Developing a Framework for Green Logistics in the Floriculture Sector: Case study- Ethiopian Horticulture Producers and Exporters Association (EHPEA)

Thesis Submitted to Department of Logistics and Supply Chain Management in Partial Fulfillment of the Requirements for Master of Science Degree in Logistics and Supply Chain Management

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Declaration

This is to certify that this thesis entitled as is my original work or any part thereof "Developing a Framework for Green Logistics in the Floriculture Sector: Case study- Ethiopian Horticulture Producers and Exporters Association (EHPEA)" has not been previously submitted in any form to the University or to any other body whether for the purpose of assessment, publication or for any other purpose. All sources of materials used in the thesis have been duly acknowledged. I confirm that except for any express acknowledgements, reference cited in the work, the original work is the result of my own efforts.

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The thesis entitled “Developing a Framework for Green Logistics in the Floriculture Sector: Case study- Ethiopian Horticulture Producers and Exporters Association (EHPEA)" is approved for the Master of Art in Logistics and Supply Chain Management

As a member of the board of examiners of the Master in Logistics and Supply Chain thesis open defense examination, we certify that we have read and evaluated the thesis prepared by Aida Bereket and examined the candidate. We recommend that the thesis be accepted as fulfilling the thesis requirement for the master's degree of Arts in Logistics and Supply Chain Management.

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Acronyms and Abbreviations

EHPEA – Ethiopian Horticulture Producer Exporters Association

EU – European Union

PPWR – Packaging and Packaging Waste Regulation

FloriPEFCR – Floriculture Product Environmental Footprint Category Rules

IFPA – International Fresh Produce Association

Table of Contents

Figures

Abstract

This thesis explores the impact of European Union (EU) sustainability regulations on the adoption of green logistics practices in Ethiopia's floriculture sector using a qualitative research approach. Ethiopia, a rapidly growing flower exporter, faces challenges complying with EU policies such as the Packaging and Packaging Waste Regulation (PPWR) and the Product Environmental Footprint Category Rules (FloriPEFCR), which require recyclable packaging and environmental impact assessments. Despite favorable growing conditions and government incentives, Ethiopian flower growers struggle with infrastructural limitations, limited awareness of sustainable logistics, and the costs of transitioning to greener practices.

Through in-depth interviews and qualitative data analysis with key stakeholders in Addis Ababa's floriculture industry, this study identifies existing logistics practices, barriers to green logistics adoption, and the influence of EU regulations on operational adjustments. The research develops a context-specific framework for green logistics that addresses transportation, packaging, warehousing, waste management, and data monitoring tailored to Ethiopia's unique challenges and regulatory environment.

The findings offer practical recommendations to improve regulatory compliance, enhance sustainability, and strengthen the competitiveness of Ethiopian flower growers in international markets. This thesis contributes to the understanding of sustainable logistics implementation in developing countries and provides a strategic guide for fostering environmentally responsible growth in Ethiopia's floriculture sector.

Keywords: Ethiopian floriculture, green logistics, green transport, green warehouse, cold chain, green packaging, EU regulation, PPWR, FloriPEFCR

Chapter One

Introduction

The word "logistics" first appeared thousands of years ago, initially serving as a means of providing time and place utility (Weld & McKinnon, 2010). However, as technology advanced, logistics evolved into a crucial component of business operations, while also contributing to significant environmental challenges through the consumption of non-renewable resources and greenhouse gas emissions (McKinnon et al., 2021). Since the 1950s, governments and the public have increasingly focused on environmental issues, leading to the emergence of green logistics in academic discourse during the 1960s (Kardinal, 2021). Over the past five decades, pressure from both the public and governmental bodies has encouraged companies to adopt green logistics practices (Murthy et al., 2024).

Green logistics is now recognized as an essential outcome of modern logistics development (McKinnon et al., 2021). The logistics industry is closely linked to various environmentally friendly concepts such as green production, green marketing, and green consumption (Kardinal, 2021). It is imperative that economic activities do not excessively consume resources solely within the logistics sector (Murthy et al., 2024). Furthermore, green logistics is viewed as a necessary approach for companies to reduce operating costs (McKinnon et al., 2021). Research indicates that from production to sales, manufacturing accounts for only a small portion of total time; most time is spent on warehousing, transportation, handling, packaging, distribution processing, information processing, and other logistics activities (Kardinal, 2021). Therefore, developing green logistics can lead companies toward a more eco-friendly operational structure (Murthy et al., 2024).

The global floriculture market is experiencing significant growth, currently valued at approximately $56.98 billion in 2024 and projected to exceed $90 billion by 2037, with a compound annual growth rate (CAGR) of over 3.6% during the forecast period from 2025 to 2037 (Research Nester, 2024). This expansion is driven by rising consumer demand for floral

products across various sectors, including personal celebrations, weddings, and corporate events (Research Nester, 2024). The increasing popularity of edible flowers, such as hibiscus and lavender, reflects a growing consumer trend toward health-conscious choices that enhance the aesthetic appeal of food while providing nutritional benefits (Research Nester, 2024).

In developed countries, particularly in Europe and North America, the floriculture market is characterized by high consumption rates and premium pricing for quality floral products (LP Information Data, 2025). The Netherlands serves as the epicenter of the global flower trade, leveraging advanced greenhouse technologies and efficient logistics to maintain its leading position as an exporter (LP Information Data, 2025). In 2024, Europe accounted for over 50% of the global floriculture market share, with other significant players including the USA and Japan (LP Information Data, 2025). These regions are increasingly focusing on sustainability practices, influenced by consumer preferences for eco-friendly products and regulatory frameworks that promote environmental responsibility (Market.us News, 2025).

Conversely, developing countries are making substantial inroads into the floriculture sector, capitalizing on favorable climatic conditions and lower production costs (Petal and Poem, 2025). Nations such as India and Colombia are emerging as key players in the industry due to their ability to produce high-quality flowers at competitive prices (Petal and Poem, 2025). The rise of e-commerce platforms has further facilitated access to international markets, allowing these countries to reach consumers directly (Petal and Poem, 2025). For instance, online sales of flowers are expected to account for a significant portion of global retail sales, reflecting a shift in consumer purchasing behavior towards digital transactions (Spherical Insights & Consulting, 2024).

In Africa, the floriculture sector has gained momentum over recent decades (Market.us News, 2025). Kenya is recognized as the continent's leading flower exporter, known for its high-quality roses and other floral products (Market.us News, 2025). The country's favorable climate and established export channels have made it a hub for flower exports (Market.us News, 2025). Ethiopia is rapidly emerging as a significant player in this sector, leveraging its rich resources and favorable growing conditions to produce high-quality blooms for international markets

(Market.us News, 2025). Ethiopia's flower exports primarily focus on large-budded roses with vibrant colors appealing to consumers in Europe and beyond (Research Nester, 2024).

Focusing specifically on East Africa, Ethiopia's floriculture industry is characterized by rapid growth and increasing competitiveness (LP Information Data, 2025). The country benefits from vast arable land and abundant water resources that support flower cultivation (LP Information Data, 2025). Major production areas include regions around Addis Ababa and the Rift Valley (LP Information Data, 2025). However, Ethiopian growers face challenges related to compliance with international sustainability standards set by the European Union (EU) (LP Information Data, 2025). As global demand shifts towards sustainable practices, Ethiopian producers must adapt their logistics processes to align with these regulations (LP Information Data, 2025).

The EU has implemented several policies aimed at promoting sustainability within the floriculture sector (Market.us News, 2025). The Circular Economy Action Plan (CEAP) encourages businesses to adopt sustainable practices throughout their supply chains, emphasizing waste reduction and resource efficiency (Market.us News, 2025). The Packaging and Packaging Waste Regulation (PPWR) mandates that all packaging must be recyclable by 2030 and contain a minimum percentage of recycled materials, directly impacting how flowers are packaged for export (Spherical Insights & Consulting, 2024). Additionally, the Product Environmental Footprint Category Rules (FloriPEFCR) require businesses to assess their environmental impact using standardized methodologies, promoting transparency in sustainability claims (Research Nester, 2024).

Ethiopia's floriculture sector has established itself as an essential component of the national economy and an influential player in global floral trade, but it now faces significant challenges related to EU regulations on sustainability (LP Information Data, 2025). Addressing these issues through comprehensive frameworks for green logistics will be crucial for ensuring the long-term viability of this critical sector within Ethiopia’s economy (McKinnon et al., 2021). By aligning with international standards in logistics practices—such as optimizing transportation routes and improving packaging efficiency—Ethiopian growers can enhance their competitiveness in an increasingly regulated market while contributing to global sustainability (LP Information Data, 2025).

1.2 Overview of Ethiopian Floriculture

Ethiopia's floriculture sector has rapidly evolved into a significant player in the global flower market, becoming the second-largest exporter in Africa and ranking among the top four globally. As of 2022, the industry generated approximately $541 million in revenue and covers a production area of nearly 2,000 hectares, employing around 200,000 people, with a substantial proportion of these jobs benefiting women (EHPEA, 2022; Tewodros Zewdie, 2022). This remarkable growth trajectory is supported by favorable agroecological conditions, government incentives, and increasing global demand for high-quality cut flowers, particularly roses (FloralDaily, 2024).

The Ethiopian government has played a pivotal role in fostering this growth through various export incentive policies aimed at promoting private sector engagement in the flower export business. These incentives include easy access to agricultural land at low rental rates, income tax exemptions for up to five years, duty-free importation of essential equipment, and access to loans (FloralDaily, 2024). As a result, approximately 120 investors have entered the floriculture subsector over the past three decades, significantly contributing to the country's export revenues (Tewodros Zewdie, 2022).

Despite these achievements, the sector faces significant challenges that threaten its sustainability and competitiveness. Recent legislative developments in the European Union, such as the Packaging and Packaging Waste Regulation (PPWR) and the Product Environmental Footprint Category Rules (FloriPEFCR), impose stringent requirements on packaging and environmental impact assessments that Ethiopian flower growers must meet to maintain access to lucrative European markets (European Commission, 2024). The PPWR mandates that all packaging used in products must be recyclable and contain a minimum percentage of recycled materials by 2030. Similarly, FloriPEFCR outlines specific methodologies for assessing the environmental footprint of cut flowers across various indicators.

As production shifts towards regions with more efficient logistics systems—countries that have already established robust green logistics practices—Ethiopian growers risk losing market share unless they can enhance their sustainability efforts. The convergence of growing domestic consumption and stringent international regulations creates a complex landscape for Ethiopian

flower growers. As they navigate these challenges, there is an urgent need for effective strategies that promote sustainable practices while enhancing competitiveness in both domestic and international markets.

Thus, there is an urgent need for a comprehensive framework that guides Ethiopian flower growers in adopting green logistics practices tailored to their specific context and challenges. This research aims to fill this gap by developing a structured framework for green logistics specifically designed for the Ethiopian floriculture sector.

1.3. Statement of the problem

The global floriculture market is increasingly prioritizing sustainability, driven by consumer demand for eco-friendly products and practices. This shift has led to a significant rise in the demand for sustainably grown flowers, with certifications such as Fair Trade and Rainforest Alliance influencing consumer choices (Petal & Poem, 2025). As a result, growers worldwide are adopting organic farming practices and reducing their carbon footprints to meet evolving consumer preferences.

In developed countries, particularly within the European Union (EU), stringent regulations are being implemented to enhance sustainability in the floriculture sector. The EU's Packaging and Packaging Waste Regulation (PPWR) mandates that all packaging must be recyclable and contain a minimum percentage of recycled materials by 2030. Additionally, the Product Environmental Footprint Category Rules (FloriPEFCR) require businesses to assess and disclose their environmental impact, including packaging practices (European Commission, 2024). These regulations create pressure on producers to adopt sustainable logistics practices that comply with these standards, pushing them towards greener operations.

Conversely, developing countries are increasingly entering the floriculture market but face unique challenges in adopting sustainable practices. While some nations have made significant strides in implementing eco-friendly methods, many developing regions struggle with inadequate infrastructure and resources. The rise of e-commerce platforms has opened new opportunities for these countries to reach international markets; however, logistical inefficiencies often hinder their competitiveness (Greenhouse Grower, 2024). Furthermore, technological advancements

such as hydroponics and vertical farming are gaining traction globally; yet many developing regions lack access to these innovations that can enhance sustainability in flower production.

In East Africa, Kenya has established itself as a leader in flower exports due to its favorable climate and developed logistics systems. However, Ethiopia is rapidly emerging as a key player in this sector. Despite its potential, Ethiopian flower growers face significant challenges related to compliance with international sustainability standards. The new EU regulations on packaging present substantial barriers for Ethiopian producers who must adapt their practices to meet these requirements or risk exclusion from lucrative European markets (France 24, 2024). Poor road infrastructure and insufficient cold chain logistics complicate timely delivery to markets, affecting product quality and increasing costs (Ethiopian Horticulture Producers Exporters Association [EHPEA], 2024).

Moreover, there is a notable lack of awareness among Ethiopian flower growers regarding best practices in green logistics. Many growers are unfamiliar with the benefits of adopting eco-friendly packaging practices or do not have access to training programs emphasizing sustainable methods (Wani et al., 2023). This knowledge gap can hinder the adoption of necessary changes that could improve compliance with international standards.

While existing literature has explored various aspects of sustainability within floriculture—such as water usage and pesticide impact—there is a significant theoretical gap regarding specific frameworks for implementing green logistics practices that address packaging-related environmental challenges in Ethiopia's unique context. Recent studies have identified barriers to adopting sustainable practices but have not sufficiently connected these barriers to actionable green logistics strategies tailored for Ethiopian flower producers (Floriculture Sustainability Initiative [FSI], 2023). This lack of focused research limits stakeholders' ability to develop effective solutions that enhance both environmental performance and competitiveness in an increasingly regulated market.

