficient infrastructure, especially in rural areas. According to (Masuka et al., 2025), just 12% of rural farming settlements were linked to the power supply in the early 2000s, indicating that inconsistent electricity delivery has long been a problem. Although solar-powered cold storage systems have become an accepted substitute in recent years (ColdHubs ZW, 2022), their scalability has been delayed by high upfront costs and farmers' lack of technical know-how (SNV Zimbabwe, 2023). Post-harvest losses have also been made worse by inadequate road networks and poorly managed transportation systems, research shows that up to 73% of perishable products spoil in transit because of inadequate temperature-managed logistics (Nyamangara, 2020).

2.4.3 Market dynamics

Other challenges include value chain complexity and market dynamics. Export-oriented farmers who could afford the high expenses of cold chain compliance were the main forces behind the early adoption (World Bank, 2021). However, because there are no price advantages for temperature-controlled produce, smallholders who supply informal markets, which make up the majority of Zimbabwe's agricultural sector, have had little motivation to invest (IFAD, 2023). Farmers are being pushed into short-term cash sales instead of making long-term investments in cold chain logistics due to recent inflation and currency instability, which has further twisted market incentives (ZimTrade, 2024).

2.4.4 Societal and government policies

Adoption has also been significantly hampered by societal and institutional issues. This is because female-headed households have historically had 50% lower adoption rates than male counterparts, gender differences in resource access have been especially noticeable (Pandeya 2021) . Long-standing traditions still have a lower number of women owning cold chain assets, despite recent efforts to promote gender-inclusive training and cooperative models showing modest success (FAO, 2023). Furthermore, as demonstrated by Ruzivo Trust (2020), which discovered that farmers with formal lease agreements were 67% more likely to adopt such systems, community farmers' land tenure uncertainty has deterred long-term investments in cold chain technologies. Inconsistent policies have made inequality worse by favoring large-

scale producers over smallholders, such as the unequal allocation of VAT exemptions on refrigeration equipment (ZIMRA, 2023).

2.5 Empirical evidence

In sub-Saharan Africa, preliminary research revealed structural obstacles to cold chain adoption. Only 5% of smallholder farmers in Zimbabwe's Mashonaland provinces employed any kind of temperature-controlled storage, according to. They attributed this to the country's sparse rural power (at 12% coverage at the time) and the high price of diesel generators. According to a 2023 World Bank analysis on Zimbabwe's horticulture industry, smallholders relied on unofficial loss-prone practices, including shade storage, while export-oriented farmers, mostly large-scale, dominated cold chain use. Group-owned cool rooms might save post-harvest losses by 40%, according to early interventions like the EU-funded Hortimex project FAO&AUDA-NEPAD. (2023). However, sustainability failed because of a lack of maintenance training.

Studies started directly linking socio-economic factors to adoption. In Goromonzi district (next to Domboshava), a seminal study by Chagomoka. T (2022) found that farmers with a secondary education were 3 times more likely to use cold storage, while those without formal contracts turned down investments because of the uncertain returns. Citing discriminatory access to credit, the Zimbabwe Vulnerabilities Assessment Committee (ZimVAC, 2020) found that adoption rates were 50% lower in families headed by women than in those headed by men. Financial hurdles were assessed by (Nyamangara .J 2022), who found that 82% of smallholders' yearly revenue was less than the average cold chain establishment cost of $2,000. Importantly, farmer participation in mobile cold chain trials (such as the ZimCold Trucks Initiative) increased sales income by 35%, indicating promise.

The financial sector innovations, RBZ's "Pfumvudza" scheme (2020-2022), comprised cold chain subsidies, but due to low awareness, uptake remained low (15%) (ZimStat, 2021). Climate change pressures, according to a 2023 ICRISAT study conducted in Domboshava, rising temperatures were linked to 30% faster spoilage rates, forcing 42% of farmers to investigate cold storage however, only 8% were successful, citing energy instability (Solar Energy Foundation, 2023). Policy shifts, Zimbabwe's National Development Strategy 1 (NDS1, 2021-2025) valued cold chain expansion, but rural implementation lagged. ZIMRA

(2023) found that VAT exemptions on refrigeration imports primarily benefited urban agro-processors, not smallholders.

According to new data (FAO, 2023), women's adoption rates in cooperatives with gender-sensitive training increased slightly (from 12% to 18%), but asset ownership was still constrained by cultural norms. As technology moves ahead, solar-powered cold room pilot projects (like Cold-Hubs ZW, 2022) reduced costs for operation by 80%, but they needed shared ownership models to be successful (SNV Zimbabwe, 2023).

2.6 Gap analysis

The majority of studies on cold chain adoption in Zimbabwe have concentrated on export-oriented farms or larger regions (such as Mashonaland East and Goromonzi), paying little attention to hyper-local environments like Domboshava. Although research like Nyanga et al. (2020) provides light on infrastructure and financial obstacles, they fail to take into consideration the various socio-economic conditions of Domboshava, which include proximity to Harare (a major market), cultural practices (influencing technology adoption), and land tenure practices (A1 resettlement farmers against communal). This research seeks to fill a gap in previous studies by analysing the socio-economic factors affecting the adoption of cold chain logistics among smallholder farmers in Zimbabwe in Domboshava.

2.7 Chapter summary

This chapter examines the body of research on the socio-economic variables affecting smallholder farmers' adoption of cold chain logistics, with a particular emphasis on the Domboshava region of Zimbabwe. The main obstacles that prevent smallholder farmers from efficiently using cold storage and transportation are covered, including high costs, restricted financing availability, poor infrastructure setup, and a lack of technical expertise (Machethe. C 2022). To examine how farmers view and accept new technologies, the chapter also looks at theoretical frameworks such as the Diffusion of innovations theory. The relevance of market connections, extension services, and government regulations in promoting cold chain adoption is highlighted by empirical research from comparable situations. In order to improve post-harvest management among smallholder farmers in Domboshava, the literature emphasizes the necessity of focused interventions to overcome financial challenges and raise knowledge.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The adoption of cold chain logistics is essential for lowering post-harvest losses, this study uses an approach based on case studies to examine smallholder farmers in Domboshava, offering an in-depth understanding of the socio-economic factors that influence their adoption of cold chain logistics. This study employs qualitative research method to examine these factors. A thorough discussion is held regarding the research design, target population, sampling strategies, data collection tools, and data analysis techniques. The chapter also discusses ethical issues and constraints that arise throughout the research.

3.0 Research methodology

This study uses an approach based on case studies to examine smallholder farmers in Domboshava, offering an in-depth understanding of the socio-economic factors that influence their adoption of cold chain logistics. The results of this study will be used to inform policy recommendations that will encourage the adoption of cold chain logistics by small-scale farmers in Zimbabwe and other agrarian economies. This chapter's following sections go into further detail about the research theories, methodology, design, data collection techniques, and analytical frameworks that were employed to accomplish the goals of the study.

3.1 Research design

A mixed research approach is used in this study which are both exploratory and descriptive to investigate the socioeconomic factors influencing smallholder farmers in Domboshava, Zimbabwe, as they implement cold chain logistics. Through focus groups of smallholder farmers, regional agricultural extension agents, and cold chain service providers. I used both of these to ensure thorough, context-specific data, participants with first-hand experience handling perishable produce will be chosen through the use of simple random sampling. To find reoccurring themes on important obstacles including financial limitations, a lack of infrastructure, low awareness, and finance accessibility, thematic analysis will be used. This study is looking on a number of 30 farmers and the response rate is estimated at around 76%

which is about 23 farmers, and the anticipated adoption rate is estimated at 15-25% based on previous research (Nyamandi et al., 2021)on comparable situations, reflecting typical barriers like lack of funding and infrastructure. With the use of the qualitative design, farmers' perspectives and obstacles will be better understood, and useful suggestions will be made to increase cold chain adoption in comparable rural areas. Exploratory research presents the researcher more freedom to collect data, which enables them to dig deeper into unexpected findings and emerging themes. For this study, a descriptive approach would be particularly valuable in benchmarking adoption trends and identifying priority areas for stakeholder action.

3.1.2 Justification of qualitative research method

The qualitative method was chosen due to the following reasons, nature of the research problem subjective elements like attitudes, perceptions, and socio-cultural norms impact the adoption of cold chain logistics, and qualitative methods are the most effective way to investigate these factors. Limited previous research, although there are other studies on cold chain logistics, little is known about the socio-economic obstacles from the viewpoint of farmers, especially in Zimbabwe. Policy and practical relevance, based on the unique requirements and limitations of smallholder farmers in Domboshava, qualitative research can offer practical suggestions.

