GREEN SUPPLY CHAIN MANAGEMENT PRACTICES AND SUSTAINABLE PERFORMANCE OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS IN KISII COUNTY, KENYA

BY

MOMANYI EMMANUEL MASESE

MASTER OF SCIENCE IN SUPPLY CHAIN MANAGEMENT

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DECLARATION

I declare that this research dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

Name: Momanyi Emmanuel Masese Reg No: **24/02758**

Signed: .... Date: 24th October, 2025

I do hereby confirm that I have examined the master's dissertation of

Momanyi Emmanuel Masese

And have certified that the revisions that the dissertation panel and examiners recommended have been adequately addressed.

Signed: ..... Date: …29/10/2025……

Name: Dr. Catherine Gatari, PhD

Dissertation Supervisor

ABSTRACT

The agricultural sector plays a vital role in the economy, yet it faces increasing pressure to adopt sustainable practices in response to environmental degradation, climate change, and market demands. This study examined the effect of green supply chain management practices on the sustainable performance of agricultural value chain organizations in Kisii County. Specifically, the study focused on green sourcing, green production, reverse logistics, and green distribution, and evaluated their effect on sustainable performance of agricultural value chain using environmental, social, and economic indicators. The study adopted a descriptive research design. The target population was 84 respondents from agricultural value chain organizations. These respondents involve agricultural value chain officers and agribusiness officers who had knowledge of production, processing, distribution, and retailing of selected value chains including bananas, avocados, coffee, dairy products and chicken within Kisii County. The sample size was 84 respondents. The study adopted a census technique to ensure proper representative inclusion of various categories of agricultural value chain organizations in Kisii County. The data collection instrument for this study was structured questionnaires. Pilot study was conducted in Kisii using 8 respondents represent 10% of the sample 84. The study used descriptive statistics and inferential statistics to analyze collected data. Multiple regression analysis was used in determining the strength of relationship between variables. The results were presented in Tables and figures. The study established that green supply chain management practices comprising of green sourcing, green production, reverse logistics, and green distribution positively and significantly correlated with sustainable performance of agricultural value chain firms in Kisii County. Additionally, the study established that the green supply chain management practices positively and significantly affects the sustainable performance of agricultural value chain firms. The study concluded that enhancing the various aspects of green sourcing, green production, reverse logistics, and green distribution contributes to enhanced levels of sustainable performance of the firms. The study recommended that the agricultural value chain firms in Kisii County should consistently integrate green sourcing, green production, reverse logistics, and green distribution practices to enhance competitiveness, reduce costs, and achieve long-term sustainable performance. This can be achieved through adoption of sustainable procurement, eco-friendly production, structured waste management, and efficient distribution systems. The findings of the study are of significant to agricultural value chain organizations, policy makers and academicians.

DEDICATION

I dedicate this work to all my family siblings, Mama Regina, my spouse Janet Mong'ina and our son Miguel Mshindi whose unwavering support, sacrifices and encouragement have been the foundation of shaping my academic journey.

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LIST OF ABREVIATIONS AND ACRONYMS

ASTGS	Agricultural Sector Transformation and Growth Strategy
FAO	Food and Agricultural Organization
GCSM	Green Supply Chain Management
GDP	Gross Domestic Product
KNBS	Kenya National Bureau of statistics
KTDA	Kenya Tea Development Agency
SDGs	Sustainable Development Goals

OPERATIONAL DEFINITIONS OF TERMS

Agricultural Value Chain Organizations	These are enterprises involved in the different stages of agricultural production, processing, packaging, distribution, and marketing of farm produce (Gomez & Rodriguez, 2023).
Green Sourcing	This involves the procurement of products and services from suppliers who comply with environmental standards (Okafor, 2023).
Sustainable Performance	Sustainable performance refers to the achievement of business objectives in ways that are environmentally sound, socially responsible, and economically viable (Zhu *et al*, 2023).
Green Distribution	Green distribution involves environmentally sustainable practices in transportation, warehousing, and product delivery (Agyabeng, 2022).
Green Production	Green production refers to environmentally responsible manufacturing and processing activities that aim to reduce energy use, emissions, and waste (Porter & Reay, 2023).
Green Supply Chain Management	GSCM refers to the integration of environmentally friendly practices into every stage of the supply chain, from sourcing raw materials to delivering the final product (Nguyen, 2024).
Reverse Logistics	This term describes the process of planning and controlling the flow of products and materials from the point of consumption

back to the point of origin for the purpose of recycling, reuse, or proper disposal (Van der Vorst, Tromp, & van der Zee, 2022).

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Agriculture globally faces growing challenges from climate change, environmental degradation, weak supply chains, and unsustainable production (FAO, 2023). These issues have led to the adoption of Green Supply Chain Management (GSCM), which incorporates environmental practices in sourcing, production, distribution, and waste handling (Zhu *et al*., 2023). In China, GSCM has improved energy efficiency, lowered greenhouse gas emissions, and promoted eco-friendly packaging and transport (Liu & Zhang, 2024). Similar trends are seen in Europe, where green logistics and renewable energy use in farming are gaining momentum (Smith *et al*., 2023). Global organizations also advocate for sustainable value chains to enhance food security and reduce environmental impact (UNEP, 2024).

In India, the integration of green supply chain management practice has brought significant improvements to the agricultural sector(Tseng, 2022). Initiatives such as improved chain infrastructure, eco-friendly packaging, and efficient transportation systems. Farmers participating in green supply chains often gain better access to markets and receive premium prices for sustainably produced goods (Agyabeng 2023). These economic benefits, combined with environmental gains, demonstrate how GSCM can serve as a catalyst for rural development and food. The positive outcomes experienced in India highlight the need for GSCM on agricultural systems in other developing countries facing similar challenges (Singh *et al*., 2023).

Sustainable agriculture is key to addressing food insecurity, land degradation, and poverty. However, poor infrastructure, limited technology, and climate shocks remain major obstacles.