The Ethiopian floriculture sector is at a critical juncture as it seeks to align with international environmental sustainability standards while facing significant challenges related to compliance with new EU packaging regulations. Addressing this theoretical gap through the development of

a structured framework for green logistics specifically designed for Ethiopian growers is essential for enhancing their competitiveness in an increasingly regulated market**.**

1.4 **Objectives of the Study**

1.4.1. General Objective

To examine the effects of European Union regulations on the adoption and implementation of green logistics practices among Ethiopian flower growers, aiming to enhance operational efficiency and regulatory compliance within the floriculture sector

1.4.2. Specific Objectives

To identify current practices and challenges related to green logistics within the Ethiopian floriculture sector.

- To analyze how new European policies related to Sustainability impact operational practices among Ethiopian flower growers.
- To develop a comprehensive framework that integrates best practices for green logistics tailored to meet regulatory compliance and enhance sustainability.
- To provide actionable recommendations based on empirical data collected through interviews with stakeholders .

1.5 Research Questions

To guide this research effectively, several key questions will be addressed:

1. What are the current logistics practices employed by Ethiopian flower growers?

2. How do EU regulations such as PPWR and FloriPEFCR influence these practices?

3. What barriers do Ethiopian flower growers face in adopting green logistics?

4. What factors significantly impact the implementation of sustainable logistics practices among these growers?

5. How can a tailored framework be developed to enhance sustainability in Ethiopian floriculture?

1.6 Scope of the Study

This research focuses on the floriculture sector in Addis Ababa, Ethiopia, examining the impact of recent European Union regulations—specifically the Packaging and Packaging Waste Regulation (PPWR) and the Product Environmental Footprint Category Rules (FloriPEFCR)—on the adoption of green logistics practices among local flower growers. The study concentrates on both smallholder farmers and larger commercial producers who export primarily to European markets, aiming to identify the challenges and opportunities they encounter as they adapt their logistics operations to meet evolving regulatory requirements. Conceptually, the research centers on the integration and application of green logistics principles across four critical operational areas: transportation, warehousing, cold chain management, and packaging. These areas represent key points along the floriculture supply chain where environmental impact mitigation and regulatory compliance intersect.

Methodologically, the study relies mainly on secondary data sources such as industry reports, policy documents, and sector analyses to establish a comprehensive understanding of trends and regulatory influences. Complementing this, purposive qualitative interviews with selected key stakeholders—including farm managers, logistics coordinators, export company personnel, and representatives from sector associations—provide contextual insights and deepen understanding of green logistics adoption within the sector. Temporally, the research covers developments over approximately the past three years, corresponding with the introduction and progressive enforcement of the EU regulations in question. This timeframe allows for analysis of how recent policy shifts influence current practices and future planning in Ethiopia's floriculture logistics sector.

Geographically, the focus is confined to Addis Ababa and its immediate floriculture-producing environs, which function as the primary hub for Ethiopia's flower exports. While this localized scope offers detailed insight into the sector's operational dynamics and stakeholder experiences, it may limit the generalizability of findings to other regions or sectors.

1.7. Significance of the Study

The significance of this research extends far beyond academic inquiry; it has profound implications for both the floriculture sector in Ethiopia and broader discussions on sustainable agriculture in developing countries. As EU regulations become increasingly stringent, understanding their implications for Ethiopian flower growers is essential for maintaining market access. This study will provide a comprehensive analysis of how these regulations affect operational practices, compliance costs, and overall competitiveness in international markets. By identifying specific compliance challenges—such as adapting packaging methods or improving waste management systems—the research will offer valuable insights that can assist growers in effectively navigating these complexities.

Moreover, this study aims to enhance sustainability practices within the floriculture sector by developing a practical framework for integrating green logistics. This framework will serve as a guide for Ethiopian flower growers seeking to adopt sustainable practices that align with international standards. Given the growing consumer preference for sustainably sourced products, this framework will not only help growers comply with regulatory requirements but also enhance their marketability and brand reputation. Research has shown that companies adopting sustainable practices often experience improved customer loyalty and competitive advantage (Khan et al., 2020). Thus, by facilitating access to sustainable logistics practices, this research can contribute significantly to the economic viability of flower growers.

Additionally, by identifying key barriers to adopting green logistics practices—such as limited access to eco-friendly packaging materials or insufficient training—the research will highlight areas where intervention is needed. This information is crucial for policymakers, non-governmental organizations (NGOs), and industry associations aiming to support sustainable development initiatives within the sector. For instance, targeted training programs could be developed to enhance growers' knowledge about sustainable practices and compliance requirements.

The findings from this study can also inform policymakers about the specific needs and challenges faced by Ethiopian flower growers concerning EU regulations. By providing evidence-based recommendations, this research can contribute to developing policies that

support sustainable agricultural practices while ensuring that local businesses remain competitive in global markets. Policymakers can utilize these insights to create supportive regulatory environments that facilitate compliance without imposing undue burdens on growers.

Finally, engaging various stakeholders—including government agencies, industry associations, NGOs, and academic institutions—will be a key aspect of this research. By fostering collaboration among these groups, the study aims to create a supportive network that encourages knowledge sharing and resource mobilization for sustainable practices in floriculture. Such engagement is essential for building a cohesive strategy that addresses both local challenges and international expectations regarding sustainability.

This research holds significant potential to positively impact Ethiopia's floriculture sector by enhancing understanding of regulatory compliance, promoting sustainability practices, identifying barriers to implementation, contributing to policy development, and fostering stakeholder engagement. The outcomes of this study will not only benefit Ethiopian flower growers but also contribute to broader discussions on sustainable agriculture in developing countries. By addressing these critical issues through empirical research and stakeholder collaboration, this study aims to pave the way for more sustainable practices within Ethiopia's floriculture industry. This version provides a comprehensive overview of both the scope and significance of your thesis proposal while emphasizing its relevance to various stakeholders within Ethiopia's floriculture sector.

1.8 Limitation of the study

This research primarily utilized qualitative methods, relying on purposively selected interviews supplemented by secondary data sources. While this approach provided rich and context-specific insights into green logistics practices in Ethiopia’s floriculture sector, it also imposed certain constraints. The relatively small, non-random sample limits the generalizability of findings across the entire sector or other geographical regions. Moreover, reliance on secondary data restricted the extent to which contemporary, quantitative measures of environmental and economic impacts could be captured.

The study's geographic focus on Addis Ababa and its immediate surroundings, though representing a key hub, may not fully reflect the practices or challenges in more peripheral floriculture production.

Chapter Two

Literature review

2.1 Theoretical Review of Green Logistics

Green logistics is the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information in a way that minimizes environmental impact. It extends traditional logistics by incorporating environmental considerations at every stage of the supply chain, from sourcing raw materials to delivering finished products to the end user and managing returns or recycling.

The primary aim of green logistics is to reduce the ecological footprint of logistics operations. This includes lowering greenhouse gas emissions, reducing energy and fuel consumption, minimizing waste and packaging, and promoting the use of renewable resources. Green logistics strategies may involve optimizing transportation routes to save fuel, using eco-friendly vehicles, adopting recyclable or biodegradable packaging materials, and implementing energy-efficient practices in warehouses and distribution centers.

Green logistics also encompasses reverse logistics, which refers to the process of moving goods from their final destination back to the manufacturer for reuse, recycling, or proper disposal. This helps create a more circular supply chain and reduces the amount of waste sent to landfills.

Overall, green logistics is about finding a balance between economic efficiency and environmental responsibility, ensuring that the movement and storage of goods support both business goals and the broader objective of sustainable development.

2. 2 Importance of Green Logistics

Green logistics has emerged as a critical focus in both environmental and economic discussions, evolving into a prominent concept in the 20th century and continuing to gain importance in the 21st century. It refers to the integration of environmentally friendly practices throughout logistics and supply chain processes, aiming to minimize the ecological footprint associated with the transportation, packaging, and distribution of floral products. This approach is particularly significant in the floriculture sector, where reliance on air freight contributes significantly to

carbon emissions (Babalola et al., 2011). The primary objectives of green logistics include reducing waste, optimizing resource use, and enhancing overall operational efficiency (Kardinal, 2021). By adopting green logistics practices, companies can not only comply with regulatory standards but also enhance their brand reputation in an increasingly eco-conscious market.

2.3 Green Logistics System: Components and Recent Developments

A Green Logistics System represents an integrated and holistic approach to logistics management that prioritizes environmental sustainability at every stage of the supply chain. As global awareness of climate change and resource depletion intensifies, organizations are increasingly adopting green logistics systems to minimize their ecological footprint, comply with evolving regulations, and meet the expectations of environmentally conscious consumers. The system encompasses a range of interconnected components—namely green transportation, green warehousing, green packaging, green logistics data collection and management, and green waste management. Recent technological advancements and regulatory pressures have accelerated the adoption of these practices, making green logistics a cornerstone of sustainable supply chain management in sectors such as floriculture, food, and manufacturing.

2.3.1 Green Transportation

Green transportation is a foundational element of green logistics systems, focusing on reducing energy consumption, emissions, and environmental impact throughout the movement of goods. Strategies for green transportation include optimizing routing to minimize travel distances, utilizing clean vehicles such as electric or hybrid trucks, consolidating freight to maximize load efficiency, and selecting carriers with strong sustainability credentials. Recent developments in this area feature the integration of artificial intelligence for route planning, the deployment of renewable energy-powered vehicles, and the adoption of intermodal transport solutions that combine rail, road, and sea to reduce reliance on high-emission modes like air freight. These innovations not only lower greenhouse gas emissions but also contribute to cost savings and improved regulatory compliance (Murthy et al., 2024; Union Fleurs, 2024).

2.3.2 Green Warehousing

Green warehousing refers to the implementation of environmentally sustainable practices within storage and distribution facilities. This includes the use of eco-friendly building materials,

installation of renewable energy systems such as solar panels, and the adoption of energy-efficient heating, cooling, and lighting solutions. Modern warehouses are increasingly equipped with smart sensors and Internet of Things (IoT) technologies to monitor and optimize energy usage, reduce waste, and ensure optimal storage conditions—especially for perishable goods like flowers. On-site recycling facilities, rainwater harvesting, and waste reduction initiatives are also becoming standard features. These advances help reduce the ecological footprint of warehousing operations while enhancing overall operational efficiency and resilience (Bartolini, 2019; Ofori et al., 2022).

2.3.3 Green Packaging

Green packaging is designed to minimize environmental impact by adhering to the 4R1D principles: reduce, reuse, reclaim, recycle, and degradable. This involves using biodegradable, compostable, and recycled materials, as well as designing packaging to use less material without compromising product protection. Recent innovations include plant-based plastics, modular packaging that can be reused or easily recycled, and water-based inks for printing. Regulatory mandates, such as the EU's Packaging and Packaging Waste Regulation (PPWR), are accelerating the shift toward sustainable packaging, compelling companies to reduce single-use plastics and increase the recycled content in their packaging. These efforts not only reduce waste but also align with consumer demand for eco-friendly products and support the transition to a circular economy (Murthy et al., 2024; European Commission, 2024).

2.3.4 Green Logistics Data Collection and Management

The collection and management of logistics data are critical for monitoring and improving environmental performance. Green logistics data systems leverage digital technologies such as IoT devices, blockchain, and advanced analytics to track key metrics including carbon emissions, energy consumption, and waste generation across the supply chain. Real-time data collection enables organizations to identify inefficiencies, benchmark performance, and make informed decisions to enhance sustainability. Transparent data management also supports regulatory compliance and facilitates sustainability reporting, which is increasingly demanded by stakeholders and investors. The use of digital platforms for data sharing and collaboration further

strengthens the ability of supply chain partners to coordinate green initiatives and achieve shared sustainability goals (Li, 2021; Kassa & Gebremedhin, 2022).

2.3.5 Green Waste Management

Green waste management encompasses a range of practices aimed at minimizing, recycling, and reusing waste generated throughout logistics operations. This includes the implementation of reverse logistics systems for the collection and processing of used packaging, unsold goods, and obsolete equipment. Companies are increasingly conducting waste audits, investing in recycling infrastructure, and forming partnerships with specialized waste management firms to divert materials from landfills and recover value from waste streams. Composting, especially in sectors like floriculture, is used to recycle organic waste and return nutrients to the soil. Effective green waste management not only reduces environmental harm but also helps organizations comply with regulatory requirements and achieve cost savings through resource recovery and reduced disposal fees (McKinnon et al., 2021; UNECA, 2022).

2.4 Theoretical Literature: Green Logistics Along the Global Cut Flower Chain

Green logistics has emerged as a critical focus within environmental and economic discussions, particularly relevant to the cut flower industry, which generates annual revenues of approximately $55 billion globally (Coventry University, 2024). This sector presents unique challenges and opportunities for implementing green logistics practices. Various definitions of green logistics highlight its multifaceted nature, encompassing strategies aimed at minimizing environmental impacts throughout the supply chain—from production to transportation and distribution.

One foundational definition emphasizes the need for equitable resource distribution while ensuring minimal ecological footprints. This aligns with Willard's (2012) perspective on sustainability as “enough for all, forever,” which underscores the importance of balancing economic growth with environmental stewardship. Similarly, Paula et al. (1999) describe green logistics as a continuous process aimed at improving living conditions while safeguarding ecosystems. This holistic approach is essential in addressing the complexities of the floriculture sector, where intensive agricultural practices can lead to significant environmental degradation.