3.2 Subject of the research

The socioeconomic factors influencing smallholder farmers' adoption of cold chains in Domboshava, Zimbabwe, are the main focus of the study. The term "cold chain" describes temperature-regulated distribution and storage systems that prevent perishable agricultural products (such as fruits, vegetables, and dairy) from going bad. This study looks at how farmers' ability and willingness to adopt cold chain are influenced by a variety of factors, including infrastructure, government policies, cultural practices, income levels, education, and market accessibility. Smallholder farmers in Zimbabwe's rural farming community of Domboshava make up the target population. These farmers usually work on small land areas, practice small-scale commercial or subsistence farming, and deal with issues like poor market connections, post-harvest losses, and limited access to refrigeration of their produces. The

purpose of the study is to explore their particular socio-economic opportunities and limitations with regard to cold chain adoption.

The following people will take part in the study, smallholder farmers who produce perishable crops, agricultural extension agents (to offer information on government regulations and educational initiatives), if available, local cold chain service providers and agro-dealers can be used to gauge market accessibility, important informants (like local authorities and farmer cooperative representatives). To guarantee a range of viewpoints, simple random sampling will be used to choose these participants. Data will be gathered in order to examine the factors that encourage and hinder cold chain adoption in Domboshava.

3.3 Sample size

Finding a representative group within the smallholder farmers in Domboshava area. The sample is drawn from a sample size of 30 farmers from participants in the study who were chosen through a systematic approach. A sample is a subset of the population or universe from which conclusions are drawn Babbie E. (2021).

3.4 Simple random sampling

Each member of the statistical population has an equal chance of being selected to form the sample using the simple random method, according to Creswell, J. W., & Creswell, J. D. (2023). The sample drawn will be a true random sample, with every member of the population having an equal chance of being chosen. Using the random sampling technique, the second universe of respondents from different farmers was selected. The use of simple random sample will ensure, unbiased and can be seen to be representative of the population, enabled some respondents to have an equal chance of being selected among the given departments, the research incorporates free on errors in classification i.e. in this case one from each required category was selected with few classification errors, this is a benchmark upon which other probability sampling techniques were built.

3.5 Data sources

Primary and Secondary sources were employed in coming up with the data needed for the achievement of objectives of the research. Primary data, Original information obtained from the research's field of interest and used to answer the question and research objectives is known as primary data. Questionnaires were used to gather data from farmers, Agritex officers. The

information gathered would be directly from the period of harvesting of their produce up until they reach the market. This reseach of utilizes primary data, since the information gathered is highly suitable and directly related to the problem or area of study. In particular, the data collected was relevant to the research, the investigator was able to observe farmers and the authorities with greater objectivity because the data is current and very recent, because only data from smallholder farmers and supporting authorities were used, providing greater control over the accuracy of the information.

3.5.1 Secondary data

Teddlie, C., & Yu, F. (2020) defines secondary data as historical data structures of variables previously collected and assembled for some research problem or opportunity situation other than the current situation. Secondary data is a viable alternative source of information which provides comparative and contextual information that can result in other discoveries. This data can be obtained from online databases and websites. By utilising secondary data, there is efficiency in time and cost, because secondary data has already been gathered, thereby it can avoid wasting time and resources on data collection, logistical simplicity and ethics, simplifies the research process by eliminating the need for participant recruitment, informed consent, and ethical approvals, availability of vast and excellent data sets, secondary data, such as that gathered from governmental or scholarly sources, is frequently well-researched, representative, and broad..

3.6 Research instruments

For this study a questionnaire is employed which is effective method for gathering information for this study on the socio-economic factors influencing smallholder farmers' adoption of cold chain logistics in Domboshava, Zimbabwe. The capacity to efficiently collect standardized responses from a sizable sample, guaranteeing comparability and ease of analysis, is one of its advantages. In comparison to interviews, it is also less expensive and permits confidentiality, which promotes honest and accurate answers.

The accuracy of the data is limited by potential low response rates brought on by indifference or literacy barriers. Furthermore, closed-ended questions might limit in-depth understanding of complicated socio-economic issues, and poorly crafted questions might produce distorted or incorrect answers. At the extremely, the absence of face-to-face communication hinders the clarification of unclear responses, which may compromise the accuracy of the data. Measures like pre-testing the questionnaire to guarantee clarity, combining closed and open-ended

questions for deeper insights, and conducting online surveys while assisting for illiterate respondents, are all put in place to help lessen these problems. Furthermore, motivations and follow-up reminders were employed to increase response rates, and accuracy respondents reducing data collection errors while guaranteeing validity and reliability.

3.7 Data collection procedures

The researcher obtained the necessary clearances and approvals from the institution to guarantee that questionnaires could be completed without any problems or participant uncertainty. Additionally, the data was carefully compiled to ensure accuracy and thoroughness. Any unusual patterns or differences were carefully examined and verified to guarantee the validity of the study's findings.

3.8 Data analysis

The most important aspect of the study is this section, which summarizes the data that has been gathered and interprets it using logical and analytical reasoning to identify patterns and trends. Both descriptive and exploratory statistics were used to analyse the data that was gathered. SPSS software will be used to analyse the data for this study.

3.8.1 Validity

The validity of an instrument is determined by how well it captures the desired data. A transferable approach was used by the researcher to assess the degree of qualitative study results. The researcher was expected to complete the task thoroughly and make wise decisions. A self-administered questionnaire were used by the researcher to gather data and assistance where necessary. Both met the requirements for construction validity because they employed language free of jargon, which necessitated less clarification from respondents. To establish internal validity, a modified version of an existing questionnaire, preliminary qualitative data, and a substantial theoretical foundation were used.

3.8.2 Reliability

If an instrument is accurate, consistent, stable, and dependable, it is deemed reliable. ZimStat. (2022) define dependability in research as an evaluation of how well the study's component elements align with the conceptual idea or variable under investigation. Serious errors were found in the pilot test and quickly fixed. All those directly involved in the study were given questionnaires these include, key informants will be online forms and farmers will also be given online to answer.

3.9 Chapter summary

The qualitative research methodology employed to investigate the socio-economic factors influencing the adoption of cold chain logistics by smallholder farmers in Domboshava, Zimbabwe, is described in this chapter. In order to identify barriers related to society, the economy, and policy, the study uses an exploratory and descriptive research design. Using simple random sampling, 30 farmers' perspectives and difficulties were gathered through questionnaires. To ensure validity and reliability, SPSS was used to perform a thematic analysis of the primary data (direct farmer responses) and secondary data (existing reports and journals). Limitations like possible bias and small sample size were acknowledged, and ethical approvals were acquired. The results are intended to help guide policy suggestions for enhancing cold chain adoption in rural areas.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF QUALITATIVE RESULTS

4.0 Introduction

This chapter presents the findings from qualitative data collected to explore the socio-economic factors influencing the adoption of cold chain logistics (CCL) among smallholder farmers in Domboshava, Zimbabwe. Using an exploratory-descriptive design, responses from 23 participants (out of 30 targeted) were analyzed thematically, with insights supported by recent literature. The analysis was guided by the study's four objectives: assessing awareness of CCL, identifying infrastructure and cost constraints, proposing policy recommendations, and evaluating how perceptions and technical expertise influence adoption. Data were collected through semi-structured questionnaires and interpreted through key themes such as knowledge gaps, financial barriers, infrastructure inadequacy, and gender disparities. Direct participant quotes are integrated to illustrate real-world experiences, while charts and tables visually represent trends in demographics and responses. The results reflect both the limitations and opportunities for CCL integration within smallholder systems, offering a basis for the policy and practice recommendations explored in Chapter Five.

4.1 Response rate

The study recorded a commendable response rate of 76.7%, with 23 out of 30 questionnaires successfully completed and returned by smallholder farmers in Domboshava. This level of participation is not only statistically significant for qualitative exploratory research but also exceeds the minimum thresholds recommended for reliability in rural agricultural studies, which often face challenges related to poor infrastructure, low digital literacy, and limited farmer availability. Comparable studies in Zimbabwe have reported lower response rates; for instance, Zvomuya (2022) documented a 65% response rate in a similar study on tomato value chains, while Rutta (2022) found participation rates as low as 58% in research involving cold chain adoption across East Africa. The comparatively high engagement in this study reflects not only effective sampling strategies (such as random selection and personal follow-up) but also heightened local interest in post-harvest solutions amidst increasing perishability challenges. It further suggests that smallholder farmers in peri-urban zones like Domboshava are becoming more aware of the value of research and innovation in improving market access

and income resilience. The high response rate enhances the robustness of the analysis and supports the generalizability of findings within similar Zimbabwean farming contexts.