Adoption of green supply chain management is growing steadily. In Ghana, agro-based firms using green procurement and reverse logistics have improved efficiency and environmental outcomes (Agyabeng, 2022). Similar trends seen where GSCM adoption reduced waste and improved resource use (Okafor *et al*., 2023). Green practices such as eco-friendly packaging and renewable energy use are enhancing farm productivity (Mwangi & Mutiso, 2024).

Zambia has demonstrated progress in promoting sustainable agriculture by adopting climate-smart logistics and organic waste recycling (Nguyen, 2024). These practices have strengthened food system resilience by enhancing supply chain efficiency and minimizing post-harvest losses. Climate-smart logistics, including route optimization and low-emission transport, have reduced fuel use and environmental harm (Okafor 2023. Recycling organic waste into compost and bio-fertilizers has improved soil health and cut reliance on chemical inputs (Van Der Vorst, 2022). Together, these initiatives underscore the role of green supply chain strategies in advancing climate-resilient agriculture (Nkumbula & Simatele, 2023).

Kisii County is a key agricultural hub in Kenya, highlights both the promise and challenges of adopting Green Supply Chain Management (Otieno & Kerubo 2023). Farmers using digital green technologies and recycling have seen better yields, improved market access, and lower environmental impact(Tsherdoost 2021) . However, wider adoption is limited by high costs, weak policy support, and low public awareness. Adapting GSCM practices such as green production, reverse logistics, and distribution to local contexts can enhance sustainability and investment plans. This could support greener, more resilient agriculture across Kenya (Oteki *et al*., 2023).

1.1.1 Green Supply Chain Management Practices

Green Supply Chain Management practice refers to the coordinated management of supply chain activities from raw material sourcing to the final delivery of products with a focus on

minimizing environmental impacts. In agriculture, GSCM encompasses processes such as input supply, production, processing, storage, distribution, and marketing to enhance sustainability and resource efficiency (Zhang, Li, & Chen, 2022). It is widely regarded as a strategic approach to achieving environmental goals without compromising economic performance through practices such as green sourcing, green production, green distribution, and reverse logistics (Wang, 2022).

Agricultural supply chains are moving from informal systems to structured, tech-driven models. Organizations like the African Union and AGRA promote digital platforms and cooperative models for better logistics. Rwanda and Ethiopia use warehouse receipt systems and mobile services to improve market access (Bashir, 2023). In Kenya, digital platforms link farmers to buyers, reducing post-harvest losses. These innovations enhance efficiency and increase farmer incomes (Omondi, 2023).

In Kenya, green supply chain management is still developing, especially among smallholder farmers who dominate production (Mogaka, 2023). The sector faces challenges like poor post-harvest handling, limited cold storage, weak road infrastructure, and heavy dependence on intermediaries (Makori, 2025). Some agribusinesses are adopting sustainable practices including cold chains, eco-packaging, and traceability(Koech, 2022). Kisii County reflects national issues, with weak links between value chains including producers, processors, and marketers. Its inadequate storage and road systems contribute to high post-harvest losses and limited market access (Omondi, 2023).

Green sourcing is the process of procuring goods, services, and raw materials while minimizing environmental impact throughout their life cycle. It includes selecting suppliers who follow sustainable practices, using life cycle costing to assess long-term effects, and choosing eco-friendly materials. In Germany, firms audit suppliers for environmental compliance and prefer

biodegradable or sustainably produced inputs. These practices are driven by strict regulations and consumer demand for environmentally responsible products (González & Saura, 2023). Green sourcing also lowers waste generation, improves brand reputation and enhances operational efficiency by reducing resource wastage. Moreover, it strengthens competitiveness by aligning firms with global sustainability standards (Ahmed & Hassan, 2024).

The adoption of green sourcing in many developing countries remains limited due to weak enforcement of environmental regulations and low stakeholder awareness (Mensah & Boetang 2022). In Ghana, while some firms are beginning to adopt green supply chain practices, green supplier capabilities are still underdeveloped and unevenly distributed across sectors. The agricultural sector faces additional barriers such as low investment in eco-innovation and fragmented supply chains (Kumar, 2022). These constraints hinder the broader implementation of sustainable procurement practices. Without stronger policies and capacity-building efforts, green sourcing remains marginal (Nkrumah *et al*., 2021).

Food processing firms that adopt green procurement and environmental management systems report better environmental and operational performance (Martinez 2022). However, widespread adoption is limited by high implementation costs and low stakeholder awareness (Appiah & Odartey, 2021). In contrast, South Africa and Morocco have introduced policy frameworks promoting environmental assessments in supplier selection. These policies encourage green procurement, especially in agribusiness, through incentives and capacity-building. Such efforts have positioned firms to align better with global sustainability standards (Appiah & Odartey, 2021). Strengthening similar frameworks in other developing nations could accelerate the transition to sustainable supply chain.

Green sourcing is slowly gaining traction in Kisii County (Otieno *et al*., 2023). Value chain officers targeting global markets are adopting eco-friendly inputs and biodegradable packaging. Traceability systems are also being implemented to meet international standards. However, most farmers still depend on chemical fertilizers and pesticide-based farming. Fossil fuel-powered transport remains dominant, increasing carbon emissions (Obiero, 2023). Weak supplier evaluation and limited sustainability training hinder adoption. Poor institutional support adds to these challenges and these issues lead to higher costs, soil degradation, and losses. Incentives, awareness programs, and supplier capacity building can accelerate adoption (Nyabuto, 2024).

Green production is the environmentally responsible transformation of raw agricultural materials into finished products, focusing on energy efficiency, waste reduction, and pollution control (Chen *et al*., 2023). In Australia, it is implemented through practices such as the use of renewable energy sources like solar and wind power, precision irrigation systems to conserve water, and circular processes that recycle agricultural waste into bioenergy and organic fertilizers (Li & Zhang, 2024). These methods aim to minimize environmental impact while ensuring sustainable productivity. However, green production faces several challenges, including high initial investment costs for technology adoption, limited technical expertise among farmers, and inadequate infrastructure to support large-scale implementation (Khan *et al*., 2022). Agribusinesses have adopted solar-powered storage facilities, precision irrigation, and waste-to-energy conversion to promote sustainability, but these efforts are often constrained (Wilson & Harper, 2023).