The World Commission on Environment and Development (1987) encapsulated sustainability by defining it as development that meets current generations' needs without compromising future generations' ability to meet their own needs. This definition highlights that green logistics challenges are multifaceted and cross-sectoral, necessitating collaborative efforts among stakeholders in the cut flower supply chain. In the context of African agriculture, these challenges encompass social, economic, political, and environmental dimensions.

Economic sustainability is intrinsically linked to both environmental and social sustainability. Meadows et al. (1972) argue that economies cannot be sustainable if natural resources are exploited beyond their limits. Today, global challenges related to economic inequality, environmental degradation, and social injustice necessitate urgent actions to achieve sustainable development within the floriculture sector. The reliance on intensive agricultural practices often leads to issues such as over-packaging, plastic waste from floral foam, and excessive pesticide application (Spiral Botanicals, n.d.). The Sustainable Cut Flowers Project emphasizes adopting green logistics practices that minimize these negative impacts while promoting local production (Sustainable Cut Flowers Project, 2023).

Local flower production offers an opportunity to reduce carbon footprints by decreasing reliance on imported flowers that travel thousands of miles to reach consumers (University of Minnesota Horticulture, 2023). The environmental benefits of cultivating flowers locally include lower transportation emissions and reduced chemical inputs during production. Furthermore, ethical considerations in sourcing flowers have gained traction within the industry. Florists are encouraged to purchase from Fairtrade-certified suppliers or those with other ethical accreditations to ensure fair labor practices and environmentally friendly growing methods (Fig & Bloom, 2021). This shift towards responsible sourcing aligns with broader green logistics goals by supporting producers who prioritize both social welfare and ecological integrity.

Green logistics along the global cut flower chain involves addressing complex interrelationships between economic viability, environmental stewardship, and social equity. The floriculture industry must navigate these challenges through innovative practices that promote sustainable development while meeting consumer demands for ethically sourced products. By embedding

green logistics principles into their operations, stakeholders can enhance their competitiveness while contributing positively to environmental sustainability.

2.5 Empirical Review of Green Logistics Practices

2.5.1 Global Best Practices in Green Logistics

Globally recognized best practices in green logistics have been instrumental in shaping sustainable operations within the floriculture sector. One significant practice is the adoption of sustainable packaging solutions aimed at reducing waste throughout the supply chain. Many companies are transitioning to biodegradable materials for packaging—such as compostable wraps made from plant-based materials or recycled cardboard—which help minimize plastic waste (Murthy et al., 2024). The Floriculture Sustainability Initiative (FSI) emphasizes responsible sourcing and encourages growers to implement sustainable packaging solutions that comply with environmental standards (FSI, 2023). These practices not only address consumer demand for eco-friendly products but also align with regulatory requirements aimed at reducing packaging waste.

Transportation methods also play a crucial role in green logistics within floriculture. Reducing reliance on air freight is essential for minimizing carbon emissions associated with flower transportation; thus companies are increasingly exploring alternatives such as rail or sea transport for longer distances while promoting local sourcing to cut down on transportation needs (Pondicherry University, 2024). This shift not only reduces greenhouse gas emissions but also lowers transportation costs significantly—making operations more efficient.

Effective cold chain management is vital for maintaining flower quality during transport—a critical factor given the perishability of floral products. Implementing temperature-controlled storage facilities alongside advanced monitoring technologies can significantly reduce spoilage rates and enhance product quality during transit (Ofori et al., 2022). For instance, real-time condition monitoring systems allow growers to ensure that optimal storage conditions are maintained throughout the supply chain—thereby minimizing waste while improving customer satisfaction.

Establishing robust recycling initiatives also contributes significantly towards creating a circular economy within the floriculture sector—an essential component of green logistics practices today. Many flower farms are partnering with local recycling facilities to process waste efficiently (Murthy et al., 2024). Composting unsold or damaged flowers not only reduces landfill waste but also recycles nutrients back into soil—contributing positively towards sustainable agricultural practices.

2.5.2 Developed Countries: Case Studies from the Netherlands

The Netherlands serves as a leading example of effective green logistics implementation in floriculture due to its advanced infrastructure and commitment to sustainability principles across all levels of production and distribution processes within this industry sector. Dutch companies have integrated innovative farming techniques with sustainable logistics practices such as precision agriculture—utilizing data analytics tools—to optimize resource usage while minimizing waste generation during cultivation processes (Union Fleurs, 2024).

The introduction of EU regulations like FloriPEFCR and PPWR has further driven innovation among Dutch growers mandating compliance with stringent environmental standards (Greenhouse Grower, 2024). Research indicates that these regulations have prompted investments in research & development aimed at enhancing sustainability across entire supply chains—encouraging collaboration among stakeholders towards achieving shared goals related to eco-friendly practices within floriculture operations.

2.5.3 Developing Countries: Challenges and Opportunities

In developing countries like Ethiopia—the floriculture sector faces significant challenges when it comes adopting effective green logistics due infrastructural limitations coupled high initial investment costs required implementing necessary changes (Hove-Sibanda et al., 2018). However there are notable opportunities for growth through international investments which facilitate knowledge transfer regarding sustainable practices from more developed nations such as those seen in Europe or North America (Flora Culture International ,2022).

The introduction of EU regulations necessitates a shift towards more sustainable logistics practices among Ethiopian growers; compliance with regulations such as PPWR requires

substantial changes operational processes related packaging transportation methods(Borgen Project ,2023). Key features included mandates all packaging must be recyclable by year 2030 alongside requirements plastic packaging contain at least 35% recycled material—a challenge given current infrastructural limitations faced across many regions within Ethiopia’s agricultural landscape.

2.5.4 Overview of Ethiopia's Floriculture Sector

Ethiopia has rapidly become a key player in the global floriculture market due its favorable climate combined abundant natural resources specializing primarily rose production intended export markets . As Ethiopian flower exports continue grow—projected over $550 million—there is an urgent need local producers implement sustainable practices align global standards.

The Ethiopian Horticulture Producers Exporters Association (EHPEA) has been instrumental fostering growth within this sector providing training programs focused sustainable farming techniques compliance international regulations(EHPEA ,2017). By leveraging best practices developed countries while addressing local challenges such infrastructure deficits limited access technology; Ethiopian growers can enhance operational efficiency contribute positively towards environmental sustainability.

2.6 New EU Regulations Impacting Ethiopia

The new EU regulations impose stricter phytosanitary requirements on cut roses exported from Ethiopia starting April 26th ,2025 . These regulations aim prevent pests like False Codling Moth entering European markets by mandating detailed pest monitoring stringent treatment procedures before exportation occurs .

Compliance will require Ethiopian producers not only enhance pest control measures but also invest significantly training programs farm workers who will tasked adhering strictly these new standards set forth by EU authorities.

These regulatory changes pose significant concerns for Ethiopia's floriculture industry since approximately 30% its flowers exported directly into European markets; thus adherence will be crucial if they wish maintain competitiveness against other exporting nations such Kenya Colombia already have established systems place .

Moreover; compliance regulations like PPWR will compel Ethiopian growers rethink packaging strategies significantly; they will need innovative solutions meet recyclability requirements while still ensuring product integrity during transport—a challenge given current infrastructural limitations faced across many regions within Ethiopia's agricultural landscape.

The integration of green logistics practices within the floriculture sector is essential for minimizing environmental impacts while enhancing operational efficiency amidst new regulatory pressures from Europe's evolving legislative framework around sustainability initiatives like PPWR & FloriPEFCR . By adopting sustainable packaging solutions aligned these regulations; optimizing transportation methods; managing cold chains effectively; establishing recycling initiatives; growers can significantly reduce their carbon footprint while complying effectively new EU standards . Addressing challenges such infrastructure limitations will be crucial fully realizing these benefits ensuring Ethiopian flower producers remain competitive within increasingly eco-conscious global market .

2.7 Conceptual Framework

The conceptual framework for green logistics in Ethiopia's floriculture sector integrates four core pillars—green transport, green warehousing, green packaging, and green cold chain management—within a structure explicitly grounded in Carter and Rogers' (2008) Sustainable Supply Chain Management (SSCM) Model. This model emphasizes the strategic and transparent integration of environmental, economic, and social sustainability goals across inter-organizational processes to achieve long-term competitive advantage (Carter & Rogers, 2008). By applying this theoretical foundation, the framework guides the adoption of green logistics practices that balance ecological responsibility with economic viability and social equity.

The four pillars interact dynamically and involve important trade-offs. For example, shifting transport modes from air to sea freight reduces emissions but requires enhanced cold chain management to preserve product quality over longer transit times. Similarly, adopting lightweight, recyclable packaging can improve transport and warehousing efficiency by reducing volume and weight, but may demand upfront investments and redesign of inventory systems. Investments in warehousing and cold chain infrastructure support greener transport options and

reduce spoilage, although these require significant capital and operational adjustments. Recognizing these interdependencies is critical for coordinated implementation.

Implementation occurs across three layers: the regulatory layer, driven by EU directives such as the Packaging and Packaging Waste Regulation (PPWR) and Floriculture Product Environmental Footprint Category Rules (FloriPEFCR), as well as national policies; the organizational layer, where exporters, logistics firms, and farms adopt green practices and invest in relevant technologies; and the operational layer, which involves the day-to-day logistics activities optimized through digital tools and continuous monitoring.

Enabling factors are essential to facilitate adoption and include digitalization (real-time tracking, IoT sensors, blockchain for traceability), stakeholder collaboration (public-private partnerships, industry associations like EHPEA), capacity building (training and technical support for logistics personnel and smallholders), and supportive policies and incentives such as tax breaks and green financing. These enablers create the environment necessary for the pillars to function effectively and sustainably.

The framework's implementation is envisioned through four sequential phases: Awareness and Alignment, involving regulatory harmonization and stakeholder training; Pilot and Demonstration, which includes small-scale trials and technology testing; Scale-up and Integration, focusing on infrastructure investment and supply chain coordination; and Monitoring and Adaptation, which emphasizes KPI tracking and continuous improvement. Each phase engages specific stakeholders—governments lead policy and training efforts; industry associations provide advocacy and technical support; exporters and farms drive practice adoption; logistics providers innovate in transport and warehousing; and international partners contribute knowledge transfer and funding.

Visually, this framework can be represented with the regulatory environment at the center, surrounded by the four pillars connected with double-headed arrows to indicate mutual influence and trade-offs. An outer ring depicts the enabling layer encompassing digitalization, collaboration, capacity building, and policy incentives. Overlaying this structure are flow arrows

illustrating the implementation phases, with stakeholder roles positioned adjacent to the components they influence.

By explicitly integrating Carter and Rogers' SSCM model, this framework ensures that green logistics innovations are evaluated holistically for their environmental, economic, and social impacts. It provides a robust, practical roadmap for Ethiopia's floriculture sector to navigate the complexities of sustainability, optimize resource use, comply with evolving regulations, and enhance global competitiveness while fostering equitable stakeholder engagement (Carter & Rogers, 2008)

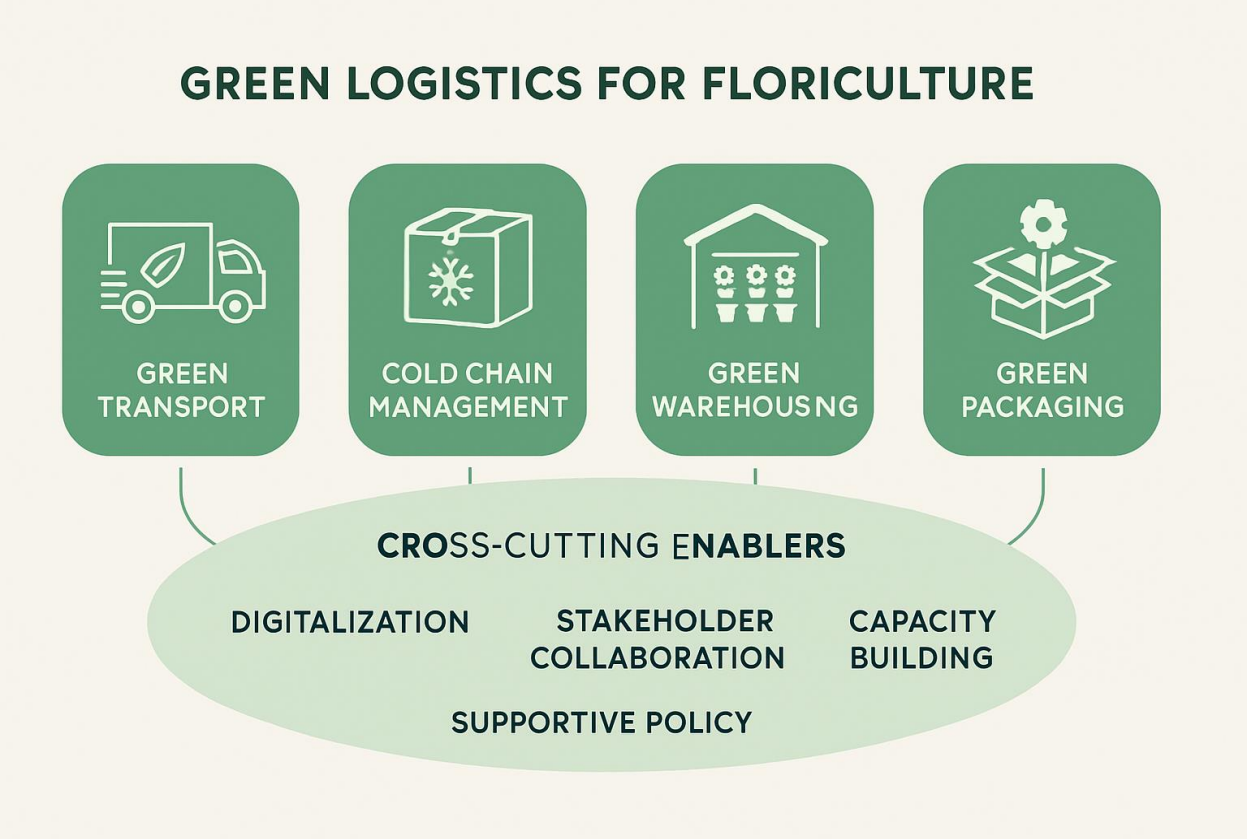

FIg. 1 Conceptual framework for floriculture in Ethiopia.