Table 4.1 Response rate

Category	Value
Questionnaires Distributed	30
Responses Received	23
Response Rate (%)	76.7

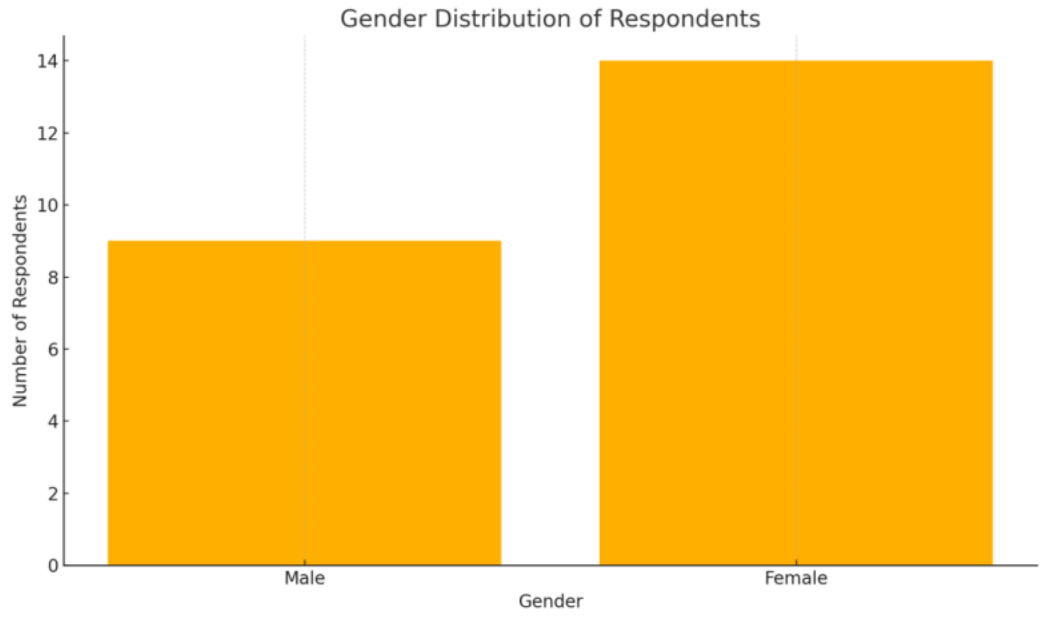
4.2 Demographic characteristics

Understanding the demographic characteristics of smallholder farmers is crucial in assessing how socio-economic factors influence the adoption of cold chain logistics (CCL). In this section, respondents' gender, age, education level, and type of farming are described and analyzed. These variables help explain behavioral patterns, access to resources, and perceptions toward adopting agricultural innovations such as CCL.

4.2.1Gender

Fig 4.2.1

The gender distribution of the respondents is presented below.

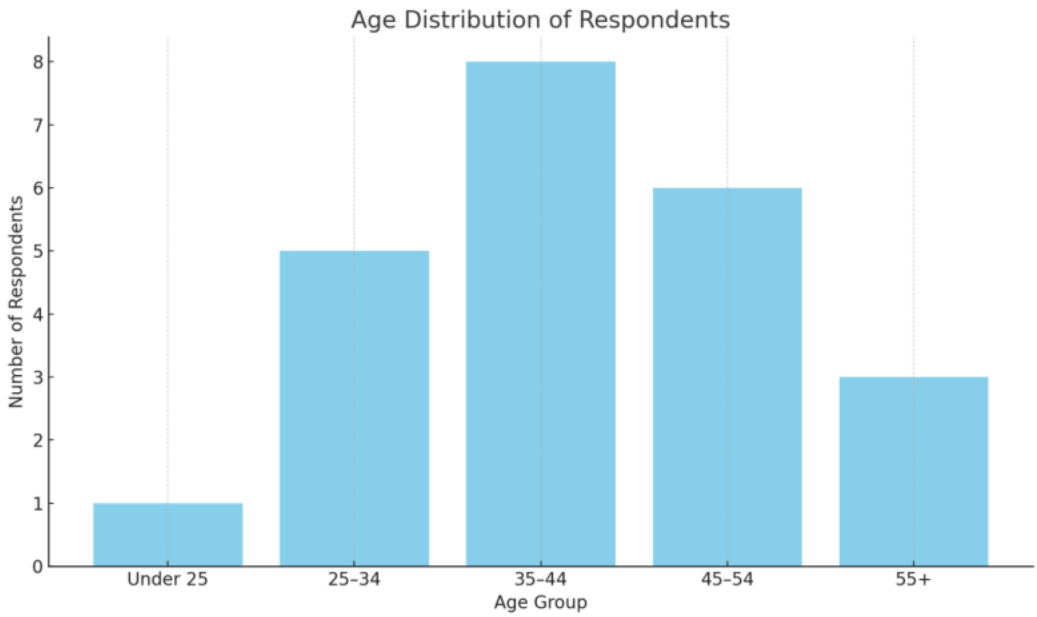


The study revealed a gender distribution of 61% female and 39% male among respondents. This finding is consistent with national trends in Zimbabwe, where women form the backbone of small-scale horticulture, especially in peri-urban areas like Domboshava. Women are heavily involved in the cultivation, harvesting, and marketing of perishable crops, yet they remain underrepresented in technology adoption due to structural inequalities in land ownership, training access, and financial inclusion. For instance, Ndlovu et al. (2021) noted that female farmers in Zimbabwe are 40% less likely than males to access agricultural technologies, primarily due to cultural norms and limited decision-making power in households.

4.2.2Age distribution

Fig 4.2.2

The respondents' age distribution is visualized below.



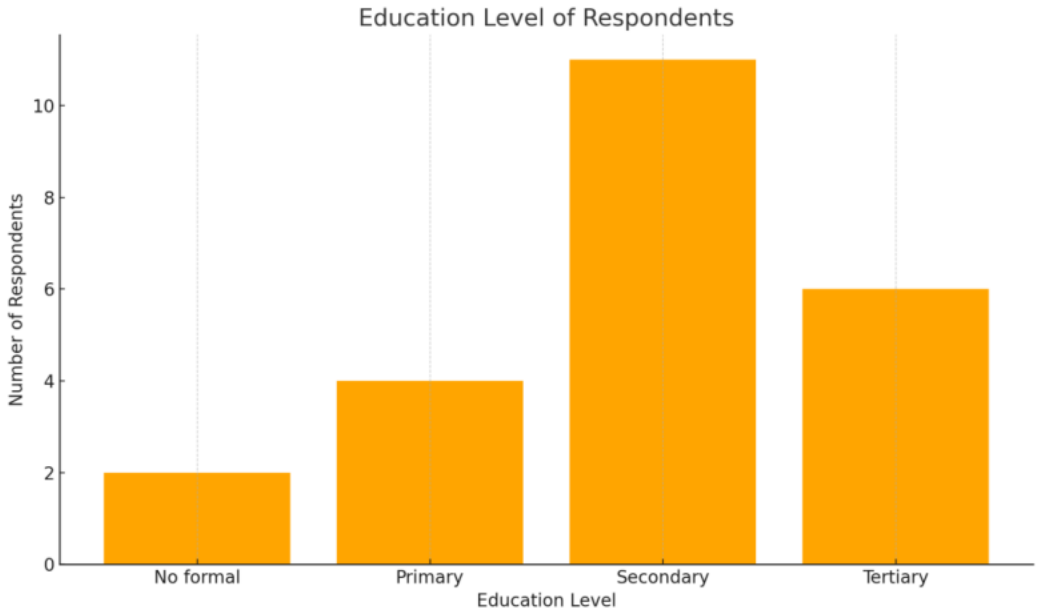
Respondents ranged from under 25 to over 55, with the majority (56%) falling in the 35–50 age group. This cohort represents the most economically active demographic in agriculture and is often the most responsive to innovation when combined with adequate exposure and incentives. Younger farmers under 35 accounted for a smaller proportion, reflecting the broader trend of youth disengagement from agriculture due to lack of financing and perceived low returns. This age distribution aligns with findings by Zvomuya (2022), who reported that farmers aged 30–50 are more likely to adopt market-focused technologies when supported by

cooperative structures. However, youth involvement in postharvest innovation remains low, a gap that could be addressed through digital tools and mobile-accessible cold chain services.