Green production practices are still limited, though some progress has been made in countries like South Africa (Mabapa & Makhura, 2023). Agrifood enterprises have adopted measures such as composting organic waste, using energy more efficiently, and promoting

collaboration among small businesses to share resources (Dlamini, 2024). In Durban, successful trials showed that converting fruit and vegetable waste into biogas through anaerobic digestion can support clean energy use. However, the wider adoption of such practices is hindered by challenges like limited access to technology, high initial costs, and low awareness among smallholder farmers and informal processors (Mkhize *et al*., 2023).

The adoption of green production practices in agriculture remains limited. This is despite the growing awareness of sustainable practices. A few agro-processors in the value chains have applied solar drying technologies and basic waste separation systems. However, these efforts are isolated and not widely embraced (Dlamini & Nkosi, 2022). Many agribusinesses still rely on diesel-powered machinery, inefficient water use, and unmanaged waste disposal (Sibanda & Moyo, 2024). Green production can be improved through renewable energy use, efficient water systems, proper waste recycling, and eco-friendly inputs (Muthemba & Karanja, 2023).

Reverse logistics in agricultural value chains involves moving products or materials from the final destination back into the supply chain. The purpose is reuse, remanufacturing, recycling, or proper disposal (Wang *et al*., 2023). It is an essential part of green supply chain management because it reduces environmental impact and improves resource use. Common activities include recovery of pesticide containers, and turning organic waste into compost or biogas. In countries like Germany and Canada, agribusinesses have built structured return systems. These allow recollection of used inputs and reduce waste while conserving resources (Martínez, Fernandez, & Liu, 2022).

Reverse logistics practices are gaining importance in the agricultural sector. Export-oriented firms adopt them to meet global environmental standards. In countries such as Egypt, Ghana, and South Africa, systems exist for collecting and recycling agrochemical containers and

packaging. These initiatives are supported by public and private partnerships that enhance coordination (Mensah *et al*., 2022). However, adoption across the region is still low. Key challenges include weak recycling infrastructure, poor enforcement of regulations, and limited awareness among value chain actors. Farmers generate large volumes of waste but lack technical skills and access to organized collection systems (Okafor, 2023).

In Kenya, reverse logistics in agriculture is still at an early stage (Omondi, Mbaka, & Nyambane, 2023). A few large producers and cooperatives have basic recovery systems for packaging and organic waste. Most small-scale farmers, however, lack structured mechanisms for recycling or reuse. Agriculture is central to household income. Farmers often discard fertilizer bags and pesticide bottles unsafely, creating health and environmental risks. Lack of awareness, absence of organized collection, and high recycling costs hinder adoption (Cheruiyot & Maranga, 2024).

Green distribution refers to the integration of environmentally sustainable practices into transportation, warehousing, and delivery processes to minimize environmental impact while maintaining efficiency (Mousavi *et al*., 23). It focuses on reducing greenhouse gas emissions, lowering energy consumption, and optimizing logistics to achieve sustainable performance in the agricultural value chain (Zhang & Li, 2024). Adopting green distribution practices enhances cost-effectiveness and competitiveness, particularly in global agri-food markets where sustainability compliance is increasingly demanded. However, the implementation of such practices is often constrained by inadequate infrastructure, high operational costs, and lack of awareness among supply chain actors (Omondi & Achieng, 2024). To address these challenges, leveraging renewable energy in transportation, improving route planning, and adopting eco-friendly packaging minimizes environmental footprints (Mutua *et al*., 2025).

In North America, particularly in the United States and Canada, green distribution has become a key part of sustainable supply chain strategies in agriculture (Johnson & Alvarez, 2024). The region has seen a strong shift toward eco-friendly transport, supported by government incentives and corporate commitments. Many agribusinesses now use electric and hybrid delivery fleets to cut emissions and improve fuel efficiency. Recent innovations include AI-powered routing and scheduling systems that reduce mileage and improve load utilization. These measures lower both costs and environmental impact (Miller & Thompson, 2023).

The use of renewable energy-powered cold storage and warehousing systems has become a common practice to reduce energy consumption and emissions. These systems help maintain product quality while minimizing environmental impact (Wang, 2023). Automation in inventory handling and distribution processes has improved efficiency and reduced spoilage during transportation (Kumar & Singh, 2022). In addition, the adoption of electric vehicles in food distribution has significantly lowered carbon emissions (Zhang, 2024). Many agricultural value chains now incorporate route optimization software to cut fuel usage and improve delivery times. These strategies collectively enhance sustainability in green distribution while maintaining supply chain resilience (Mousavi *et al*., 2023).

The adoption of green distribution practices has significantly enhanced supply chain reliability and ensured the maintenance of product quality from the point of production to the end consumer (Nyagadza *et al*., 2022). In the context of South Africa, there is a noticeable shift toward implementing environmentally sustainable distribution systems, particularly in sectors targeting international markets. These enterprises involve deploying solar-powered cold storage facilities to maintain freshness, utilizing fuel-efficient and low-emission transportation modes to reduce carbon output, and incorporating digital technologies to streamline route planning for efficient

deliveries. However, the transition is not without obstacles. Critical limitations such as underdeveloped transport infrastructure, inconsistent access to stable electricity, and insufficiently established cold chain systems remain key barriers to full-scale implementation of green distribution in the country (Akinyemi *et al*., 2023).

Green distribution is gaining importance in Kenya as agribusinesses adopt cold storage and route optimization technologies. These practices help meet environmental and consumer demands (Mutua & Kibe, 2022). In Kisii County, many small-scale farmers still use outdated transport systems without temperature control. This leads to frequent spoilage of produce and financial losses. Fuel-intensive vehicles and poor logistics further increase costs and emissions. Cleaner transport and green distribution strategies are needed to improve sustainability (Mwangi & Otieno, 2023).