Chapter Three

Data Methodology

This chapter outlines the methodological framework adopted to investigate green logistics practices in Ethiopia's floriculture sector. It describes the study area, explains the research design and approach, details the types and sources of data, and discusses the sampling techniques, data collection instruments, and data analysis methods used. The methodology is designed to ensure that the research process is systematic, credible, and aligned with the study's objectives.

3.2 Description of the Study Area

The study was conducted in Ethiopia, focusing on major floriculture production regions such as Oromia and Amhara. These areas are the primary hubs for flower farming and export activities due to their favorable agro-climatic conditions and proximity to Addis Ababa, the nation's capital and main logistics center. The presence of Bole International Airport, the main gateway for Ethiopian flower exports to Europe, further highlights the strategic importance of these regions for logistics and supply chain operations. The study area is also characterized by a concentration of stakeholders—including flower producers, exporters, and logistics service providers—actively engaged in the floriculture value chain.

3.3 Research Design and Approach

For this study, a qualitative research design was employed. This approach was selected because the research aimed to gain an in-depth understanding of green logistics practices—specifically green transport, warehousing, packaging, and cold chain management—within Ethiopia's floriculture sector. The qualitative design allowed for the exploration of stakeholders' experiences, perceptions, and challenges, which are best captured through open-ended, flexible research methods. Data were collected through semi-structured interviews with key sector stakeholders, including farm managers, logistics coordinators, and export professionals, as well as through a systematic review of relevant literature and content analysis of policy documents and industry reports. This combination of methods enabled the researcher to gather rich, context-specific data and to triangulate findings from multiple sources, thereby enhancing the credibility

and validity of the study. The qualitative research design also provided the flexibility to refine the research focus as new themes and issues emerged during data collection and analysis, ensuring a comprehensive and nuanced understanding of the complexities surrounding green logistics in Ethiopia's floriculture industry.

3.4 Data Type and Source

The study utilized both primary and secondary qualitative data. Primary data were collected through semi-structured interviews with key stakeholders, including farm managers, logistics coordinators, export professionals, and representatives from industry associations and regulatory bodies. Secondary data were obtained from policy documents, industry reports, academic literature, and relevant EU regulatory texts such as the Packaging and Packaging Waste Regulation (PPWR) and the Floricultural Product Environmental Footprint Category Rules (FloriPEFCR). The integration of primary and secondary data sources provided a comprehensive perspective on the current state of green logistics and the challenges faced by the sector.

3.5 Population, Sampling Technique, and Sample Size

The primary aim of this thesis was initially to conduct the research based solely on comprehensive secondary data, leveraging existing sector reports, policy documents, and empirical studies to outline Ethiopia's floriculture logistics landscape. However, to enhance the richness and contextual relevance of the analysis, expert insights were incorporated through qualitative interviews with key actors in the sector. These expert contributions provided valuable firsthand perspectives that complemented and deepened the secondary data findings, adding nuance and practical understanding to the otherwise document-based research.

This hybrid approach maintained the central position of secondary data as the foundational source, while purposefully integrating qualitative evidence to validate, elaborate, and interpret sector trends more robustly—thereby strengthening the thesis's overall validity and practical significance.

Data saturation was a critical consideration to ensure the quality and completeness of the qualitative inquiry. Following established qualitative research standards (e.g., Saunders et al.,

2022; Palinkas et al., 2020), interviews continued until no new themes, patterns, or insights emerged from additional participants. In this study, saturation was achieved with 15 interviews, reflecting the specialized and relatively homogeneous nature of the floriculture logistics sector experts consulted. This saturation point indicates that the collected data were sufficient to comprehensively capture the essential perspectives needed to answer the research questions. The concept of saturation provided confidence that the sample size was adequate to produce meaningful, credible, and transferable findings without unnecessary over-sampling.

3.6 Instruments of Data Collection

Data collection was carried out using several qualitative instruments. Semi-structured interview guides were developed to elicit detailed information on green logistics practices, challenges, and compliance strategies. These guides included open-ended questions, allowing participants to freely share their experiences and insights. In addition, document review checklists were used to systematically analyze policy documents, industry reports, and regulatory texts for relevant information on green logistics and sustainability requirements.

3.7 Data Analysis Techniques

The qualitative data for this study were analyzed using thematic analysis, a method focused on identifying and interpreting patterns across interview transcripts and documentary sources. Following transcription, the researcher carefully reviewed the data and applied coding to highlight recurring concepts and issues related to green logistics practices and challenges within Ethiopia's floriculture sector. This coding combined both inductive approaches, allowing themes to emerge naturally from participants' perspectives, and deductive approaches guided by the research questions and conceptual framework.

These codes were then organized into broader themes that captured the main patterns present in the data. To enhance the accuracy and credibility of the analysis, triangulation was employed by cross-checking these themes against recent secondary data sources such as industry and sector reports. The finalized themes were explicitly linked to the study's objectives, enabling comprehensive and evidence-based answers to the research questions regarding green logistics adoption and challenges in Ethiopian floriculture.

3.8 Validity

To ensure validity, the research used triangulation by comparing and corroborating information from literature, official documents, and primary data collected through questionnaires and interviews. All steps of the research process—including how participants were selected, how data was gathered, and how it was analyzed—were clearly documented to maintain transparency. Key findings were shared with selected participants for feedback where feasible, helping to confirm that their perspectives were accurately captured. The advisor's regular review of the research process and findings further supported the accurate interpretation of data.

3.9 Reliability

Reliability was maintained by applying a consistent coding framework to all qualitative data, ensuring that similar information was categorized in the same way throughout the analysis. The advisor provided ongoing oversight, reviewing the coding and interpretation of results. This external evaluation helped reduce individual bias and reinforced the dependability of the study's conclusions.The advisor's critical input helped identify any inconsistencies or potential biases in the analysis, ensuring that the findings were robust and dependable. Regular advisor evaluation provided a strong foundation for the reliability of the study's conclusions.

3.10 Ethical Considerations

Participation in the qualitative questionnaire was voluntary, with informed consent obtained from all participants. All data were anonymized and used exclusively for research purposes. Proper citation and copyright compliance were maintained for all literature and documents.

Chapter Four

Result and Discussion

This chapter presents the findings of the research, beginning with primary insights derived from the Ethiopian Horticulture Producer Exporters Association (EHPEA) and sector stakeholders. These findings are then contextualized and supported by a systematic review of global, regional, and national literature and policy documents. The analysis is structured around the established research questions and framed within the four pillars of green logistics: green packaging, green transport, cold chain management, and green warehousing.

4.0 Demographic Analysis of Respondents

This study employed a qualitative research approach with a purposive sample of 15 respondents, all of whom were male, reflecting the gender composition of key decision-makers in the Ethiopian floriculture logistics sector. The participants included flower farm owners, logistics managers, export coordinators, and other relevant stakeholders directly involved in the logistics and supply chain operations of flower production and export.

The age of respondents ranged from 30 to 55 years, with an average age of approximately 42 years, indicating a mature group with substantial industry experience. Their professional experience in the floriculture sector varied between 5 and 20 years, providing a rich depth of knowledge regarding current logistics practices, challenges, and the impact of European Union sustainability regulations.

Geographically, all respondents were based in Addis Ababa and the surrounding floriculture production zones, which are the primary hubs for Ethiopia's flower export industry. This focused sample allowed for in-depth insights into the local context of green logistics adoption and compliance with international environmental standards.

While the sample size was limited to 15 participants, the qualitative nature of the study prioritized depth and detail of information, enabling a comprehensive understanding of the sector's logistics challenges and opportunities from experienced insiders.

4.1 Awareness of EU Sustainability Regulations

Stakeholders—including farm managers and industry association representatives—expressed a good general awareness of major EU environmental regulations affecting logistics, notably the PPWR (Packaging and Packaging Waste Regulation) and the FloriPEFCR (Floriculture Product Environmental Footprint Category Rules). This awareness largely results from EHPEA-led educational programs and communications designed to prepare exporters to meet evolving compliance demands.

However, these regulations are currently enforced more strictly in other agricultural sectors like fruits and vegetables, not yet rigorously on floriculture. This creates a "watch-and-wait" mindset in the Ethiopian flower sector, where most firms are tentatively observing regulatory developments but have yet to undertake deep operational changes.

This cautious stance is rational given the financial risks associated with early investments in green logistics without clear enforcement mandates. It also reflects a strategic approach to compliance based on regulatory certainty.

As one participant said:"The PPWR is prominent in our discussions. Yet, since flowers are not yet strictly regulated like vegetables, most companies adopt a wait-and-see approach."

4.2 Status of Green Logistics Practice Adoption

Despite the relatively high awareness, actual adoption of sustainable logistics practices remains low for a majority of exporters. Key practices such as switching to sustainable packaging materials, optimizing transport routes to reduce emissions, or investing in energy-efficient cold chain technologies are still confined to a small subset of firms, primarily larger or better-resourced exporters.

Many respondents attend workshops or awareness sessions but indicate that investments lag due to cost constraints, lack of incentives, and competing operational priorities. Sustainability is often relegated behind maintaining reliability and cost control, critical to preserving export market access under tough economic conditions.

Nonetheless, there is broad consensus that the sector will need to increase its commitment to green logistics as EU requirements become stricter and expand explicitly to floriculture products.

4.3 Current Logistics Practices

According to EHPEA interviews and internal reports, Ethiopian flower growers predominantly rely on conventional logistics methods. The majority of growers use manual pre-cooling, basic sorting and packing in corrugated cartons, and transport flowers to Bole International Airport in refrigerated trucks. However, these trucks are often outdated and susceptible to breakdowns, leading to delays and occasional spoilage. Cold storage facilities exist at major consolidation points and at the airport, but their capacity and reliability are notably limited. For example, the combined cold storage capacity at Bole International Airport and key regional hubs is estimated at under 2,000 metric tons, which is insufficient during peak export periods when demand can exceed 2,500 metric tons per week (IFC, 2022; GCCA, 2022). Furthermore, a recent assessment found that power outages and equipment failures result in temperature fluctuations in 40% of storage facilities surveyed, leading to an estimated 8–12% post-harvest loss rate—significantly higher than the 2–4% loss rate typical in leading floriculture exporters such as Kenya and the Netherlands (GCCA, 2022; RVO, 2024).

Only a few leading exporters—such as Sher Ethiopia, Afriflora, Golden Rose Agrofarms, and Florensis Ethiopia—often with direct EHPEA support or international partnerships, have begun piloting digital tracking systems, reusable packaging, and energy-efficient storage solutions. These firms are recognized for adopting best practices in cold chain management and logistics innovation, setting benchmarks for the rest of the sector. However, sector-wide adoption of these advanced practices remains very limited.

Globally, the floriculture industry has set benchmarks in logistics efficiency and technological integration. Leading exporters in Europe, Asia, and South America have adopted sophisticated supply chain technologies such as real-time GPS tracking, automated inventory management, and advanced cold chain systems, which allow flowers to be shipped across continents with minimal spoilage and high quality (Research and Markets, 2024). In developed economies, especially within the EU and North America, logistics operations are not only automated but are also deeply embedded with sustainability principles. Growers employ reusable and recyclable

packaging, leverage electric or hybrid vehicles for transport, and utilize digital platforms for route optimization and temperature control. Warehouses are increasingly energy-efficient, often powered by renewable energy sources, reflecting both regulatory requirements and consumer demand for sustainable production (European Commission, 2023).

However, this level of advancement is far from universal. In developing countries, logistics practices are much more varied and often constrained by limited resources. While some large-scale exporters in Latin America and Africa have managed to implement modern cold chain systems and digital tracking, the majority of small and medium growers still rely on manual sorting, single-use packaging, and conventional trucks. These limitations stem from persistent challenges such as inadequate infrastructure, high costs of technology adoption, and limited access to finance (IFPA, 2024).

East Africa, and Kenya in particular, has made notable progress in upgrading floriculture logistics. Kenya's investment in modern logistics hubs, cold storage facilities, and international partnerships has enabled its leading exporters to meet the stringent requirements of global markets. Certification schemes such as Fairtrade and GlobalG.A.P. have further incentivized sustainable logistics practices, though smaller Kenyan exporters continue to face challenges related to cost and technical capacity (Fairtrade Foundation, 2024).

In Ethiopia, floriculture logistics remain in a transitional phase. Most growers still use manual pre-cooling, basic sorting and packing in corrugated cartons, and transport flowers in refrigerated trucks that are often outdated and susceptible to breakdowns. While cold storage is available at key consolidation points and at Bole International Airport, its capacity and reliability are limited. Only a handful of leading exporters—often those with direct EHPEA support or international partnerships—have begun to pilot digital tracking, reusable packaging, and energy-efficient storage solutions, leaving the majority of the sector reliant on basic, labor-intensive methods (EHPEA, 2024; Mekonnen & Ejigu, 2023).

As one participants said : "During peak periods, we simply don't have enough cold storage; temperature fluctuations are common, impacting flower quality."