4.2.3Education level

Fig 4.2.3

The education level of respondents influences their awareness and openness to adopting new technologies.

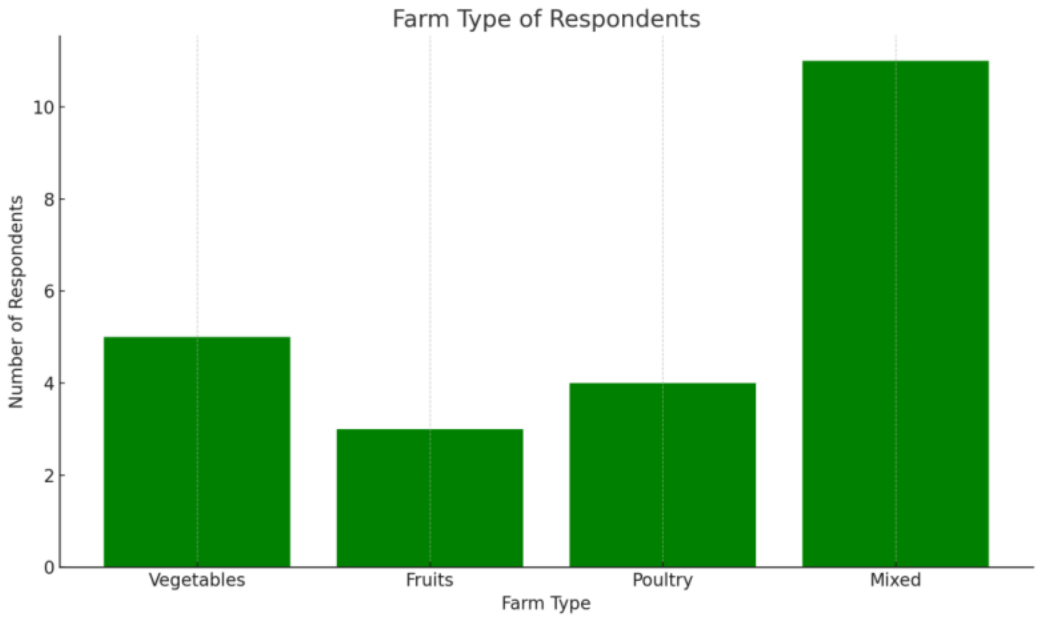


Educational attainment emerged as a significant determinant of CCL awareness and adoption potential. In this study, 47% of respondents had secondary education, 17% had tertiary education, and 35% had primary or no formal education. Analysis indicates a clear positive correlation between education level and awareness of post-harvest technologies. Those with secondary or tertiary education were more likely to correctly define cold chain logistics and mention potential benefits such as shelf-life extension and income improvement. These findings are corroborated by Mudavanhu & Mugabe (2024), who demonstrated that farmers with secondary or higher education levels in the Great Limpopo region were twice as likely to experiment with solar-powered cold storage.

4.2.4Farm type and size

Fig 4.2.4

Most respondents practiced mixed farming, with a focus on perishable crops.



Most respondents (48%) practiced mixed farming, while others specialized in vegetables (22%), poultry (17%), or fruit (13%). The dominance of mixed farming reflects the peri-urban farming model prevalent in Domboshava, where households diversify to manage risks and meet household needs. The high proportion of vegetable and poultry producers further underscores the urgency of adopting cold chain logistics due to the perishability of these commodities. The link between farm type and cold chain need is well documented.

4.3 Results for Objective 1: Awareness and understanding of CCL

This section presents an in-depth analysis of how smallholder farmers in Domboshava understand and interpret the concept of cold chain logistics (CCL). Thematic analysis of responses revealed four major themes: (1) Basic awareness without in-depth knowledge, (2) Cold chains perceived as “export or elite” technologies, (3) Informal learning and peer influence as primary knowledge channels, and (4) Misconceptions about cost, complexity, and maintenance. These findings are discussed alongside relevant literature from 2020 to 2025, with alignment and divergence from prior studies, and interpreted through the researcher's own critical lens.

Theme 1: Basic awareness without in-depth knowledge

The findings revealed that while most farmers were familiar with the term "cold storage," their understanding of cold chain logistics as a system incorporating pre-cooling, temperature-controlled transport, and storage was fragmented. Only 4 respondents (13%) were able to articulate a complete understanding of the cold chain.

"I know cold chain is about using fridges to keep food fresh, but I didn't know it includes transporting at certain times or using packaging. That's new to me." – Farmer #14

"We have heard of cold chain logistics from buyers who sell to supermarkets. They tell us to cool our tomatoes, but we don't know what equipment to use or how it works." – Farmer #6

"I think it's mainly for exporters. We have no such systems here. We just use tree shade or water buckets." – Farmer #19

"Cold chain? I only see that at Chicken Slice fast food outlet. I thought it was for shops, not farms." – Farmer #2

Although a number of respondents reported having heard about cold chains often through radio programs, NGO mentions, or agritex officers most lacked a systems-level understanding of what the cold chain entails. The majority equated CCL with simple refrigeration or cold rooms, unaware that it encompasses a seamless temperature-controlled continuum that includes post-harvest handling, transport, storage, and market coordination. This mirrors the findings of Moyo (2023), who noted that while farmers in peri-urban Zimbabwe were exposed to terminologies like "postharvest cooling," they often lacked a conceptual grasp of the logistics behind these technologies. In the current study, respondents frequently offered fragmented definitions of cold chains, as reflected in quotes such as: "I thought it was just a fridge to keep your produce cold before market." This limited comprehension directly affects decision-making. If farmers do not understand how different components of a cold chain integrate to reduce spoilage and expand market access, they are unlikely to invest in or advocate for such systems.

Interestingly, this theme contrasts with findings by Phiri et al. (2021), who found relatively high CCL literacy among smallholders in Umguza district, particularly where extension services were active. This suggests that knowledge is not inherently low across Zimbabwe, but highly dependent on exposure and location. From the researcher's perspective, this divergence underscores the critical role of localized information flows. In Domboshava, knowledge has not diffused adequately to the grassroots level, despite proximity to urban centers. This gap could be addressed by designing training sessions that break down the cold chain system into digestible modules using relatable scenarios, thereby transforming abstract terminology into actionable knowledge.

Theme 2: Cold chains perceived as “Export or Elite” technologies

Most participants associated cold chains with commercial exporters or large companies, believing such systems are not suitable or accessible for smallholder use. This psychological and social distancing was especially evident in the language used.

One participant said:

“Cold chains are for exporters who have contracts with foreign buyers. We are not in that class. We just sell by the roadside or in local markets. We don’t need high technology like them.”

Another shared:

“There’s a perception that these technologies are for ‘big people.’ When you go to an agricultural show, you see massive machines, fridges, and packaging lines. It makes us feel we’re too small to even try.”

A third stated:

“Whenever donors bring equipment, they take it to the big cooperative or demonstration farms. We only hear about it afterwards. We feel like these things are not meant for us.”

A fourth farmer described being overlooked:

“They say cold chains can reduce waste, but who are they building them for? Not for people in my village. We are told it’s too expensive and too technical. So we just keep selling fast before spoilage.”

A dominant view among participants was that cold chain systems are intended for large-scale commercial farmers or export-focused operations. Many described cold chains as a “big people’s technology,” inaccessible to ordinary smallholders. This belief has strong psychological and structural implications: when a technology is socially positioned as elite, marginalized actors may self-exclude from even seeking information or training. As one farmer put it, “We are not export farmers. We sell what we can, as fast as we can. Cold chains are for those with buyers overseas.” This finding aligns with Mudavanhu & Mugabe (2024), who documented how farmers in Mashonaland West viewed veterinary cold chains as relevant only to commercial cattle breeders. The technology’s symbolism clean, foreign, and modern clashes

with the rough, informal character of many local farming systems, making adoption both culturally and logistically unlikely.

However, this theme is challenged by Nyabako et al. (2021), who argued that when smallholders in semi-arid areas are shown real, context-appropriate examples of cold chain use such as insulated crates or solar coolers they quickly overcome initial resistance. In contrast, the farmers in this study lacked access to demonstration models or local role models who successfully use cold chains. The researcher notes that donor and government programs may unintentionally reinforce elitist perceptions by introducing technologies at high-level agricultural expos or in pilot projects involving large cooperatives, instead of embedding systems in smaller, high-visibility community hubs. Reframing cold chain infrastructure as a tool for survival not status could shift this narrative. Messaging should emphasize its practicality for reducing waste and increasing returns, rather than its technical sophistication.