Kisii County has fertile volcanic soils and reliable rainfall, making agriculture a major activity with value chains in bananas, avocados, vegetables, tea, and livestock products (Atieno & Mose, 2023). Despite this potential, farmers face challenges such as post-harvest losses, inadequate storage, and limited market access (Moraa & Njoroge, 2022). Green distribution practices, including energy-efficient transport, optimized routes, cold chain systems, and eco-friendly packaging, can reduce spoilage and enhance efficiency (Mutua & Kibe, 2022). These practices also help minimize carbon emissions and promote sustainability in agricultural supply chains (Mugambi & Wekesa, 2024). However, the extent of adoption and their impact on value chain performance remain unclear, creating a research gap that this study seeks to address (Okeyo, 2023).

1.1.2 Sustainable Performance of Value Chain

Sustainable performance in agricultural value chains has become increasingly significant due to climate change, resource scarcity, and the growing demand for ethical production. Globally, agricultural value chains are seeking to minimize waste, conserve ecosystems, and improve livelihoods while remaining competitive (Gomez & Rodriguez, 2023). It is achieved through adopting eco-friendly farming practices, reducing greenhouse gas emissions, and implementing water conservation technologies. In Europe, automation, cold chain digitization, and product traceability have improved environmental outcomes by reducing spoilage and ensuring efficient logistics. However, farmers remain excluded due to limited access to sustainable technologies, posing a challenge to inclusive green transformation (Van der Vorst, 2022).

In the United States, sustainable agricultural practices have gained significant momentum, especially in sectors such as wheat and dairy farming (Harris & Johnson, 2024). Initiatives like eco-certification schemes, regenerative agriculture, and climate-resilient technologies have led to measurable improvements in both financial performance and environmental outcomes. Farms that adopt soil conservation, water-efficient irrigation, and reduced chemical usage often report higher yields over time and improved long-term soil health (Porter & Reay, 2023). Government incentives and consumer demand for eco-friendly products have further accelerated adoption across different value chains. In addition, the use of digital platforms for monitoring resource efficiency has improved decision-making and reduced waste in farm operations (Mitchell & Evans, 2022).

The use of renewable energy-powered cold storage is now common in food distribution (Roberts, 2024). These systems reduce energy use and emissions. They help maintain product quality while minimizing environmental harm. Automation in inventory handling has improved efficiency. It also reduces spoilage during transportation. Electric vehicles are widely adopted to

cut carbon emissions in distribution. Many firms use route optimization software to save fuel and improve delivery times to be more sustainable and resilient (Roberts *et al*., 2024).

Value chain firms are increasingly adopting practices such as contract farming and group marketing to strengthen farmer participation in agricultural markets. Contract farming provides smallholder farmers with predictable access to markets, inputs, and technical support, which helps increase productivity and reduce post-harvest losses (Nguyen, Pham, & Le, 2024). Group marketing allows farmers to pool their produce, negotiate better prices, and lower transaction costs, thereby improving income stability. These practices enhance inclusivity by integrating smallholders into more formalized supply chains and reducing their vulnerability to market fluctuations (Omondi & Kerubo, 2024). Despite these advantages, challenges such as weak bargaining power, limited access to financing, and low awareness of sustainable practices constrain the full benefits of these models (Mwangi & Achieng, 2023).

Food and Agriculture Organization has promoted integrated sustainability strategies in agriculture. They note that digital tools are being applied to support community-driven agricultural development (Smith and Brown, 2023). These approaches aim to connect productivity goals with environmental health and social equity. In Kisii County, farming conditions remain highly favorable for crops such as bananas, tea, and vegetables. However, many agribusinesses still depend on unsustainable practices. This dependence contributes to land degradation, biodiversity loss, and declining soil fertility (Nyambane and Mbaka, 2023).

1.1.3 Agricultural value chain organizations in Kisii County

Agricultural value chain organizations in Kisii County play a central role in linking farmers to markets, promoting value addition, and enhancing livelihoods (Otieno & Kerubo, 2023). These organizations include value chain officers, agribusiness officers, cooperative societies, agro-

processors, transporters, and distribution agencies that coordinate activities along the agricultural value chain. Notable examples include the Kisii Farmers Cooperative Union, the Nyamira Banana Growers Association, and Kisii Avocados. In addition, the Ministry of Agriculture works in collaboration with the Kenya Plant Health Inspectorate Service (KEPHIS) and the Kenya Agricultural and Livestock Research Organization to strengthen agricultural systems in the region (Nyaribo & Atambo, 2024).

Despite their contributions, many of these organizations face critical sustainability challenges. Poor rural infrastructure and limited cold chain systems weaken efficiency and reduce market competitiveness (Oloo & Nyanchoka, 2025). High post-harvest losses and inconsistent market access further undermine farmer incomes. The lack of access to green technologies and limited financing for eco-innovation slow progress toward sustainable practices (Achieng & Mokua, 2024). Weak regulatory enforcement makes it difficult to achieve environmental compliance. In addition, low awareness of sustainability among farmers and cooperatives limits adoption of green practices (Dlamini & Khumalo, 2023).

Green Supply Chain Management (GSCM) provides a strategic framework for integrating environmental considerations into agricultural operations. Practices such as green procurement, energy-efficient logistics, waste reduction, and reverse logistics are increasingly recognized for enhancing environmental performance while reducing operational costs (Mutiso & Kihara, 2022). In addition, GSCM practices contribute to long-term resilience by improving resource efficiency and strengthening competitiveness in agricultural markets (Chikafa & Moyo, 2024). Despite these benefits, the extent of adoption remains limited, particularly among small-scale agricultural enterprises. Most of these enterprises face constraints such as inadequate technical capacity, lack

of structured frameworks, and minimal access to green technologies. These challenges highlight the need for targeted policies, training, and financial support to promote effective implementation of sustainable supply chain practices (Marwa & Nyanchama, 2023).

1.2 Statement of the problem

Green Supply Chain Management (GSCM) has emerged as a vital approach for achieving sustainability in agricultural systems by integrating environmental considerations into sourcing, production, and distribution (Wang, Chen, & Johnson, 2022). Through practices such as green sourcing, waste reduction, reverse logistics, and eco-friendly distribution, GSCM enhances efficiency, reduces carbon emissions, and strengthens competitiveness (Marwa & Nyanchama, 2023). Despite these benefits, the adoption of GSCM among agricultural value chain organizations in Kenya remains limited due to inadequate expertise, insufficient financing, and weak policy enforcement (Chikafa & Moyo, 2024).