4.4 Influence of EU Regulations as Catalyst and Barrier

According to the official report published by the Ethiopian Horticulture Producer Exporters Association (EHPEA, 2024), awareness of EU regulations such as the Packaging and Packaging Waste Regulation (PPWR) and Floriculture Product Environmental Footprint Category Rules (FloriPEFCR) is increasing among Ethiopian exporters. Leading exporters such as Afriflora Sher, Golden Rose Agrofarms Ltd., and Flamingo Horticulture Ethiopia have initiated pilot projects using reusable packaging and digital monitoring to align with EU standards. However, approximately 70% of exporters continue to face significant challenges in achieving full compliance. Key barriers identified in the EHPEA report include the high cost and limited local availability of compliant packaging materials, the financial burden of upgrading logistics systems, and fragmented supply chains. While EHPEA has facilitated workshops and technical assistance, the report notes that sector-wide adoption of EU-compliant practices remains limited.

The influence of EU regulations—most notably the Packaging and Packaging Waste Regulation (PPWR) and Floriculture Product Environmental Footprint Category Rules (FloriPEFCR)—has become a defining factor in shaping floriculture logistics worldwide. These regulations have established new global standards for environmental compliance, requiring exporters to adopt recyclable and reusable packaging, reduce carbon emissions, and provide comprehensive documentation of environmental impacts throughout their supply chains (European Commission, 2023). Developed countries have responded proactively, leveraging their advanced regulatory systems, infrastructure, and access to compliant materials to quickly adapt to and often lead in packaging innovation and low-emission logistics (Research and Markets, 2024).

For developing countries, however, the path to compliance is fraught with challenges. Exporters often need to completely overhaul their packaging, transportation, and cold chain systems—a process that is both financially and technically demanding. Many rely on donor-funded projects, technical assistance, or partnerships with international organizations to bridge these gaps (IFPA, 2024).

In East Africa, the EU's regulatory influence is particularly pronounced due to the region's export orientation toward European markets. Kenyan and Ethiopian exporters face intense

pressure to comply, prompting investments in green packaging, cold chain upgrades, and digital monitoring. Nevertheless, persistent infrastructural and capacity gaps continue to hinder full compliance, especially among smaller exporters (Fairtrade Foundation, 2024).

Within Ethiopia, awareness of EU regulations is gradually increasing. Leading firms such as Afriflora Sher, Golden Rose Agrofarms Ltd., and Flamingo Horticulture Ethiopia have initiated pilot projects involving reusable packaging and digital monitoring systems to align with EU standards. However, for approximately 70% of Ethiopian exporters, full compliance remains elusive due to the high cost and limited local availability of compliant packaging materials, the financial burden of upgrading logistics systems, and fragmented supply chains that complicate traceability and quality control (EHPEA, 2024; Mekonnen & Ejigu, 2023).

As one participant said : “We consider these rules an opportunity to improve our competitiveness by providing greener products to discerning European markets.”

4.5. Barriers to Green Logistics

Transitioning to green logistics remains a formidable challenge across the global floriculture industry, with barriers manifesting at every stage of the supply chain and in every market context. At the global level, the high upfront investment required for green infrastructure—such as energy-efficient cold storage, low-emission vehicles, and advanced monitoring systems—poses a significant obstacle. Even in developed economies, where regulatory frameworks and consumer demand strongly favor sustainable practices, exporters are compelled to make continuous upgrades to comply with ever-tightening standards. For large firms, this often means substantial capital outlays for technology adoption and regulatory compliance, while smaller producers may struggle to access the necessary financing and technical support (World Bank, 2022; UNCTAD, 2023). The complexity of navigating international certifications, environmental reporting, and traceability requirements further adds to the operational burden, especially as regulations evolve rapidly in major markets like the European Union and North America.

In developing countries, these barriers are magnified by systemic financial and infrastructural limitations. Many growers and exporters face acute capital shortages, making it difficult to invest in green technologies or modernize their logistics operations. Access to affordable credit is often

limited, and the cost of imported green technologies—such as solar-powered refrigeration or biodegradable packaging—can be prohibitive. Unreliable electricity supply exacerbates the challenge, as frequent power outages undermine the effectiveness of cold chain systems and increase the risk of spoilage. The lack of technical expertise in both green logistics management and compliance documentation further hinders progress, while fragmented supply chains and poor road infrastructure result in higher transportation costs, longer delivery times, and greater product losses (USAID, 2021; IFC, 2022).

In East Africa, and particularly in Kenya and Ethiopia, these challenges are compounded by the region's dependence on export markets with stringent environmental requirements. Outdated transport fleets, limited access to modern refrigerated vehicles, and a shortage of integrated logistics providers create persistent bottlenecks. The administrative burden of complying with EU standards—such as the need for detailed environmental reporting, product traceability, and third-party certification—can be overwhelming for small and medium enterprises. The International Trade Centre (ITC, 2022) notes that the cost of certification and ongoing monitoring often exceeds the capacity of many exporters, leading to uneven compliance and missed market opportunities. Additionally, the lack of coordinated public-private investment in logistics infrastructure means that sector-wide improvements are slow and fragmented.

Focusing on Ethiopia, the barriers to green logistics are particularly acute for small-scale growers, who make up the majority of the sector. Most lack the financial resources to invest in modern cold chain equipment, energy-efficient vehicles, or advanced packaging solutions. Locally available, compliant packaging materials remain scarce, and those that meet international standards are often prohibitively expensive. The high cost and administrative complexity of obtaining and maintaining environmental certifications further discourage adoption of green logistics practices. Moreover, the sector continues to grapple with unreliable power supply, which disrupts cold storage operations and increases the risk of post-harvest losses. Limited technical expertise in cold chain management and environmental compliance adds another layer of difficulty, perpetuating a reliance on basic, less sustainable practices and undermining the sector's ability to consistently meet international quality and sustainability standards (USAID, 2021; IFC, 2022; World Bank, 2022; GCCA, 2022).

These barriers create a cycle in which Ethiopian exporters are unable to fully capitalize on the growing demand for sustainably produced flowers in global markets. Without targeted investment, capacity-building, and policy support, the transition to green logistics will remain slow, limiting both the sector's competitiveness and its contribution to sustainable development.

One participant noted: "It's challenging to source sustainable packaging locally. Imports are expensive and often delayed, which disrupts our production schedules."

4.6 Enabling Factors and Framework Development

EHPEA's experience indicates that enabling factors for green logistics adoption include targeted technical assistance, growing awareness of international standards, and pilot capacity-building programs. Government support and alignment of national standards with EU requirements are seen as critical, as is the development of local supply chains for green packaging materials. EHPEA recommends a phased framework that prioritizes affordable, locally sourced packaging, investment in modern cold storage and transport, and ongoing training for growers and logistics providers.

The implementation of sustainable logistics practices in Ethiopian floriculture is shaped by a complex interplay of regulatory, financial, technological, and institutional factors that operate at multiple levels. At the global scale, regulatory pressure from major markets, particularly the European Union, has become a decisive driver for change. The EU's Packaging and Packaging Waste Regulation (PPWR) and Floriculture Product Environmental Footprint Category Rules (FloriPEFCR) set stringent requirements for recyclability, traceability, and carbon reduction, compelling exporters worldwide to adopt greener logistics strategies or risk losing market access (European Commission, 2023). In developed economies, these regulatory demands are supported by robust policy frameworks, advanced logistics infrastructure, and access to green financing, making it feasible for growers and exporters to invest in closed-loop packaging, digital supply chain management, and energy-efficient warehousing (Research and Markets, 2024). Industry associations and consumer demand further reinforce these trends, creating a virtuous cycle of innovation and compliance.

In contrast, developing countries face a more challenging environment. Financial constraints, limited access to advanced technologies, and gaps in technical expertise often hinder the widespread adoption of sustainable logistics. Many growers and exporters in these regions rely on donor-funded projects, concessional loans, and technical assistance from international partners to pilot and scale up green logistics solutions. The World Bank (2023) notes that successful transitions in Latin America and Southeast Asia have depended on targeted capacity-building, phased infrastructure investment, and the adoption of international certification schemes, which provide both market incentives and technical guidance. These experiences highlight the importance of combining external support with local ownership and gradual scaling.

Regionally, East Africa presents a mixed picture. Kenya's floriculture sector has made significant progress through multi-stakeholder platforms that unite growers, exporters, logistics firms, government agencies, and NGOs. The widespread adoption of Fairtrade and GlobalG.A.P. certifications has encouraged investment in energy-efficient cold storage, reusable packaging, and digital monitoring systems. Public-private partnerships have played a key role in developing logistics hubs and modernizing transport fleets, while ongoing training programs have built local technical capacity (UNCTAD, 2023; Fairtrade Foundation, 2024). However, despite these advances, smaller growers in Kenya and neighboring countries still struggle with access to finance and affordable compliant packaging, as well as the costs of certification and compliance.

In Ethiopia, the landscape is characterized by both progress and persistent barriers. The sector benefits from growing awareness of international standards, active engagement from the Ethiopian Horticulture Producer Exporters Association (EHPEA), and increasing collaboration with development partners. EHPEA's initiatives, including workshops and technical assistance, have raised awareness and piloted new solutions among leading exporters (EHPEA, 2024). Nevertheless, many Ethiopian growers remain constrained by the high costs of logistics upgrades, limited availability of compliant packaging, unreliable electricity for cold storage, and a shortage of technical expertise in cold chain management. Fragmented supply chains and the absence of unified digital tracking systems further complicate compliance and traceability, making it difficult for the sector as a whole to meet the evolving demands of international markets.

Given these realities, developing a tailored framework for sustainable logistics in Ethiopia requires a holistic and phased approach. The framework should be grounded in the development of affordable, locally sourced green packaging and supported by strategic investment in modern cold storage, energy-efficient transport, and logistics hubs. Capacity-building for growers, logistics providers, and warehouse managers must be prioritized, focusing on cold chain management, digital supply chain tools, and compliance documentation. Collaborative platforms that bring together government, EHPEA, exporters, logistics firms, and development partners are essential for coordinating investments, sharing best practices, and monitoring progress. It is also crucial that national regulations are aligned with EU and other international standards, and that incentives such as tax breaks, grants, or premium market access are introduced to encourage early adoption of green logistics. Finally, robust systems for continuous monitoring, feedback, and adaptive management will ensure that the sector remains responsive to regulatory changes and market trends. By integrating these elements, Ethiopia can build a resilient and competitive floriculture logistics sector that not only secures access to demanding export markets but also positions the country as a regional leader in sustainable horticulture logistics (World Bank, 2023; UNCTAD, 2023; EHPEA, 2024).

One participant shared: “Developing local green packaging industries will reduce costs and support sustainability goals.”

4.7 Thematic Analysis by Logistics Pillar

Efficient management of logistics pillars—storage, transportation, handling and packaging, marketing stages, and air freight cargo service—is fundamental to the quality, competitiveness, and sustainability of Ethiopia’s floriculture export sector. Given the highly perishable nature of flowers, each stage of the logistics chain is critical for preserving product quality, minimizing losses, and ensuring timely delivery to international markets (Ofori, 2022; UNECA, 2022).

In Ethiopia, the logistics system continues to face challenges such as lack of coordination, outdated and insufficient cold storage infrastructure, high transportation costs, and fragmented logistics networks (Frontiers in Environmental Science, 2022; Royal HaskoningDHV, 2023). While recent years have seen incremental improvements—including investments by large-scale

farms in modern cold rooms and the piloting of sea freight and refrigerated trucking—most growers still struggle with inconsistent temperature control and unreliable power supply, particularly during peak export seasons (Further Africa, 2024).

Transportation remains a major cost driver, with air freight charges estimated at nearly 59% of total export costs—far exceeding costs for fertilizers, labor, and packaging combined (Ethiopian Press Agency, 2023). Ethiopian Airlines, with its extensive cargo network, continues to play a dominant role in flower exports, recently transporting hundreds of millions of stems to global markets during peak seasons (Further Africa, 2024). However, the absence of dedicated cargo service facilitators, limited number of refrigerated trucks, and ongoing road and infrastructure challenges continue to impact efficiency and product quality (Royal HaskoningDHV, 2023).

Handling and packaging have improved with the entry of new packaging manufacturers and technology upgrades, yet the sector remains reliant on single-use cartons due to cost and supply chain constraints (International Journal of Horticulture and Floriculture, 2017; Ofori, 2022). Export marketing is still heavily concentrated in the EU, with most flowers routed through Dutch auction markets or direct sales to European retailers (UNECA, 2022).

As Ethiopia explores new logistics modalities, such as sea freight via the Modjo Green Logistics Hub, and continues to invest in cold chain infrastructure, addressing these persistent logistics challenges will be crucial for maintaining competitiveness and meeting evolving international standards (Royal HaskoningDHV, 2023; UNECA, 2022). The following thematic analysis examines each logistics pillar in detail, drawing on empirical findings and recent literature to highlight progress, ongoing challenges, and opportunities for further improvement in Ethiopia's floriculture supply chain.