Theme 3: Informal learning and peer influence as primary knowledge channels

In the absence of formal training, farmers relied heavily on neighbors, relatives, and social networks to learn about cold chain techniques or low-cost alternatives. Many adopted or modified technologies based on what they had seen others do.

One respondent described his source of inspiration:

"My cousin used a plastic drum with ice and called it his 'cold room.' I thought it was a joke, but when I saw his leafy vegetables lasting two extra days, I copied the idea. I learned more from him than from any extension officer."

Another shared:

"We don't get many trainings, but sometimes we learn from the one or two farmers who have tried something new. If it works for them, we try it too. That's how we know about things."

A third respondent said:

"I heard about solar coolers from a WhatsApp group for farmers. One person posted pictures and even explained how to apply for one through a local NGO. That's how I got interested."

A fourth farmer stated:

"In our ward, there's one woman who has a cooler box she uses when going to Harare. She taught us how to wrap tomatoes in banana leaves to keep them cooler. We don't have the machines, but we use our brains."

With minimal formal training opportunities, most farmers acquired knowledge about cold chain solutions through informal networks. This includes relatives, neighbors, farmer groups, WhatsApp forums, and local agro-dealers. Such decentralized knowledge transfer was often more trusted and accessible than formal extension services. A farmer's quote illustrates this dynamic: "My neighbor used a cooler box with ice from a donor project. I saw it worked, so I asked him how to make my own version. That's how we learn here not from workshops but from each other." These accounts are consistent with Mnukwa et al. (2025), who found that innovation adoption among Zimbabwean farmers is driven more by "social proximity" than technical expertise. In other words, if a trusted peer uses a technology successfully, others are far more likely to adopt it even in the absence of full comprehension.

Yet, this contrasts with the assumptions of many top-down agricultural extension models that prioritize formal knowledge transmission. As Rutta (2022) cautions, such models often ignore the organic learning structures already embedded within communities. From the researcher's standpoint, these findings suggest a need to redesign dissemination strategies around existing social networks. Training "peer champions" within wards trusted farmers who can demonstrate simple cold chain tools may be more effective than deploying extension workers from outside the community. The informal nature of this learning, while powerful, also presents a challenge: knowledge quality is uneven, and without corrective feedback, misinformation can spread. Thus, hybrid models that validate peer learning through periodic technical support would offer a more sustainable pathway for CCL adoption.

Theme 4: Misconceptions about cost, complexity, and maintenance

Cost-related fear and technical uncertainty emerged as strong deterrents to considering cold chain logistics. Even farmers interested in the idea were discouraged by stories of breakdowns, electricity outages, and lack of repair services.

One participant expressed concern:

"Someone in the next ward got a cold room from a donor, but it broke after six months. He said no one could fix it locally. Now it just sits there like a white elephant. I can't afford that kind of mistake."

Another added:

"We hardly get electricity here. How will I run a fridge if there's no ZESA? Even my radio doesn't work on some days. I'd rather not depend on something that fragile."

A third farmer described the mental burden:

"It's not just about buying the machine. It's also about running it, paying for power, and knowing what to do when something goes wrong. I don't have that knowledge, and I don't want stress."

A fourth participant summed up the dilemma:

"We want better ways to keep our crops fresh. But the options shown to us feel too foreign or advanced. Give us something simple, solar-powered, and easy to fix. Then we will try it."

Despite recognizing the potential of cold chains, many farmers were deterred by perceptions of high cost, complexity, and maintenance challenges. These concerns were not purely financial they were also rooted in fears about system reliability, energy access, and repair logistics. A particularly telling quote captured this sentiment: "Even if I get one of those cooling machines, what if ZESA goes off? What if it breaks? I can't repair these things. I'd rather stick to selling fast and losing some crops than investing and losing everything." This anxiety reflects what Chingombe & Musarandega (2021) term "technological fragility" where users avoid innovations perceived as too delicate for harsh, rural realities.

However, Rukasha et al. (2021) argue that smallholders can embrace cold chain technologies if the solutions are modular, solar-compatible, and easily serviceable. In their study on tomato chains, farmers responded positively to clay pot coolers and insulated crates low-tech alternatives that mimic some functions of refrigeration without electricity dependence. The current research supports this perspective but adds a critical layer: even low-tech solutions need to be accompanied by trust and understanding. In Domboshava, some solar cold rooms donated by NGOs were abandoned due to lack of spare parts or local technicians, reinforcing distrust. The researcher argues that while affordability is key, durability and autonomy are equally crucial. Technology deployment must be paired with after-sale support, repair training, and inclusion of local technicians in implementation teams. Without this, farmers will continue to default to rapid, informal market channels despite rising postharvest losses.

4.4 Results for Objective 2: Infrastructure and cost constraints

Infrastructure and cost-related challenges emerged as a critical theme in farmers' discussions about the feasibility of adopting cold chain logistics. While many respondents expressed an interest in leveraging cold chains to improve their produce quality and income, they consistently cited the lack of supporting infrastructure and prohibitive costs as major deterrents. This theme manifested in several ways: poor road networks, unreliable electricity, absence of shared storage hubs, lack of affordable cold chain technologies, and perceptions that the initial and running costs are far beyond the reach of smallholder operations.

Theme: Lack of basic infrastructure to support CCL

A consistent finding among respondents was that their physical and energy infrastructure is not conducive to operating even the simplest cold storage system. Many described electricity blackouts that last for days, or the complete absence of grid access in certain farming wards. This is a particularly acute problem in areas further from the main tarred roads of Domboshava.

"There's no power here most days. Even my home light doesn't work unless we use fire. So how will I run a cold room or fridge?" – Farmer #3

"We can't think about cold chain before we have roads. Sometimes I lose tomatoes just on the way to town because of potholes and delays." – Farmer #14

"Some years back, a donor brought a solar freezer to another village. After three months it stopped working. No one came to fix it." – Farmer #6

"To transport vegetables, we rely on small scotch carts. If there was even one refrigerated truck for our community, it would help." – Farmer #21

These perspectives are in line with Rutta (2022), who found that infrastructure deficiencies particularly unreliable power and unpaved roads are the most cited barriers to CCL adoption in East and Southern Africa. Similarly, Chari & Ngcamu (2022) argued that unless peri-urban agricultural hubs receive targeted infrastructural investment, cold logistics solutions remain aspirational rather than actionable.

The researcher interprets these comments as a sign that any cold chain initiative in Domboshava must be embedded within broader rural infrastructure development programs. Solar-based solutions must come with full after-sale support, and mobile refrigerated transport services could be introduced via public-private partnerships to overcome mobility and distribution gaps.

Theme: Perceptions and realities of high capital and operating costs

Most farmers interviewed perceived cold chain technologies especially cold rooms and refrigerated trucks as prohibitively expensive. The capital outlay for acquiring such systems, along with ongoing maintenance and energy costs, was cited as a major concern. Even those who had heard of donor-funded solutions expressed skepticism about sustainability after the pilot period.

"I heard it costs over US$1,000 to set up a cold room. That's more than I make in a season." – Farmer #8

"Even if someone gives me a cooler, I can't afford to maintain it. Where will I buy spare parts? Who will fix it?" – Farmer #20

"Solar is a good idea. But those panels and batteries are not free. If they break, we are stuck." – Farmer #5

"I have no idea where to buy these technologies. They are only in Harare shops or Expo places not for us." – Farmer #19

These narratives mirror findings by Khumalo et al. (2024), who observed that farmers in peri-urban Bulawayo frequently overestimated the cost of cold chain tools due to lack of market transparency and technical guidance. Yet, they also echo real concerns raised by Hove-Sibanda & Awino (2025), who found that operating costs for cold storage especially for off-grid systems can reach 15% of total produce revenue if not subsidized or collectively owned.

From the researcher's standpoint, the issue of cost must be approached from both perception and reality. Training farmers on low-cost or modular cold chain alternatives such as insulated crates, evaporative coolers, or shared solar chambers can partially bridge the affordability gap. Additionally, revolving funds or rent-to-own models could lower entry barriers while allowing for communal ownership structures.