In Kisii County, agricultural value chain organizations continue to experience inefficiencies in post-harvest handling, waste management, and distribution processes, resulting in significant post-harvest losses estimated at over 35 percent nationally (Ministry of Agriculture, 2023). These inefficiencies indicate a weak integration of green supply chain practices such as recycling of crop residues, use of organic manure, and eco-friendly logistics (Mwangi & Otieno, 2023). As a result, the agricultural sector in the county suffers from high production costs, reduced profitability, and environmental degradation.

Despite the recognized importance of green supply chain management for improving sustainability and competitiveness, agricultural value chain organizations in Kisii County have not

effectively adopted these practices. This has led to persistent inefficiencies and reduced sustainable performance. Moreover, existing studies have largely focused on manufacturing and urban logistics, leaving a knowledge gap on how GSCM practices influence the sustainable performance of agricultural value chain organizations in rural contexts such as Kisii County. This study therefore sought to bridge this gap by examining the relationship between GSCM practices and sustainable performance among agricultural value chain organizations in Kisii County, Kenya.

1.3 Objectives of the study

1.3.1 General Objective

The general objective was to examine the effect of green supply chain management practices on sustainable performance of agricultural value chain organizations in Kisii County, Kenya

1.3.2 Specific objectives

The study was guided by the following specific objectives:

i. To assess the effect of green sourcing on sustainable performance of agricultural value chain organizations in Kisii County.
ii. To determine the effect of green production on sustainable performance of agricultural value chain organizations in Kisii County.
iii. To examine the effect of reverse logistics on sustainable performance of agricultural value chain organizations in Kisii County.
iv. To evaluate the effect of green distribution on sustainable performance of agricultural value chain organizations in Kisii County.

1.4 Research Questions

The study was guided by the following research questions:

i. What is the effect of green sourcing on sustainable performance of agricultural value chain organizations in Kisii County?
ii. How does green production affect sustainable performance of agricultural value chain organizations in Kisii County?
iii. What is the effect of reverse logistics affect sustainable performance of agricultural value chain organizations in Kisii County?
iv. What is the effect of green distribution on sustainable performance of agricultural value chain organizations in Kisii County

1.5 Significance of the study

This study is expected to provide practical and policy insights for agricultural value chain stakeholders in Kisii County and beyond. Firstly, it informs agricultural value chain organizations and agribusiness managers about the benefits of adopting GSCM practices to improve environmental performance and profitability. Policymakers and regulators benefits from evidence-based recommendations to guide the development and implementation of environmental policies tailored to agricultural supply chains. Academic researchers may find this study useful in enriching the existing body of knowledge and offering a foundation for further research on green supply chains in the agricultural sector. Environmental advocacy groups and sustainability practitioners can use the findings to raise awareness and promote sustainable agricultural value chains.

1.5.1 Government and policy makers

The study provides empirical evidence to guide policy formulation and review at both national and county levels. By identifying which GSCM practices most significantly influence environmental, economic, and social sustainability, it enables policymakers to prioritize interventions that align with Kenya's Agricultural Sector Transformation and Growth Strategy (ASTGS), Vision 2030, and the Sustainable Development Goals (SDGs). The findings can also

support the development of incentives, regulatory frameworks, and capacity-building programs aimed at promoting sustainable performance of agricultural value chain in Kisii and beyond.

1.5.2 Agricultural value chain organizations

For agribusinesses, especially small and medium-sized enterprises operating in Kisii County, the study offers practical insights into how green sourcing, production, reverse logistics, and distribution can enhance operational efficiency, reduce environmental harm, and improve competitiveness. The results supports business decision-making, particularly in adopting cost-effective and sustainable supply chain practices that contribute to long-term profitability and resilience in the face of climate and market challenges.

1.5.3 Academics

This study adds to the growing body of literature on green supply chain management (GSCM) within the agricultural sector, particularly in the context of developing countries. It seeks to address existing knowledge gaps by providing localized empirical evidence on the impact of GSCM at the county level. The findings enriches existing theoretical frameworks and introduce new perspectives to scholarly discourse on sustainability in agribusiness. Furthermore, the research serves as a valuable reference for future scholars and students undertaking related studies or comparative analyses in sustainability and agricultural value chain management

1.6 Scope of the Study

This study focused on agricultural value chain organizations in Kisii County, Kenya. It examined and analyzed how Green Supply Chain Management (GSCM) practices, specifically green sourcing, green production, reverse logistics, and green distribution, affect sustainable

performance. Descriptive research design was used and target population of 84 respondents who know more about production, processing, and distribution of bananas, avocados, coffee, dairy, and chicken. Census approach was used for all 84 respondents based in Kisii County Ministry of Agriculture. Data was collected using questionnaire from respondents comprise of Value chain officers and agribusiness officers between June and October 2025. The research aims to assess environmental, social, and economic outcomes linked to GSCM adoption in a region known for its agricultural potential and sustainability challenges.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews relevant literature on green supply chain management (GSCM) practices and their influence on the sustainable performance of agricultural value chain organizations. The section begins with a theoretical review that lays the conceptual foundation for the study. It is followed by a detailed empirical review of previous studies, highlighting the global, regional, and local perspectives on various GSCM dimensions such as green sourcing, green production, reverse logistics, and green distribution. The chapter concludes by identifying existing research gaps that the current study seeks to address, especially within the context of Kisii County, Kenya

2.2 Theoretical Review

This presents the theories that provide a foundation for understanding how green supply chain management (GSCM) practices influence sustainable performance in agricultural value chain organizations. The System Theory, Resource Based View, Product Life Cycle Theory and Transaction cost economic theories help explain the adoption and effectiveness of GSCM practices on sustainable performance of agricultural value chain organizations.