4.7.1 Cool Chain Management and Handling/Forwarding Services

Maintaining a robust cool chain is fundamental for the Ethiopian floriculture sector, given the extreme perishability of cut flowers and the demands of international markets. Fieldwork from this study confirms that every commercial flower farm has invested in on-site pack-houses and cold rooms, often at considerable capital cost, to ensure immediate post-harvest cooling and quality preservation. Despite these investments, the sector has long struggled with the absence of

specialized third-party cold chain service providers. Until very recently, over 70% of farms were forced to purchase or rent their own refrigerated trucks, increasing both operational complexity and financial burden. The establishment of EthioHorti-Share in 2004 and Flower Port Cargo Plc in 2009 marked important steps toward collective logistics, but these entities have not yet achieved the scale or integration needed to serve the entire industry. As a result, most farms still handle their own documentation, cold chain management, and logistics, leaving them exposed to risks of quality loss and shipment delays. According to the USAID Feed the Future Ethiopia Value Chain Activity Final Report (2021), the lack of integrated cold chain providers continues to be a major constraint, raising costs and limiting the competitiveness of Ethiopian flowers in global markets. The report notes that, as of 2021, only a minority of exporters could access end-to-end cold chain services, and that this gap remains a top priority for sector modernization and investment.

4.7.2 Transportation (Air Freight Cargo Service)

Transportation, particularly air freight, is the backbone of Ethiopia's floriculture export logistics. This study's interviews and export data confirm that Ethiopian Airlines is the principal cargo carrier, operating direct flights to key European hubs such as Amsterdam, Liege, and Brussels. While competition from other international airlines (including KLM, Emirates, and Turkish Airlines) has increased, Ethiopian Airlines still handles the vast majority of shipments. Airfreight charges, which account for 38–45% of total logistics costs according to the Ethiopian Horticulture Producer Exporters Association (EHPEA) Annual Report (2023), are negotiated annually but remain among the highest in the region. The sector has seen a modest rise in the number and quality of refrigerated trucks—over 80 modern vehicles are now available—but many farms continue to operate their own fleets to ensure timely and temperature-controlled delivery to the airport. Despite these improvements, high transportation costs and limit³ed competition in the air cargo market continue to constrain profitability and sector growth. The EHPEA report also highlights that logistical bottlenecks, such as road congestion and occasional flight delays, can still result in quality losses and missed market windows, especially during peak export seasons.

4.7.3 Storage

Cold storage capacity and reliability remain critical bottlenecks in the Ethiopian floriculture supply chain. This thesis finds that most growers load flowers directly from farm cold rooms into palletized shipments for air export, bypassing third-party cold storage at the airport. This practice, while minimizing handling and potential damage, means that growers retain responsibility—and risk—for product quality until the flowers are loaded onto the aircraft. Although some improvements have been made in airport cold storage facilities, these remain insufficient, particularly during high-volume export periods. The World Bank's Ethiopia Horticulture Sector Diagnostic (2022) reports that less than 35% of exporters have access to reliable cold storage throughout the logistics chain, and that frequent power outages, limited backup capacity, and insufficient airport storage space continue to threaten product quality and export value. The report emphasizes that strengthening cold storage infrastructure, both on-farm and at the airport, is essential for reducing post-harvest losses and maintaining the high quality demanded by European buyers.

4.7.4 Packaging

Packaging is a crucial but often overlooked component of the floriculture logistics chain. Findings from this research show that the quality of locally produced corrugated cartons has improved since 2020, driven by new entrants and technology upgrades in the packaging sector. However, most exporters still rely on single-use cartons, and the adoption of reusable or biodegradable packaging remains minimal due to high costs and limited supply chain development. The International Trade Centre's (ITC) 2022 report on Market Access and Packaging Trends in African Floriculture found that only 14% of surveyed Ethiopian exporters had piloted eco-friendly packaging by 2022, citing price sensitivity and lack of local suppliers as the main barriers. The report also notes that, while packaging quality has improved, exporters continue to express concerns about carton durability during long-haul air shipments, and that further innovation and investment are needed to meet evolving EU sustainability standards.

4.7.5 Marketing Agents/Actors

The Ethiopian floriculture value chain is characterized by a diverse set of actors, including producers, exporters, transporters, and facilitative organizations such as the EHDA, Customs, and insurers. As of 2024, approximately 70 major rose farms are active, primarily in Oromia, with some in SNNP and Amhara. These farms employ both permanent and seasonal labor, and yields typically range from 120–180 stems per square meter. Export analysis confirms that over 95% of sector revenue is derived from exports, with the EU—especially the Netherlands—remaining the primary destination. According to the Centre for the Promotion of Imports from developing countries (CBI) 2024 Trends Report, the Dutch auction system continues to dominate, but there is a growing trend toward direct sales to European supermarkets and specialty retailers. The report also highlights that compliance with EU market standards and certifications is increasingly vital for maintaining and expanding market share, and that exporters are investing in traceability, quality assurance, and direct marketing channels to capture higher margins and reduce reliance on auction markets.

4.8 Sectoral Challenges and Opportunities

Ethiopia's floriculture sector has experienced remarkable growth and gained global recognition as a key supplier in the international cut flower market. This success has been driven by favorable climatic conditions, proximity to large export markets, supportive government policies, and active private sector investment. Despite this progress, the sector continues to face a series of persistent challenges that threaten its sustainability and overall competitiveness. Among these challenges are substantial infrastructure deficiencies, particularly in cold chain logistics, including limited availability of energy-efficient warehousing and an aging refrigerated transport fleet. Frequent power outages further exacerbate storage and transport risks, leading to increased product losses and higher costs(Gebre, 2022).

In addition, the sector must navigate rising regulatory and compliance pressures as environmental and phytosanitary standards evolve, especially within its largest export destination, the European Union. These regulatory requirements introduce complexity and cost, which can be particularly burdensome for small and medium-sized enterprises lacking adequate technical support. Furthermore, fragmentation within the supply chain and insufficient coordination among

logistics actors generate inefficiencies, delays, and product quality degradation(Ethiopian Horticulture Producers Exporters Association [EHPEA], 2023).

Skills shortages in logistics management and sustainable operations compound these challenges, limiting the sector's capacity to innovate and implement advanced green logistics practices. Environmental and resource constraints, such as high water usage and energy-related emissions, also present significant sustainability risks requiring urgent attention. Financial barriers, particularly limited access to affordable capital, further hinder infrastructure upgrades and adoption of clean technologies (World Bank, 2023).

Conversely, the sector is well positioned to capitalize on emerging opportunities that can propel its sustainable development and global competitiveness. Ongoing policy reforms and enhanced government support aimed at infrastructure improvements, export facilitation, and industrial clustering provide a conducive environment for transformation (African Development Bank, 2022).

The growing global demand for environmentally responsible products offers a powerful incentive to invest in green logistics innovations, such as solar-powered cold storage, electric refrigerated vehicles, and sustainable packaging solutions. Advances in digital technologies — including Internet of Things (IoT) sensors, route optimization software, and blockchain-enabled traceability — represent promising tools to enhance supply chain transparency, efficiency, and compliance capabilities(International Trade Centre, 2022).

Robust partnerships with international development organizations, industry associations, and private investors afford access to technical expertise, financing, and market channels, supporting sector-wide modernization. Expansion into new export markets and diversification of product lines further enhance resilience and growth potential. Finally, scaling capacity-building initiatives tailored to logistics management and sustainability standards can bridge existing human resource gaps, enabling the sector to continuously improve and innovate(TradeMark Africa, 2024; Mekonnen & Ejigu, 2023).

Together, these challenges and opportunities position Ethiopia's floriculture industry at a critical juncture. Successfully addressing infrastructure and capacity limitations while embracing

sustainability, innovation, and collaboration will be pivotal to advancing the sector's long-term viability, environmental stewardship, and competitiveness in the global marketplace. Strategic alignment of policy, investment, and industry collaboration will be essential to ensure the sector capitalizes on its comparative advantages while mitigating existing vulnerabilities(European Commission, 2023; Royal HaskoningDHV, 2023; UNCTAD, 2025).

4.8.1 Technical and Infrastructure Constraints

The Ethiopian floriculture sector is hampered by persistent technical and infrastructure constraints that undermine its export competitiveness. One of the most critical issues is the inadequacy of cold chain infrastructure. Despite some progress in on-farm investments, a significant proportion of flower farms and exporters lack access to reliable, energy-efficient refrigerated storage and transportation. This leads to frequent spoilage and deterioration in product quality, particularly during the journey to Bole International Airport and onward to international markets. A recent assessment by the International Finance Corporation (IFC, 2022) found that only 28% of surveyed Ethiopian flower exporters had access to continuous, temperature-controlled logistics, and that post-harvest losses due to cold chain breakdowns remain above 15% annually.

The situation is further complicated by Ethiopia's unreliable electricity grid and limited backup power options. Many exporters have reported that power interruptions cause temperature fluctuations in cold rooms, directly impacting the shelf life and marketability of flowers. The Energy for Growth Hub (2023) highlights that power reliability in Ethiopia's horticulture clusters is among the lowest in Sub-Saharan Africa, with outages averaging 6–8 hours per week in peak seasons.

Packaging innovation also lags behind global standards. While the entry of local manufacturers such as Burayu and Ethio Pulp and Paper has improved carton quality, most exporters still rely on conventional, single-use packaging. The adoption of eco-friendly or reusable packaging is limited by both cost and supply chain constraints. According to the Global Cold Chain Alliance (GCCA, 2022), less than 10% of Ethiopian floriculture exporters had piloted green packaging

solutions by 2022, with most citing the high price and limited availability of sustainable materials as major obstacles.

High transportation costs remain another formidable barrier. Outdated truck fleets, fragmented logistics services, and the lack of integrated freight forwarding solutions contribute to elevated logistics expenses and increased risk of delays or spoilage. A study by TradeMark Africa (2023) found that logistics costs for Ethiopian floriculture exports are 18–25% higher than those of regional competitors, largely due to inefficiencies in domestic transport and limited access to consolidated air freight services.

These technical and infrastructure constraints are compounded by the lack of coordinated sector-wide investment and policy support. The Netherlands Enterprise Agency (RVO, 2024) notes that, despite Ethiopia's strong potential as a floriculture exporter, the sector's growth is stifled by fragmented cold chain development, insufficient public-private collaboration, and slow adoption of international logistics standards.

Collectively, these challenges erode exporters' profit margins and reduce Ethiopia's ability to compete with established flower-exporting countries such as Kenya, Ecuador, and Colombia. Addressing these issues will require not only investment in modern, energy-efficient infrastructure and packaging innovation but also the development of integrated logistics services and stronger policy coordination across the sector.

4.8.2 Regulatory and Market Access Issues

Ethiopian floriculture exporters operate within a complex and multifaceted regulatory landscape that significantly influences their market access and operational efficiency. One of the primary challenges lies in the inefficiencies and complexities surrounding customs clearance and foreign exchange procedures. These processes are often slow and cumbersome, leading to increased transaction costs and heightened uncertainty for exporters. Given the highly perishable nature of floriculture products, such delays can critically impact product freshness and market competitiveness (Ethiopian Horticulture Producers Exporters Association [EHPEA], 2023; Mekonnen & Ejigu, 2023).

Moreover, the sector faces mounting pressure from evolving European Union regulatory frameworks, which remain pivotal as the EU constitutes the largest export market for Ethiopian floriculture. Regulations such as the Packaging and Packaging Waste Regulation (PPWR) and the Product Environmental Footprint Category Rules specifically address sustainability requirements, including mandatory traceability, adoption of sustainable and recyclable packaging materials, and comprehensive environmental impact reporting. Compliance with these regulations demands significant investments in green logistics practices and robust data management systems. Failure to meet these standards risks restricted access to lucrative markets, shipment rejection, and damage to Ethiopia's reputation as a reliable supplier (European Commission, 2024; United Nations Conference on Trade and Development [UNCTAD], 2023).

Compounding these challenges, regulatory fragmentation and unpredictability at the domestic level exacerbate exporters' difficulties. Phytosanitary inspections, critical for preventing pest and disease transmission, are often unpredictable due to poor harmonization among relevant regulatory agencies. This results in inconsistent enforcement, shipment delays, and occasional rejections, adversely affecting export reliability and increasing operational risks (World Bank, 2022; International Trade Centre, 2023). The multiplicity of agencies without coordinated processes impairs efficiency and raises the burden of compliance for exporters.

Addressing these regulatory and market access issues calls for coordinated policy reforms that streamline procedural bottlenecks in customs and foreign exchange, enhance regulatory capacity, and foster inter-agency cooperation to establish transparent and efficient frameworks. Additionally, providing targeted technical assistance and financial incentives to exporters can facilitate compliance with stringent EU green standards, thereby safeguarding market access and promoting sustainable trade growth (TradeMark Africa, 2024; African Development Bank, 2022; Mekonnen & Ejigu, 2023).

4.8.3 Marketing and Diversification Challenges

The Ethiopian floriculture sector’s concentrated reliance on a small number of export markets—primarily the Netherlands and Germany—presents significant strategic risks, including market shocks, regulatory changes, and shifting consumer preferences within these countries (Ethiopian

Horticulture Producers Exporters Association [EHPEA], 2023; Mekonnen & Ejigu, 2023). Further compounding these risks, recent studies highlight how global disruptions such as the COVID-19 pandemic and geopolitical tensions have exposed vulnerabilities stemming from limited market diversification (Food and Agriculture Organization [FAO], 2022). The sector's ability to pivot to emerging regions like the Middle East, East Asia, and new European Union member states remains constrained due to weak market intelligence and insufficient market entry strategies (African Development Bank, 2022; World Bank, 2023; UNCTAD, 2024).

Domestic market development also remains underleveraged, restricting cushioning opportunities against international fluctuations while limiting innovation incentives (African Development Bank, 2022; International Trade Centre, 2023). Within export markets, reliance on intermediaries further limits direct relationship-building with end consumers, inhibiting branding, customization, and premium pricing backed by provenance or sustainability credentials (International Trade Centre, 2022; Mekonnen & Ejigu, 2023; TradeMark Africa, 2024). This reduces Ethiopia’s competitive edge in an increasingly conscious global marketplace where certifications such as Fairtrade, Organic, and Rainforest Alliance play growing roles (Global Green Growth Institute, 2023; European Floriculture Association, 2023).