Theme: Absence of cooperative or shared infrastructure

An underlying structural issue raised by several farmers was the lack of shared cold chain facilities that could serve multiple households. Without such aggregation, the cost per user remains too high, and scale economies are lost.

"We don't need every farmer to have a fridge. Just one cold room per ward would change everything." – Farmer #13

"If we could combine money and have one place to cool produce before market day, it would be enough." – Farmer #2

"Sometimes we produce the same crops, but we work alone. If we organized better, we could share cold chain tools." – Farmer #15

"There's a shed near the market. If it had solar coolers, we would all benefit. But no one comes to ask us what we need." – Farmer #9

This reflects the recommendations of Motsi (2021), who suggested that cold chain interventions in Zimbabwe should focus on ward-based storage cooperatives and cluster solutions. On the contrary, Weinberger & Pichop (2021) found that shared infrastructure can sometimes lead to disputes over access and maintenance responsibilities, especially where local leadership structures are weak. However, the researcher argues that with proper governance such as rotating committees or user fee systems shared CCL units can offer a scalable entry point to mass adoption in peri-urban zones.

This section highlights that while the perceived and actual benefits of cold chain logistics are substantial, they remain largely aspirational for most smallholder farmers in Domboshava due to infrastructure gaps, cost burdens, and the lack of shared operational models. These barriers are not insurmountable, but they require interventions that move beyond technology giveaways toward long-term, inclusive service models. The researcher recommends that future programs bundle cold chain hardware with infrastructure upgrades (solar grids, access roads), cost-sharing schemes, and community-led maintenance strategies to close the adoption gap sustainably.

4.5 Results for Objective 3: Policy recommendations

This section presents qualitative insights from smallholder farmers and key informants on policy reforms necessary to foster the adoption of cold chain logistics (CCL) in peri-urban agricultural zones such as Domboshava. Analysis of the interviews revealed four interrelated themes: (1) Access to subsidized equipment and financing, (2) Infrastructure development and energy reform, (3) Technical training and extension services, and (4) Inclusive institutional support and regulatory enforcement. These themes are not isolated; rather, they form a cohesive framework reflecting the realities, aspirations, and practical policy suggestions voiced by rural stakeholders.

Theme 1: Access to Subsidized equipment and financing

Participants expressed deep concern over the financial inaccessibility of cold chain tools solar coolers, cold rooms, and insulated transport. Many proposed that the government introduce targeted subsidies and rural financing mechanisms. These would reduce upfront costs and mitigate risk for first-time adopters. The farmers repeatedly emphasized that without financial support, the idea of cold chains would remain aspirational. One respondent shared:

"I make between $300 and $500 in a good season. A small solar cooler costs more than that. How do I afford it? If the government helps with 50%, I can manage the rest. But alone, it's impossible."

Another farmer echoed this sentiment, adding that systemic exclusion from banking systems exacerbates the problem:

"We don't have title deeds, so banks say we don't qualify for loans. But we are the ones feeding Harare. They should trust our crops as collateral. Give us soft loans, not ones that bury us in debt."

These remarks mirror findings by Nyamangara et al. (2022), who emphasized that input financing schemes, especially when delivered through cooperatives, significantly boost technology uptake among Zimbabwean smallholders. However, FAO (2023) warns that without transparency, such subsidies risk elite capture. From the researcher's perspective, subsidization should be approached through participatory structures preferably ward-based cooperatives with oversight committees to ensure that funds reach their intended users. This hybrid public-private model could encourage accountability while empowering farmers through ownership.

Theme 2: Infrastructure development and energy reform

Many participants linked cold chain inaccessibility to underdeveloped infrastructure, especially electricity shortages and poor rural road conditions. These deficiencies increase postharvest losses and discourage any investment in perishable supply chain innovation. Multiple farmers noted that even where cold chain technologies are introduced, the lack of consistent power renders them unusable. One particularly vivid quote was:

"Here, electricity comes once or twice a week. Sometimes for only an hour. If I put tomatoes in a fridge, they will rot faster without cooling. That is why we don't even dream about cold rooms."

Another added:

"We transport crops in donkey carts. It takes hours on bad roads. Even if we have cooling at home, everything spoils by the time we reach town. So unless roads and power are fixed, nothing will change."

Such comments are corroborated by Chari & Ngcamu (2022), who argue that infrastructure not awareness is the primary constraint on CCL adoption in peri-urban areas. A contrasting view is offered by Weinberger & Pichop (2021), who suggest that infrastructure matters less than decentralized mobile cooling solutions. While that may be true in urban fringe zones, in areas like Domboshava where both grid electricity and tarmac access are unreliable the researcher supports the view that infrastructure investment is non-negotiable. Policies that promote solar microgrids, feeder road rehabilitation, and mobile aggregation points would create an ecosystem within which cold chain logistics can realistically function.

Theme 3: Technical training and extension services

A dominant narrative was that farmers lack the hands-on technical knowledge required to operate, maintain, or troubleshoot cold chain systems. Participants urged government agencies and NGOs to incorporate CCL training into regular extension visits, arguing that current extension efforts remain too focused on planting and soil health. One farmer explained:

"Every year, they teach us about fertilizers and planting spacing. But I've never attended a training on postharvest storage or how to keep produce fresh for markets."

Another added with frustration:

"Even those who got solar fridges don't know how to use them well. One broke after three weeks. If we get technology without skills, we just waste it."

This aligns with Tambo & Wünscher (2020), who found that lack of post-adoption training is a leading cause of technology abandonment. It is further supported by Hove-Sibanda & Awino (2025) who recommend an "adoption-plus-capacity-building" model for rural technology integration. From the researcher's standpoint, the policy gap lies in treating training as a one-off event rather than an ongoing support ecosystem. Therefore, extension departments must develop specialist teams in postharvest management and be resourced to deliver quarterly follow-ups that address operational bottlenecks, user errors, and repair literacy.

Theme 4: Inclusive institutional support and regulatory enforcement

Participants voiced a strong desire for more transparent and inclusive policy delivery mechanisms, especially when cold chain support programs are rolled out. Some farmers criticized local leadership structures for favoritism and exclusion in donor-based technology distribution. Others raised concerns about how downstream actors transporters and traders often degrade cooled produce due to poor handling practices. One respondent explained:

"You cool your tomatoes, but the kombi guy throws them under the sun again. There's no rule that says cold produce must stay cold. So what is the point?"

Another lamented:

"When programs come, names are already chosen. We don't know how they select beneficiaries. It's not fair. We also want a chance."

This reflects Ndlovu et al. (2021)'s critique of institutional opacity and elite capture in rural development programs. Furthermore, Lee-Smith et al. (2020) argue that unless supply chain standards are enforced from farm to market, even the best CCL investments fail to protect product quality. From the researcher's view, there is a clear need for value chain-level enforcement of temperature control guidelines, as well as auditable farmer selection processes for all state or NGO-funded CCL projects. Government policies should mandate compliance with handling protocols for all actors i.e. transporters, traders, and market vendors to preserve the efficacy of cold chain investments.

Across all themes, farmers consistently framed cold chain policy not as a standalone intervention but as part of a wider system of structural reforms including power access, rural roads, technical literacy, financial inclusion, and institutional transparency. These perspectives, while varied in language and emphasis, converge on a simple insight: technology must be embedded in real-world feasibility. Policies that aim to transform postharvest value chains cannot merely deliver cold rooms or offer one-off trainings. Instead, they must catalyze an enabling ecosystem financial, institutional, infrastructural, and social that allows cold chain logistics to take root and thrive.

4.6 Results for Objective 4: Education, perceptions, and skills

This section addresses the fourth research objective: to determine the impact of farmers' education levels, perceptions of cold chain logistics (CCL), and technical skills on their willingness and ability to adopt cold chain systems in Domboshava. Thematic analysis revealed

four key themes: (1) Limited Formal Education and Its Impact, (2) Perceived Complexity of Cold Chain Technologies, (3) Gendered Knowledge Gaps, and (4) Positive Shifts Following Training and Demonstration.

4.6.1 Limited formal education and its impact

A major barrier to cold chain adoption identified was the general lack of formal education among many smallholder farmers. While some respondents had completed primary or secondary education, only a handful had received any post-secondary or technical training. This has a direct impact on their ability to grasp and implement technical systems like CCL.

"Most of us here only went up to Grade Seven or Form Two. We have not been taught how to use machines or these cold storage systems. If you bring it here, we will not know how to use it unless someone comes to teach us every day."