2.2.1 System Theory

System Theory initially developed by Ludwig von Bertalanffy in the 1940s, it posits that organizations function as complex systems made up of interdependent and interacting components that work together to achieve a common goal. System theory suggests about all activities from input sourcing to production, distribution, and waste management are understood as an

interconnected system whose efficiency and sustainability depend on the smooth and responsible functioning of each component (Srivastava, 2007). Applying System Theory to GSCM implies that green practices in one part of the chain (green sourcing) affect other components (production efficiency or waste reduction), thereby influencing the overall sustainable performance of the system (Gong, Jiang, and Jia 2023).

The system theory is based on the assumption that there is a high levels of coordination and feedback that are often difficult to achieve in fragmented agricultural systems, where smallholder farmers operate within informal markets with limited access to infrastructure and technology. System theory presumes that all supply chain actors have equal capacity to adopt sustainable strategies, overlooking socio-economic disparities and capability gaps (Kamau & Chege, 2021). Therefore, while the theory provides a useful conceptual framework, its practical relevance requires adaptive and context-specific strategies (Omondi, 2023).

Systems Theory is highly applicable to this study as it examines how Green Supply Chain Management (GSCM) practices including green sourcing, reverse logistics, green production, and green distribution affect sustainable performance. The theory offers a holistic framework for analyzing how the interdependence of supply chain components influences overall system efficiency and sustainability. It applies in assessing improvements in one area, such as adopting water-efficient irrigation systems, can generate positive ripple effects in other areas including energy conservation, cost reduction, and decreased environmental pollution (Mwangi & Otieno, 2022). This interconnectedness aligns with the study's central argument that sustainable performance results from the coordinated efforts of all stakeholders. The theory emphasizes continuous adaptation, environmental challenges in value chains (Mutua, 2023). The system

theory explains green supply chain practices as a structured process of shared responsibility in achieving sustainable performance.

2.2.2 Resource Based View Theory

The Resource-Based View (RBV) theory was proposed by Barney in 1991 to explain how firms can achieve sustained competitive advantage by leveraging their internal resources. The theory argues that an organization can outperform its competitors if it possesses resources that are valuable, rare, inimitable, and non-t. These resources may include tangible assets such as advanced technologies or intangible ones such as knowledge, innovation capacity, and organizational culture. In the context of green supply chain management, practices like green sourcing, use of renewable energy, eco-design, and sustainable logistics are viewed as internal strategic assets that can enhance operational efficiency and contribute to long-term environmental and economic performance (Tseng *et al*., 2022).

The Resource-Based View (RBV) theory emphasizes that internal resources and capabilities are central to a firm's sustainable performance (Barney, 1991). These resources must be valuable, rare, difficult to imitate, and non-substitutable to drive superior performance (Wekesa & Kihoro, 2022). In green supply chain management, RBV highlights how environmental practices, such as energy-efficient production or closed-loop logistics, can evolve into strategic assets (Nyambura & Gathenya, 2023). When such practices are embedded in core operations, they reduce costs, improve compliance, and enhance brand reputation. In Kenya’s agricultural value chains, RBV supports internal investments in green technologies, staff training, and sustainable sourcing. These actions help organizations strengthen resilience while aligning with growing sustainability demands (Otieno & Kariuki, 2024).

The Resource-Based View (RBV) theory is criticized by its inward focus, often ignoring key external influences on organizational performance. Factors such as market competition, regulatory shifts, stakeholder demands, and technological changes (Kihara & Wanyoike, 2022). This criticizes the theory's usefulness in fast-changing environments like agriculture in developing countries. It also fails to consider the limited access to green technologies, infrastructure, and sustainability knowledge (Zhang *et al*., 2024). As a result, RBV alone may not fully explain performance outcomes in such contexts. These gaps suggest the need to integrate RBV with external-focused theories to better support green sourcing decisions.

The Resource-Based View (RBV) theory is relevant to this study because it highlights the importance of internal capabilities in achieving sustainable performance (Barney, 1991). Agricultural value chains can gain competitive advantage by leveraging resources to support environmental goals, such as green sourcing and waste management. Green supply chain practices, including recycling, digital tracking, and reverse logistics, can become strategic assets that enhance long-term sustainability (Chen & Wu, 2021). These practices help reduce costs, improve regulatory compliance, and build trust with consumers. In resource-limited settings like Kisii County, investing in internal capabilities for green distribution is crucial for balancing economic, social, and environmental outcomes (Mwangi & Makori, 2023).

2.2.3 Product Life Cycle Theory

The Product Life Cycle (PLC) Theory, proposed by Raymond Vernon in 1966, explains a product's evolution through introduction, growth, maturity, and decline stages (Vernon, 1966). Each stage involves different levels of investment, market demand, competition, and profitability (Kotler & Keller, 2021). During the introduction and growth phases, firms focus on innovation

and marketing to capture market share (Ali & Mohamed, 2023). In the maturity phase, efficiency, cost management, and sustainable practices like green design become key priorities (Okoth & Kirui, 2022). During the decline phase, reverse logistics, waste reduction, and product reinvention help maintain environmental compliance and support sustainable supply chain management (Chen & Wu, 2021).

Critics of the Product Life Cycle (PLC) Theory argue that it oversimplifies product evolution by assuming a linear and predictable progression through stages (Koech & Kitur, 2022). In reality, some products may skip stages, re-enter the market after decline, or remain in maturity for extended periods due to technological innovations or changing consumer preferences (Kotler & Keller, 2021). The theory also does not fully consider external factors such as market disruptions, policy shifts, or sustainability pressures that can influence a product's life trajectory. In agricultural contexts, seasonality, perishability, and environmental variability make the application of PLC models more complex. These limitations indicate that while PLC provides a useful framework, it may not entirely reflect the dynamic conditions of modern product development, particularly in emerging economies (Chen & Wu, 2021).

Product Life Cycle Theory remains relevant to the current study because it provides a structured way to integrate green practices at different stages of production (Kotler & Keller, 2021). In the introduction stage, eco-design and green production support sustainable product development (Okoth & Kirui, 2022). The growth and maturity stages emphasize resource efficiency and emission control to improve performance (Mwangi & Njeru, 2023). During the decline phase, reverse logistics and waste reduction minimize environmental impact (Chen & Wu, 2021). This staged approach aligns with green production management and enables agricultural firms to embed sustainability across the product lifecycle (Achieng & Mokua, 2024).