Marketing and branding investments lag behind those of competitors in other leading producing countries, causing Ethiopian flowers to often be viewed as commodities competing primarily on price rather than value differentiation or environmental responsibility (Climate Focus, 2023; Horticulture Innovation Australia, 2023). This puts the sector at risk of market commoditization and limits potential income growth.

Strategic recommendations emphasize enhancing market intelligence systems, improving data analytics capacity, and fostering direct buyer engagement to facilitate responsive product offerings. Promotion through international trade fairs, digital marketplaces, and certification acquisition can build brand visibility and consumer trust (UNCTAD, 2024; TradeMark Africa, 2024). Developing national and regional branding campaigns emphasizing Ethiopia’s unique climate advantages, quality, and sustainability credentials can also strengthen positioning (African Development Bank, 2022; Global Green Growth Institute, 2023).

Government and industry-led export promotion programs, supported by development partners, are vital to addressing these gaps. Policy frameworks facilitating market access, trade negotiations, and financial support for marketing capacity building will amplify sector resilience and competitive positioning (International Trade Centre, 2023; United Nations Industrial Development Organization [UNIDO], 2023).

4.8.4 Investment and Capacity Gaps

The transition of Ethiopia's floriculture sector toward sustainable, green logistics and production systems is critically contingent upon substantial investments in infrastructure, technology, and human capital. Upgrading essential logistics components—such as cold chain facilities, refrigerated transport fleets, renewable energy integration, and sustainable packaging—requires considerable capital outlay. These investments are indispensable not only to meet increasingly stringent international quality and environmental standards but also to enhance operational efficiency, reduce post-harvest losses, and maintain competitiveness in demanding export markets(Ethiopian Horticulture Producers Exporters Association [EHPEA], 2023; African Development Bank, 2022; United Nations Environment Programme [UNEP], 2023; International Finance Corporation [IFC], 2023).

However, the sector faces significant financial constraints, with many producers, especially small and medium-sized enterprises (SMEs), unable to access affordable and timely credit. These enterprises often lack the collateral and credit history required by formal financial institutions, resulting in limited investment and modernization capabilities. Consequently, a sizable portion of the sector remains reliant on outdated infrastructure and technologies, constraining productivity and export quality. The capital-intensive nature of green upgrades—such as solar-powered cold storage, electric refrigerated vehicles, and digital traceability platforms—exacerbates these financial barriers(Mekonnen & Ejigu, 2023; World Bank, 2022; Global Trade Review [GTR], 2023; African Union Development Agency [AUDA-NEPAD], 2023).

Equally critical is the pronounced shortage of skilled personnel across various aspects of the floriculture value chain. Key gaps exist in specialized competencies needed for effective post-harvest handling, cold chain logistics management, sustainable production techniques, and the

deployment of new green technologies. Training infrastructure, including vocational programs and extension services, remains insufficient in scope and reach. Without an adequately skilled workforce, the sector struggles to adopt and sustain innovative practices, undermining efforts to improve quality, compliance, and sustainability(International Labour Organization [ILO], 2023; Ethiopian Ministry of Agriculture, 2023; United Nations Industrial Development Organization [UNIDO], 2024; Desta & Tsegaye, 2022).

The lack of institutionalized capacity-building frameworks and certification schemes further limits knowledge transfer and professional development, resulting in fragmented expertise and slow diffusion of best practices. This human capital gap restricts scalability and operational excellence in green logistics adoption across producers and exporters alike(International Trade Centre, 2022; UNIDO, 2024; Tadesse & Seifu, 2023).

Addressing these intertwined financial and capacity challenges calls for a multi-pronged and coordinated approach. Firstly, expanding access to finance through innovative mechanisms such as concessional loans, blended finance, credit guarantee schemes, and targeted subsidies can lower investment barriers for SMEs and encourage infrastructure modernization. Enhancing financial literacy and investment readiness among producers is also essential to maximize capital utilization and business sustainability(African Development Bank, 2022; TradeMark Africa, 2024; IFC, 2023; GTR, 2023).

Secondly, strengthening institutional frameworks for workforce development is crucial. This involves establishing formal training programs, certification and accreditation schemes, and continuous professional development initiatives delivered through partnerships between government agencies, industry associations, educational institutions, and international development organizations. Tailored training focusing on green logistics, supply chain management, and sustainable production techniques will empower the sector to meet market demands and regulatory requirements(ILO, 2023; International Trade Centre, 2022; UNIDO, 2024).

Finally, integrated policy support that prioritizes green logistics transformation—through fiscal incentives, infrastructure financing, public-private partnerships, and research and development

investment—will underpin long-term sector competitiveness and environmental sustainability(World Bank, 2022; Ethiopian Ministry of Agriculture, 2023; UNEP, 2023; AUDA-NEPAD, 2023).

Overcoming the investment and capacity gaps in Ethiopian floriculture is vital for unlocking the sector's potential as a sustainable, efficient, and globally competitive exporter. Coordinated actions targeting finance accessibility, skills development, and enabling policies can drive broad-based modernization that aligns with evolving market expectations and sustainability imperatives(EHPEA, 2023; African Development Bank, 2022; IFC, 2023; UNIDO, 2024)

Chapter Five

Summary of Findings, Conclusion, and Recommendations

This final chapter synthesizes the comprehensive insights gained from this study on green logistics adoption in Ethiopia's floriculture sector. It reflects deeply on the sector's multifaceted challenges and emerging enabling factors, and articulates evidence-based recommendations aligned with strategic imperatives for sustainability and competitiveness. Given the floriculture industry's economic significance to Ethiopia's export earnings and rural employment, this chapter proposes an integrative roadmap designed to foster an efficient, resilient, and environmentally responsible supply chain that can thrive in demanding global markets.

5.2 Summary of Key Findings

The centrality of green logistics to the sustainability and future competitiveness of Ethiopia's floriculture sector is unequivocal and increasingly urgent. Faced with intensifying environmental regulations—particularly stringent standards emanating from leading export markets such as the European Union (EU)—and evolving consumer expectations for sustainable products, the sector is compelled to transition towards cleaner, more efficient, and lower-carbon logistics solutions. This regulatory and market pressure serves both as a challenge and a catalyst for innovation within the floriculture supply chain (European Commission, 2023; UNCTAD, 2023).

Current initiatives exploring greener transport alternatives—including the cautious but growing shift to sea freight—represent a promising avenue for dramatically reducing carbon emissions and logistics costs. This modal diversification offers substantial sustainability benefits compared to the sector's entrenched reliance on airfreight, which remains dominant despite its high economic and environmental costs (Fairtrade Foundation, 2024; CBI, 2024). However, transitioning to sea freight is complex and requires overcoming significant infrastructural and operational bottlenecks such as multimodal integration, transit time management, and cold chain continuity during longer shipping durations (World Bank, 2023).

Structural system-wide challenges continue to impede progress. The fragmentation and inadequacy of cold chain infrastructure at key nodes—including farms, packaging houses,

transportation fleets, and airport facilities—pose significant risks for product quality and market compliance. Most refrigerated truck fleets remain aged, inefficient, and insufficiently scalable, while investments in energy-efficient, modern warehousing and logistics centers lag behind sector needs (IFC, 2022; GCCA, 2022; Mekonnen & Ejigu, 2023). These infrastructural deficits not only increase operational costs and product losses but also constrain the sector's ability to meet evolving green logistics standards effectively.

Compounding these challenges are pervasive skills shortages and capacity gaps in critical logistics functions. The scarcity of qualified professionals in areas such as freight forwarding, customs clearance, post-harvest handling, and cold chain management hampers efficiency and sustainable service delivery (EHPEA, 2023; USAID, 2021). Furthermore, the limited availability of specialized service providers restricts access to professionalized, integrated logistics solutions, reinforcing dependency on fragmented and informal channels (TradeMark Africa, 2023).

Despite these obstacles, strategic green logistics projects like the Modjo Green Logistics Hub and the Cool Port Addis initiative exemplify the transformative potential of coordinated infrastructural modernization. These projects aim to introduce advanced cooling technologies, integrated dry port functions, and seamless multimodal corridors combining rail, road, and sea transport. If fully realized, they could drastically enhance cold chain integrity, boost export competitiveness, and position Ethiopia as a regional logistics leader (Royal HaskoningDHV, 2023; African Development Bank, 2022). Nonetheless, such initiatives require sustained, large-scale investment alongside capacity building and stakeholder collaboration to bridge existing capability gaps.

Critical to these efforts is the evolution from the presently limited, project-based collaborations among exporters, government agencies, and international partners into systematic, institutionalized, and well-coordinated partnerships. Such multi-stakeholder coalitions are essential for overcoming the entrenched fragmentation of Ethiopia's floriculture logistics sector and fostering shared ownership of sustainability goals. Strong governance structures, clear policy frameworks, financing mechanisms, and continuous knowledge exchange are pivotal to scaling green logistics practices sector-wide (UNCTAD, 2023; World Bank, 2023).

In conclusion, while Ethiopia's floriculture sector faces formidable challenges within its logistics ecosystem, there exists a clear pathway for sustainable transformation through strategic infrastructure investments, regulatory alignment, capacity building, and innovative multimodal transport solutions. The convergence of market imperatives and policy initiatives provides a unique window of opportunity to embed green logistics at the core of the sector's value chain, thereby enhancing environmental stewardship, economic resilience, and long-term export market access (International Trade Centre, 2022; European Commission, 2023).

5.3 Conclusion

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Structural system-wide challenges continue to impede progress. The fragmentation and inadequacy of cold chain infrastructure at key nodes—including farms, packaging houses, transportation fleets, and airport facilities—pose significant risks for product quality and market compliance. Most refrigerated truck fleets remain aged, inefficient, and insufficiently scalable, while investments in energy-efficient, modern warehousing and logistics centers lag behind sector needs (IFC, 2022; GCCA, 2022; Mekonnen & Ejigu, 2023). These infrastructural deficits

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Despite these obstacles, strategic green logistics projects like the Modjo Green Logistics Hub and the Cool Port Addis initiative exemplify the transformative potential of coordinated infrastructural modernization. These projects aim to introduce advanced cooling technologies, integrated dry port functions, and seamless multimodal corridors that synergize rail, road, and sea transport. If fully realized, they could drastically enhance cold chain integrity, boost export competitiveness, and position Ethiopia as a regional logistics leader (Royal HaskoningDHV, 2023; African Development Bank, 2022). Nonetheless, these initiatives require sustained, large-scale investment and an equally committed focus on capacity building and stakeholder collaboration to bridge current capability gaps.

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5.4 Proposed Floriculture-Based Green Logistics Framework

The framework is organized in distinct, interconnected layers that together create a comprehensive and systemic approach to green logistics in Ethiopia's floriculture sector. At the core lies the Regulatory Environment, which encompasses both European Union and national policies and standards. This central layer provides the essential foundation, directing and shaping all activities within the logistics ecosystem by enforcing sustainability criteria and compliance requirements necessary for market access and environmental stewardship.

Surrounding the regulatory core are the four main logistics pillars, which represent the critical operational domains within the green logistics framework:

Green Transport focuses on modernizing the transport fleet to low-emission and electric vehicles, optimizing routes and loads through digital technology, and shifting toward more sustainable freight modes. This layer addresses the logistics challenges related to carbon emissions and inefficiencies in transportation.

Green Warehousing encompasses the modernization of storage infrastructure through energy-efficient design and renewable energy integration, combined with smart inventory management techniques. This layer targets operational excellence, reducing storage losses and improving cold storage capacity reliability.

Cold Chain Management centers on maintaining product quality via solar-powered refrigeration systems and real-time environmental monitoring technologies. It also involves creating centralized cold chain hubs to enhance efficiency and reduce fragmentation, ensuring consistent product preservation throughout the supply chain.

Green Packaging aims at adopting sustainable packaging materials that are recyclable, biodegradable, and reusable, supported by local manufacturing capacity and standardized

practices. This operational layer ensures environmental responsibility extends to packaging, meeting stringent export market standards.

Beyond these four pillars, the next layer consists of cross-cutting enabling factors that support and integrate the core logistics functions. These enablers include digitalization platforms that enhance supply chain transparency and traceability, multi-stakeholder collaboration mechanisms that engage government, private sector, and development partners for cohesive action, strategic capacity-building programs that address existing skills gaps, and policy frameworks that provide fiscal incentives and regulatory support. This enabling layer forms the backbone that ensures the operational pillars work cohesively, sustainably, and at scale.

Finally, the outermost layer encompasses the broader implementation structures and governance mechanisms. This includes the coordinated efforts of key stakeholders such as government entities, industry associations, exporters, logistics providers, and international partners who collectively govern, finance, monitor, and refine the green logistics initiatives. This governance layer ensures continuous oversight, resource mobilization, stakeholder alignment, and the institutionalization of sustainability practices within the sector.

Together, these layered components represent a comprehensive approach where foundational policies guide operational pillars, which are supported by enabling systems, all integrated within strong governance and partnership ecosystems. This layered structure recognizes the complexity and interdependence involved in transforming Ethiopia’s floriculture logistics into a green, efficient, and competitive supply chain aligned with global sustainability standards.