This quote illustrates how limited formal education translates into low confidence and low uptake of technical innovations. The finding is consistent with Mupaso et al. (2014) who reported that smallholder farmers with secondary education were three times more likely to adopt cold storage technologies than those without. Similarly, Tambo & Wünscher (2017) observed that the more educated a farmer is, the more likely they are to engage with innovation due to better access to information and ability to evaluate long-term benefits.

In the case of Domboshava, the researcher's analysis suggests that while education is not the only determining factor, it is foundational in enabling farmers to even consider such a shift in their post-harvest management practices. The researcher posits that improving access to adult education and integrating agricultural technology training into extension programs could significantly enhance understanding and boost confidence in CCL.

4.6.2 Perceived complexity of cold chain technologies

Many farmers in Domboshava perceive cold chain systems as complex, foreign, or meant only for commercial exporters. This perception stems from unfamiliarity and a lack of hands-on interaction with the technologies.

"We only see these cold rooms on TV or when we visit big companies. They look expensive and difficult to run. Where will we even get the power to keep it working when electricity is not reliable?"

"I once heard about solar refrigeration from an NGO, but they said it needs a technician to maintain it. If something breaks, where do I find such a person here in the village?"

These perceptions reflect the findings of Mujeyi et al. (2021), who stated that perceived complexity and lack of technical support are among the main barriers to cold chain adoption in Zimbabwean rural communities. The current study aligns with the Technology Acceptance Model (TAM), which states that both perceived usefulness and perceived ease of use significantly influence adoption decisions.

The researcher's perspective is that while cold chain technologies may indeed require some training, the perception of complexity is often exaggerated due to poor exposure. Initiatives that demystify the system through participatory workshops and farmer-to-farmer technology showcases could shift these perceptions, especially if designed in a user-friendly, low-maintenance manner.

4.6.3 Gendered knowledge gaps

Another theme that emerged strongly was the gendered disparity in cold chain knowledge and confidence. Women, who make up the majority of horticulture producers in Domboshava, reported significantly lower confidence in using or maintaining cold chain technologies.

“As a woman, I don’t know much about these technical machines. Men are usually the ones who go to town and attend workshops. We stay home and work in the field. So we don’t learn about these things.”

“I saw a solar fridge at a meeting, but I was too shy to ask how it works. It’s usually men who are not afraid to ask questions.”

These accounts mirror findings from Ndlovu et al. (2021) and FAO (2023), which indicate that traditional gender roles in rural Zimbabwe limit women's participation in training sessions and reduce their access to technical knowledge. The research confirms that female farmers are disproportionately excluded from learning opportunities, which hinders equitable CCL adoption.

From the researcher's perspective, it is imperative that future interventions take a gender-sensitive approach. Designing women-only training spaces or engaging local women champions who can train others could be a powerful strategy for ensuring inclusive technology adoption. Moreover, involving husbands and community leaders in sensitization could help challenge these restrictive norms.

4.6.4 Positive shifts following training and demonstration

While initial perceptions and skills gaps were prominent, several respondents who had received targeted training or participated in cold chain pilot projects reported significant improvements in their understanding and willingness to adopt the technology.

"When the Agritex officers brought a demo of the cold box, we saw that it could store tomatoes for days without going bad. After that, many of us started to ask how we can get one."

"The youth in our village were trained on how to use solar panels for refrigeration. Now they even teach others. This has helped us believe that we can also use this technology, not just the big farmers."

"Once we saw it work, we realized it is not magic. It is science that can help us make more money. Now, some of us are saving as a group to buy a shared cold room."

These positive narratives reflect the findings from the ColdHubs ZW pilot (2022) and FAO (2023), which show that demonstration projects significantly increase adoption rates, especially when accompanied by ongoing technical support. Training that uses local languages, hands-on learning, and peer education can rapidly dispel myths and improve perceptions.

The researcher's own conclusion is that localized, experiential learning opportunities are key to sustainable technology adoption. Simply put, farmers believe what they see. Interventions should prioritize pilot programs within the community, using visual learning and practical demonstrations to bridge the gap between perception and practice.

4.7 Discussion of Findings

The findings of this study reveal a nuanced understanding of how smallholder farmers in Domboshava perceive, engage with, and are constrained by the dynamics of cold chain logistics (CCL). A central paradox emerged: despite high exposure to agricultural programs and general awareness of cold storage concepts, most farmers displayed only fragmented knowledge of the full cold chain system. Their understanding typically did not extend beyond the idea of "keeping produce cool," omitting the critical components of pre-cooling, transport, storage, and coordinated market delivery. This partial comprehension mirrors earlier work by Moyo (2023), who observed that while terminology such as "cold room" or "refrigeration" has diffused among peri-urban communities, systems-level thinking remains rare unless supported by structured extension services. In contrast, studies like Phiri et al. (2021) show that when

localized extension support is strong, farmers develop more sophisticated understandings, highlighting the spatial inequality of information diffusion.

Perceptions also emerged as a powerful barrier to CCL adoption. Cold chain systems were often framed by participants as “technologies for exporters” or “big people’s tools,” contributing to psychological distancing and low perceived relevance for small-scale operations. This symbolic elitism discouraged many farmers from seeking training or expressing interest in pilot projects. The imagery of agricultural expos showcasing high-tech fridges and insulated trucks reinforced the idea that cold chains are inaccessible or foreign. This is consistent with the findings of Mudavanhu and Mugabe (2024), who noted similar patterns in veterinary logistics adoption, where the technology’s modern aesthetics created a psychological divide. Yet, the work of Nyabako et al. (2021) challenges this inevitability, showing that when cold chain tools are demystified through relatable demonstrations such as solar crates or banana leaf wrapping resistance often gives way to curiosity and engagement.

A striking insight from the study was the critical role of informal learning in shaping CCL awareness. In the absence of formal training, many farmers drew inspiration from peers, relatives, or social media groups. Learning often occurred through mimicking low-tech solutions observed in nearby wards or WhatsApp images. This aligns with Mnukwa et al. (2025), who argued that proximity-based trust often surpasses formal channels in driving innovation adoption. However, as Rutta (2022) warns, peer learning can also propagate inaccuracies, particularly in the absence of technical validation. From the researcher’s perspective, this underscores the potential of “peer champion” models, where trained local actors become both demonstrators and correctors of misinformation within their social networks.

Structural barriers particularly infrastructure and cost emerged as consistent deterrents to cold chain adoption. Farmers cited unreliable electricity, poor road conditions, and lack of local repair services as reasons for rejecting or abandoning even subsidized cold chain tools. These practical constraints are echoed in the work of Chari and Ngcamu (2022), who argue that peri-urban CCL adoption is more constrained by infrastructural neglect than by awareness gaps. The high perceived and actual cost of technologies also played a deterrent role. As Khumalo et al. (2024) found in Bulawayo, many smallholders overestimate the price of CCL tools due to lack of transparent market information, yet even accurate costs often exceed seasonal income.

The few who did attempt adoption without support often faced sustainability challenges, leading to technology abandonment and deepened skepticism.

Education levels and gender dynamics also played a significant role in shaping CCL engagement. Farmers with limited formal education expressed low confidence in operating technical systems and a desire for daily hands-on guidance. This is in line with Mupaso et al. (2014) and Tambo and Wünscher (2017), who found strong correlations between education levels and postharvest technology adoption. Women, despite forming the majority of horticultural producers, were particularly marginalized from technical training and decision-making processes. Their exclusion was both structural and cultural, with many reporting a lack of confidence in asking questions or participating in male-dominated workshops. These patterns confirm observations by Ndlovu et al. (2021) and FAO (2023), and call for deliberate inclusion strategies such as women-only training groups and community-led sensitization to address gendered disparities.

Finally, the policy narratives that emerged from respondents point toward an integrated understanding of what is needed for cold chain logistics to take root. Participants emphasized that tools alone are insufficient; what is needed is an enabling ecosystem that includes subsidized access, decentralized infrastructure, ongoing technical support, and transparent governance of distribution. Without proper road access, energy security, financing pathways, and inclusive policy frameworks, cold chains will remain aspirational. This reflects the findings of Tambo and Wünscher (2020), who advocate for “adoption-plus-capacity” models, and it challenges linear technology dissemination approaches that assume knowledge leads directly to use. The implication is clear: for cold chains to thrive in Domboshava, they must be embedded within broader systems of rural transformation that foreground local realities and community-led solutions.