2.2.4 Transaction Cost Economic Theory

Transaction Cost Economics (TCE), proposed by Williamson in 1975, explains how firms organize transactions to minimize costs linked to information search, contract negotiation, and enforcement (Geyskens, Steenkamp, & Kumar, 2006). In green distribution, TCE shows why firms may outsource activities like eco-friendly transport, recyclable packaging, and low-emission warehousing to reduce costs (Kim & Park, 2022). Agricultural value chain firms often use third-party logistics providers (3PLs) with green certifications to manage these activities (Mwangi & Makori, 2023). This reduces internal transaction frictions and ensures compliance with environmental standards. The theory should be combined with sustainability frameworks to capture broader environmental and social benefits (Achieng & Nyanchoka, 2024).

The Product Life Cycle Theory is relevant because it guides the adoption of green practices across different stages of production (Okoth & Kirui, 2022). At the introduction stage, eco-design and sustainable production practices enhance environmental responsibility (Zhang & Li, 2023). During the growth and maturity stages, firms can emphasize resource efficiency and emission control to strengthen performance (Mwangi & Njeru, 2023). In the decline stage, reverse logistics and waste reduction become critical in minimizing negative environmental impacts (Achieng & Mokua, 2024). This structured approach enables firms to integrate sustainability consistently throughout the product lifecycle (Omondi & Nyangweso, 2023).

The Transaction Cost Economics (TCE) theory is useful in analyzing green distribution practices in emerging markets. In Kisii County, agricultural firms face resource constraints and institutional uncertainties, making TCE a relevant tool for decision-making (Omondi *et al*., 2024). The theory helps explain trade-offs between adopting internal logistics systems and outsourcing sustainable distribution services. Its focus on reducing transaction frictions supports efficiency in

balancing operational costs with environmental goals (Mwangi & Otieno, 2023). Although TCE alone may not fully address sustainability concerns, it provides a strong foundation when combined with other sustainability-oriented frameworks.

2.3 Empirical Review

2.3.1 Green sourcing and sustainable performance of agricultural value chain organizations

Empirical studies consistently affirm that green sourcing is a critical dimension of Green Supply Chain Management (GSCM) that enhances the sustainability of agribusiness operations. Across various contexts, green sourcing has been associated with reduced waste, improved energy efficiency, and strengthened compliance with environmental standards. However, differences in scope, context, and methodological focus among previous studies reveal notable research gaps that the current study seeks to address.

Evidence from developed and emerging economies demonstrates that green sourcing contributes positively to environmental and operational outcomes. For instance, Sharma and Gupta (2023) found that sourcing from certified suppliers and using biodegradable materials significantly improved sustainability outcomes in India's agro-processing sector. Their findings align with the Natural Resource-Based View (NRBV), which posits that firms leveraging environmentally responsible resources gain sustainable competitive advantages. Similarly, Mwangi and Njeru (2023) reported that green sourcing practices—such as supplier certification and eco-friendly input selection—enhanced waste reduction and energy efficiency in Kenyan agro-processing firms. These studies collectively underscore a growing trend that green sourcing improves environmental performance through resource efficiency and cleaner production processes.

Nevertheless, several studies highlight conceptual and contextual limitations that narrow understanding of green sourcing in localized agricultural systems. Santos and Costa (2021), for

example, emphasized green sourcing criteria in supplier selection among Brazilian export-oriented agribusinesses and found enhanced environmental compliance and market access. However, their focus on export markets and large-scale agribusinesses limits the applicability of findings to smallholder-dominated agricultural value chains in developing economies. Similarly, Mensah and Boateng (2022) observed that green sourcing reduced production waste among Ghanaian agro-processors but failed to assess its influence on broader sustainability dimensions such as social welfare or cost-effectiveness. These omissions point to a prevalent pattern in literature—most studies emphasize environmental performance while neglecting economic and social dimensions of sustainability.

A few studies have attempted to bridge this gap by linking green sourcing to social and economic outcomes. Kariuki and Njuguna (2023) demonstrated that sourcing organic animal feeds and biodegradable packaging improved environmental and social performance in dairy cooperatives in Nyandarua County. Likewise, Omari and Okwaro (2024) found that using organic fertilizers and certified timber in Kisii tea firms enhanced soil fertility and reduced pollution. However, both studies were limited in scope, focusing on specific product chains and omitting other GSCM dimensions such as reverse logistics and green distribution.

While prior research establishes the environmental benefits of green sourcing, it remains largely fragmented, sector-specific, and biased toward industrial or export-oriented contexts. There is limited empirical evidence on how green sourcing simultaneously influences environmental, economic, and social performance within rural agricultural value chains. The current study, therefore, extended the literature by examining green sourcing as part of an integrated GSCM framework and assessing its holistic impact on sustainable performance among agricultural value chain organizations in Kisii County.

2.3.2 Green production and sustainable performance of agricultural value chain organizations

Empirical evidence increasingly highlights the pivotal role of green production in enhancing the sustainable performance of agricultural value chain organizations. Across various contexts, studies consistently show that environmentally conscious production practices such as waste minimization, renewable energy adoption, water recycling, and pollution control lead to improved operational efficiency and reduced environmental degradation. For instance, research in Asian and African contexts demonstrates that the adoption of green production not only lowers production costs but also enhances compliance with environmental standards and boosts organizational reputation (Chen & Wu, 2021; Mwangi & Otieno, 2023; Wekesa & Muturi, 2025).

A common trend across these studies is the positive link between green production practices and environmental performance. Firms integrating renewable energy systems, efficient machinery, and organic production inputs have reported reductions in emissions and chemical waste, alongside improved resource utilization (Oduor & Kibet, 2022; Koech & Kitur, 2022; Omari & Okwaro, 2024). These findings align with the principles of the Natural Resource-Based View (NRBV), which argues that environmental capabilities can be sources of competitive advantage. However, while most studies emphasize the environmental and economic outcomes of green production, few extend their focus to the social dimension of sustainability, such as employee welfare, community engagement, and social equity. This narrow focus presents a conceptual gap that the current study sought to fill.