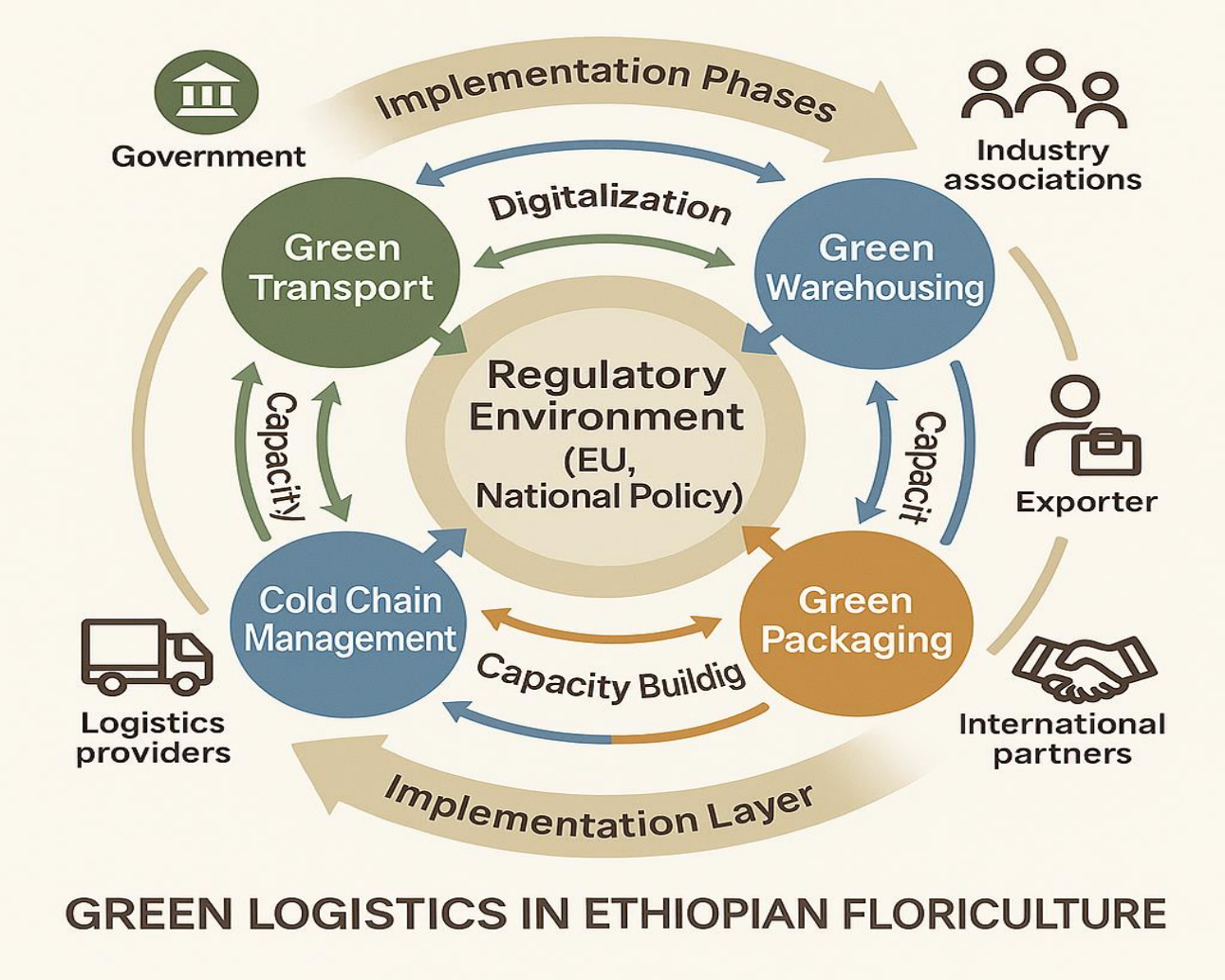

Fig 2. Proposed Floriculture-Based Green Logistics Framework

5.5 Prioritization and Key Performance Indicators (KPIs)

A comprehensive and solid system of Key Performance Indicators (KPIs) is essential for effectively monitoring and guiding the implementation of the green logistics framework in Ethiopia's floriculture sector. KPIs serve not only as tools for tracking progress and ensuring accountability among key stakeholders—including government agencies, exporters, logistics providers, and industry bodies—but also as mechanisms to facilitate evidence-based decision-making and continuous improvement (World Bank, 2023). In terms of fleet modernization, measuring the percentage of refrigerated vehicles that transition to low-emission or electric alternatives provides a clear indicator of decarbonization efforts within logistics operations, a

priority underscored by EU regulations and climate policy frameworks (European Commission, 2023; UNCTAD, 2023).

Cold storage facilities, pivotal to preserving flower quality, require KPIs that quantify both capacity expansion and operational reliability. Research from the International Finance Corporation (IFC, 2022) and Global Cold Chain Alliance (GCCA, 2022) highlights how uptime metrics—tracking temperature stability and equipment functionality—directly correlate with reduced spoilage and enhanced supply chain performance. Sustainable packaging adoption, measured by the share of exported products using recyclable, biodegradable, or reusable materials, aligns with global environmental targets and EU Packaging and Packaging Waste Regulation (PPWR) compliance requirements (International Trade Centre, 2022).

The integration of digital technologies into the cold chain is another KPI area of critical importance. Real-time monitoring of temperature and condition not only mitigates quality degradation risks but is increasingly recognized as an industry best practice for traceability, consumer assurance, and regulatory compliance (TradeMark Africa, 2023). Furthermore, post-harvest loss reduction is a pivotal KPI representing the tangible outcomes of improved logistics, handling, and storage practices, with USAID (2021) emphasizing its economic and environmental significance in floricultural supply chains.

Modal shift KPIs focus on freight transportation mix changes, with increased volumes shifted from air to lower-carbon modes such as sea freight contributing substantially to carbon footprint reduction in export logistics. This metric is informed by comparative studies that recommend gradual, scalable modal diversification to enhance sustainability and cost-efficiency (Fairtrade Foundation, 2024; CBI, 2024). Lastly, sustainability certification uptake—including internationally recognized standards like GlobalG.A.P. and Fairtrade—is a proxy indicator for industry-wide environmental stewardship and readiness to meet stringent market and regulatory demands (EHPEA, 2023; Fairtrade Foundation, 2024).

Together, these multidimensional KPIs form an integrated framework that encourages coordinated monitoring, targeted investment, adaptive management, and stakeholder collaboration. Regular review and refinement of indicators in response to technological

innovation, evolving regulations, and market trends ensure the KPI system remains fit-for-purpose (UNCTAD, 2023). Embedding the KPI system within multi-stakeholder governance platforms further enhances transparency, knowledge sharing, and collaborative action—critical factors to overcoming Ethiopia's fragmented logistics networks and accelerating the transition toward a resilient, efficient, and environmentally sustainable floriculture sector (World Bank, 2023**).**

5.6 Recommendations

Drawing on the above framework and findings, the following recommendations merit prioritization:

- First, accelerate the development and widespread adoption of green packaging solutions. This requires a concerted partnership between industry stakeholders and government agencies to create an enabling environment that incentivizes local production of sustainable packaging materials, such as recyclable, biodegradable, and reusable options. Financial mechanisms— including tax exemptions, subsidies, and low-interest loans— should be deployed to reduce the cost barriers that currently limit manufacturers' capacity to produce these materials at scale. In parallel, enforcing stringent packaging standards aligned with evolving EU regulations will ensure compliance and safeguard market access. Capacity-building initiatives are crucial to empower exporters and packaging producers alike; these should encompass comprehensive training programs covering packaging innovations, environmental impact assessments, and regulatory compliance requirements. Providing technical assistance, knowledge-sharing platforms, and facilitating access to certification schemes will enhance exporters' competitiveness and drive sector-wide transformation toward circular packaging economies.
- Second, vigorously promote the upgrading of the transport fleet toward electric and hybrid refrigerated vehicles, complemented by the integration of advanced digital logistics management tools. Modernizing the fleet addresses the sector's outsized carbon emissions and operational inefficiencies associated with aging vehicles. Digital technologies such as route planning software, load consolidation platforms, and real-time fleet monitoring can significantly improve operational efficiency, reduce fuel

consumption, and lower costs. Encouraging modal shifts from carbon-intensive airfreight toward more sustainable sea freight options requires strategic enhancements in dry port infrastructure—improving handling capacity, storage facilities, and multimodal connectivity—and streamlining customs protocols to reduce clearance delays. Mobilizing the scale of investment needed for fleet modernization and infrastructure upgrades necessitates robust public-private partnerships; these collaborations should involve financial institutions, government agencies, transport companies, and exporters to share risks, pool resources, and ensure long-term sustainability. Moreover, pilot projects demonstrating the economic and environmental benefits of electric vehicles and digital management should be supported to build trust and adoption momentum across the sector.

- Third, modernize cold chain management infrastructure and operational practices to safeguard product quality and enhance supply chain resilience. Investments are needed in solar-powered refrigeration units that reduce reliance on unstable grid electricity, lowering energy costs and carbon footprint simultaneously. Integration of IoT-enabled real-time monitoring systems for temperature and humidity ensures proactive quality control and compliance with stringent export standards. The establishment of centralized cold chain hubs accessible to multiple producers will optimize logistics efficiency by reducing fragmentation and enabling economies of scale. These hubs should be sited strategically near key production and export nodes, such as Bole International Airport, to streamline handling and reduce transit times. A parallel focus must be placed on continuous skills development and technical support to sustain cold chain innovations; this includes professional training for cold chain technicians, logistics coordinators, and quality assurance personnel. Developing standardized protocols and digital traceability systems will further enhance monitoring capabilities and build transparency and trust with international buyers.
- Fourth, scale up green warehousing practices through targeted investments and operational reforms. Energy efficiency retrofits—such as improved insulation, LED lighting, and integration of renewable energy sources like solar PV—will reduce operational costs and environmental impacts. Digitized inventory management systems can improve stock accuracy, turnover, and space utilization, reducing waste and

facilitating just-in-time logistics. Encouraging collaborative warehousing clusters where multiple producers and exporters share storage facilities can enhance capacity utilization and lower fixed costs. To incentivize widespread adoption, sector-wide certification schemes focused on green warehousing standards should be developed and promoted. These certifications can serve as both compliance tools and market differentiators, reinforcing Ethiopia's reputation as a sustainable floriculture exporter. Providing technical guidance and benchmarking tools will help warehouse operators align with best practices and measure performance improvements over time.

- Finally, successful implementation of these recommendations hinges on embedding them within a supportive, holistic policy ecosystem. This includes comprehensive capacity development programs to bridge skill gaps and foster a culture of sustainability across all levels—from farm operations to logistics management and policy enforcement. Enhanced stakeholder engagement platforms should be established to facilitate multi-sector collaboration, knowledge sharing, and coordinated decision-making among government entities, industry associations, exporters, logistics providers, and development partners. Sector-wide digitalization initiatives—such as unified traceability systems, electronic customs processing, and integrated logistics dashboards—will improve transparency, efficiency, and compliance tracking, driving continuous improvement and data-driven policy refinement. Additionally, long-term policy commitments offering fiscal incentives, streamlined regulatory processes, and innovation grants will be essential to catalyze investment and foster private sector ownership. Monitoring frameworks with clear sustainability indicators and regular reporting cycles will ensure accountability and enable adaptive management as the green logistics agenda evolves.

Together, these prioritized recommendations form an integrated roadmap that responds directly to empirical sector challenges and leverages emerging opportunities, positioning Ethiopian floriculture logistics for a sustainable, competitive, and resilient future in global markets.

5.7 Future Research Directions

Future research should employ quantitative or mixed-methods approaches to capture broader trends and enable statistical analysis across a larger, more diverse sample. Surveys and data-

driven studies can offer deeper understanding of the environmental and economic impacts of green logistics practices across different regions and business sizes. Expanding the research geographically and methodologically will help identify best practices, regional variations, and more targeted strategies for advancing sustainable logistics in Ethiopian floriculture. By linking research findings directly to policy development, governments and regulatory bodies can design targeted, context-sensitive interventions—such as subsidies for sustainable packaging, investments in cold chain infrastructure, and simplified compliance frameworks aligned with EU standards—that address identified barriers and regional disparities. Collaborative engagement among researchers, policymakers, industry associations, and exporters will further ensure that policies are practical, adaptive, and widely supported. Thus, integrating future research with policy evaluation and formulation is critical for creating an enabling environment that accelerates green logistics adoption and strengthens Ethiopia's competitiveness in global floriculture markets.

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Appendix

Interview Questions

1. Current Practices

- ★ Can you describe your current logistics practices in flower production and export?
- ★ What challenges do you face with cold chain infrastructure and transport capacity?

2. Awareness and Perception

- ★ How familiar are you with green logistics and environmental sustainability initiatives?
- ★ What is your perception of adopting green packaging and transport methods?

3. Barriers to Adoption

- ★ What are the main obstacles preventing eco-friendly logistics adoption in your operations?
- ★ How do financial, infrastructural, and technical factors affect your ability to implement green logistics?

4. Regulatory Influence

- ★ How have EU regulations like PPWR and FloriPEFCR impacted your logistics practices?
- ★ What support or challenges have these regulations introduced?

5. Opportunities and Benefits

- ★ What benefits do you see in adopting green logistics for your business?
- ★ How could green logistics improve access to European markets?

6. Capacity Building and Innovation

- ★ What training or capacity-building initiatives would help you implement greener logistics?
- ★ What innovations or technologies would you adopt if resources were available?

7. Stakeholder Collaboration

- ★ How important is collaboration among stakeholders for enhancing green logistics?
- ★ What roles do government agencies, associations, or international partners play in supporting green logistics adoption?

8. Future Perspectives

- ★ What are your plans regarding transitioning toward sustainable logistics?
- ★ What long-term impacts do you foresee from implementing green logistics practices?