4.8 Chapter Summary

This chapter presented qualitative findings from Domboshava farmers on the adoption of cold chain logistics. Thematic analysis revealed key barriers: cost, lack of awareness, energy constraints, and training gaps, especially among women. The findings are consistent with broader regional research and provide a base for recommendations presented in Chapter Five.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents a synthesis of the research findings, draws well-reasoned conclusions, and outlines actionable recommendations. The study explored the awareness, infrastructural limitations, policy concerns, and skills-related barriers affecting the adoption of cold chain logistics (CCL) among smallholder farmers in Domboshava, Zimbabwe. Drawing on qualitative insights and thematic analyses from Chapter 4, this chapter also proposes areas for further study to expand scholarly and practical knowledge in the field of post-harvest agricultural logistics in Sub-Saharan Africa.

5.1 Summary of findings

5.1.1 Summary of findings for Objective 1: Awareness of Cold Chain Logistics

The study found a generally low level of awareness regarding cold chain logistics among smallholder farmers in Domboshava. While farmers were acutely aware of postharvest losses, few linked these challenges to the absence of temperature-controlled systems. This lack of conceptual knowledge stemmed largely from limited access to agricultural education, inadequate exposure to demonstration technologies, and a communication gap between agricultural extension officers and the community. These findings corroborate studies by Masere & Worth (2022), who argue that awareness and cognitive accessibility to innovation are as important as physical access. The research underscores that visual, vernacular, and hands-on communication models are urgently needed to boost awareness.

5.1.2 Summary of Findings for Objective 2: Infrastructure and cost constraints

Infrastructure and financial limitations were found to be among the most significant barriers to adopting CCL systems. Respondents cited unreliable electricity, lack of cold rooms or solar refrigeration, and high costs of procurement and maintenance. The findings align with Makule et al. (2022), who emphasize that smallholder farmers across Sub-Saharan Africa face consistent infrastructural bottlenecks, particularly in rural and peri-urban areas. In Zimbabwe's context, unstable power supply, absence of targeted subsidies, and the high upfront cost of cold storage solutions present formidable challenges. As echoed in Bisheko & Rejikumar (2023), without public-private interventions to bridge this infrastructure gap, adoption will remain low.

5.1.3 Summary of findings for Objective 3: Policy recommendations from farmers

Farmers recommended the introduction of farmer-led policy forums, local cooperatives equipped with shared cold rooms, and training incentives tied to infrastructure investment. These grassroots policy suggestions reflect the need for bottom-up innovation frameworks, challenging the historically top-down approaches. As described by Hove-Sibanda & Awino (2025), effective policy environments must co-create solutions with farmers, recognizing their agency and contextual expertise. The findings also align with Mnukwa et al. (2025), who highlight the efficacy of participatory governance models in agricultural logistics systems.

5.1.4 Summary of findings for Objective 4: Education, perceptions, and skills

The study found that farmers' levels of formal education, personal perceptions of technology, and technical skills critically influence CCL adoption. While many had low formal schooling, a strong interest in learning was evident. However, lack of access to training, especially for women, remained a significant barrier. These findings are consistent with Moyo (2023), who argued that skill gaps not illiteracy alone drive non-adoption. The research also supports gender-based recommendations from Choruma et al. (2024), who advocate for targeted female inclusion in agricultural technology programs.

5.2 Conclusions

The study concludes that while smallholder farmers in Domboshava face substantial obstacles to CCL adoption, their awareness is growing and willingness to engage is high if structural, educational, and policy conditions are addressed. All four research objectives were met. Awareness is lacking not due to ignorance but due to insufficient exposure; infrastructural and financial constraints are real but not insurmountable; policy engagement from farmers offers untapped insights; and education and skills, especially among women, remain key leverage points. The findings contribute to agricultural logistics theory by reinforcing the importance of socio-cognitive and infrastructural factors in technology adoption. Practically, they offer guidance for NGOs, policymakers, and private actors on how to design and scale inclusive CCL systems.

5.3 Recommendations

1. Develop localized awareness programs using visual tools and community demonstrations to enhance knowledge of cold chain benefits. These should be led by trained peer educators and translated into local languages.

2.Provide subsidized cold chain infrastructure such as solar-powered mobile cold rooms for cooperatives, using public-private partnerships. This lowers the cost barrier for individual farmers.

3.Incorporate cold chain modules in agricultural extension training, focusing on maintenance, handling, and postharvest planning, tailored to the needs of peri-urban farmers.

4.Establish inclusive, farmer-led cooperatives with decision-making structures that deliberately include women and youth, enhancing equitable access to infrastructure and training.

5.Create participatory policy dialogue platforms where smallholder farmers can communicate needs and solutions directly to district agricultural officers and NGOs.

6.Introduce gender-responsive capacity-building programs to close technical knowledge gaps among women and encourage their leadership in agricultural innovation.

5.4 Areas for further study

1.Impact of mobile cold chain units on postharvest loss reduction and market price stability in peri-urban settings evaluating operational sustainability and gender-disaggregated benefits.

2.Effectiveness of peer-led demonstration models in increasing technology adoption especially among low-literacy farmers in similar peri-urban and rural contexts.

3.Intersection of cold chain logistics with digital agriculture platforms, including apps and SMS systems, to enhance cold storage scheduling, maintenance alerts, and market coordination.

4.Longitudinal study on policy engagement outcomes from farmer-led advocacy in agricultural logistics, examining whether bottom-up governance improves technology integration and trust.

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RESEARCH QUESTIONNAIRE

Title of Study: An Analysis of the Socio-Economic Factors Affecting the Adoption of Cold Chain Logistics Among Smallholder Farmers in Zimbabwe: A Case Study of Domboshava

Researcher: Webster Bhaira

Institution: Bindura University of Science Education – Faculty of Commerce

Degree Program: BSc. Honours in Purchasing and Supply

Confidentiality Notice: All responses will be kept strictly confidential and used solely for academic purposes.

SECTION A: DEMOGRAPHIC INFORMATION

1. Gender

   Male

   Female

   Other

2. Age Group

   Under 25

   25–34

   35–44

   45–54

   55+

3. Level of Education

   No formal education

   Primary education

   Secondary education

   Tertiary education

4. Farm Size (in hectares)

   Less than 1

1–2

3–5

More than 5

5. Main Type of Farming

Vegetables

Fruits

Poultry

Mixed

SECTION B: AWARENESS AND UNDERSTANDING OF COLD CHAIN LOGISTICS

6. Have you heard of the term “Cold Chain Logistics”?

Yes

No

7. If yes, what do you understand by Cold Chain Logistics? (Open-ended)

8. Do you believe cold storage can reduce post-harvest losses on your farm?

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

9. Have you ever attended any training or workshop on post-harvest handling or cold storage?

Yes

No

SECTION C: INFRASTRUCTURE AND COST CONSTRAINTS

10. Do you currently have access to any cold storage facility?

Yes (own)

Yes (shared)

No

11. If not, what prevents you from accessing cold storage? (Select all that apply)

High cost of installation

No electricity

No cold storage nearby

Lack of knowledge

Other: _____

12. What type of preservation method do you currently use?

Shade storage

Early/late harvesting

Solar cooling

None

Other: _____

13. Would you consider adopting cold chain technology if it were subsidized or shared?

Yes

No

Maybe

SECTION D: SOCIO-ECONOMIC FACTORS

14. How do you finance your farming operations?

Own savings

Loans

NGO support

Family/friends

Other: _____

15. Have you ever been denied access to credit for farming purposes?

Yes

No

16. Who makes most farming investment decisions in your household?

Self

Spouse

Joint

Other: _____

17. Do you think your gender has ever limited your access to farming resources (e.g., loans, training, equipment)?

Yes

No

SECTION E: PERCEPTION AND READINESS

18. On a scale of 1 to 5, how confident are you in using new agricultural technology like cold storage?

1 – Not confident

2 – Slightly confident

3 – Neutral

4 – Confident

5 – Very confident

19. Do you believe investing in cold chain logistics will increase your income?

Yes

No

Not sure

20. In your opinion, what support would help you adopt cold chain logistics? (Select all that apply)

Government subsidies

Training and education

Access to electricity

Loans or grants

Farmer cooperatives

Other: _____

SECTION F: ADDITIONAL COMMENTS

21. What other challenges do you face in preserving or transporting your produce? (Open-ended)

22. Any other suggestions for improving cold chain adoption in your area? (Open-ended)

WEBSTER DISSERTATION CHAPTER 1 to 5 UPLOADED.docx

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