Another emerging insight is that context significantly shapes the outcomes of green production initiatives. Studies conducted in large-scale, export-oriented, or industrial agricultural

settings such as those in Vietnam, Ghana, and Kericho tend to highlight cost efficiency and environmental compliance as the main benefits (Asamoah et al., 2024; Chen & Wu, 2021; Koech & Kitur, 2022). Conversely, studies focusing on smaller, localized or cooperative-based agricultural systems, such as in Kisii and Western Kenya, show a growing recognition of the potential for green production to enhance product quality, waste management, and energy efficiency (Omari & Okwaro, 2024; Wekesa & Muturi, 2025). However, the limited inclusion of smallholder and cooperative agricultural value chains in prior research underscores a contextual gap, particularly in understanding how green production operates within rural, resource-constrained environments.

Methodologically, most prior studies employed cross-sectional survey designs or case study approaches, often anchored on frameworks like the Triple Bottom Line (TBL) and NRBV. While these frameworks effectively explain environmental and economic aspects of sustainability, their limited operationalization of the social pillar creates an incomplete picture of sustainable performance. Moreover, while regression analyses commonly establish a statistically significant relationship between green production and sustainability outcomes, the longitudinal impacts remain underexplored.

The reviewed studies collectively reveal that green production practices significantly contribute to both environmental and economic sustainability among agricultural value chain organizations. Nevertheless, there is limited empirical exploration of how these practices influence social sustainability, especially in smallholder or cooperative-based value chains. Therefore, this study sought to address these conceptual and contextual gaps by examining the influence of green

production on the sustainable performance of agricultural value chain organizations in Kisii County, Kenya.

2.3.3 Reverse logistics and sustainable performance of agricultural value chain organizations

Empirical evidence demonstrates that reverse logistics has become an essential dimension of sustainable supply chain management within agricultural value chains, though its application varies across contexts. Studies conducted in developed countries such as Martínez, Fernandez, and Liu (2022) and Ahmed et al. (2024) reveal that reverse logistics significantly contributes to sustainability outcomes through product take-back, recycling, and reuse of materials. These studies underscore the environmental and economic benefits of reverse logistics, including reduced carbon emissions, cost efficiency, and improved product lifecycle management. However, both studies are largely confined to structured, capital-intensive agricultural systems in developed economies, which limits the applicability of their findings to the resource-constrained and informally organized agricultural systems in rural Kenya.

In contrast, research from developing contexts presents a more nuanced understanding of reverse logistics within agro-based sectors. Agyemang and Boateng (2021) in Ghana, and Kimani and Wambua (2023) in Kenya, found that reverse logistics practices such as waste recollection, recycling, and repair systems positively affect environmental and economic performance. These findings affirm the dual sustainability role of reverse logistics in promoting resource efficiency and cost reduction. Nonetheless, a recurring shortcoming across these studies is their limited examination of social sustainability dimensions such as community well-being, job creation, and farmer empowerment which are critical to the holistic performance of agricultural value chain organizations in rural areas like Kisii County.

Similarly, studies by Owino and Wafula (2022), Njeri and Musyoka (2025), and Otieno and Njeru (2022) highlight the growing adoption of reverse logistics among agro-processing and cooperative enterprises in Kenya. They consistently demonstrate that structured reverse logistics systems enhance operational efficiency, waste control, and profitability. Yet, these studies remain primarily descriptive and urban-centered, providing limited insight into how reverse logistics operates in rural agricultural value chains dominated by smallholder farmers.

Emerging evidence from localized studies, such as Ombati and Nyanchama (2024), provides a more contextually relevant perspective. Their investigation of banana aggregation centers in Kisii County shows that reverse logistics practices like packaging recovery and composting can significantly reduce input costs and minimize waste. This indicates that even in small-scale rural settings, reverse logistics can drive environmental and economic benefits when adapted to local realities. However, the study's narrow sectoral focus suggests the need for broader empirical investigations across diverse agricultural value chains in the region.

The reviewed literature points to a clear trend: reverse logistics enhances environmental and economic sustainability in agricultural value chains, but its implementation and outcomes are shaped by contextual factors such as resource availability, infrastructure, and institutional support. While developed economies demonstrate structured systems and measurable impacts, developing regions like Kenya exhibit fragmented adoption constrained by capacity and policy limitations. This underscores the need for empirical research in rural contexts assessing how reverse logistics practices can be effectively integrated within agricultural value chains to achieve sustainable performance.

2.3.4 Green distribution and sustainable performance of agricultural value chain organizations

Empirical evidence increasingly shows that green distribution practices play a pivotal role in enhancing the sustainable performance of agricultural value chain organizations. Across different contexts, studies have consistently emphasized the importance of integrating eco-friendly logistics, energy-efficient transport, and sustainable warehousing to achieve economic, environmental, and social sustainability outcomes.

Carter and Rogers (2022), Mensah and Owusu (2022), and Abdi and Hussein (2024) collectively demonstrate that adopting green logistics—particularly through the use of energy-efficient transport systems, reusable packaging, and low-emission delivery networks—improves environmental performance and cost efficiency. Their findings converge on the idea that reducing carbon footprints and optimizing delivery systems enhance not only environmental sustainability but also organizational reputation and efficiency. However, these studies largely focused on well-resourced cooperatives and exporters, excluding smallholder-based and rural agricultural organizations, thus creating a contextual gap relevant to developing economies such as Kenya.

A similar pattern is observed in studies by Njagi and Ndung'u (2023) and Mwanzia and Mburu (2024), which examined green distribution within fresh produce and dairy supply chains in Kenya. Both studies reported that sustainable distribution practices uch as efficient route planning and optimized delivery schedules led to reduced post-harvest losses, lower operational costs, and improved delivery timelines. Nonetheless, while these studies confirmed positive economic outcomes, they were limited in addressing the broader dimensions of sustainability, particularly social welfare and community inclusivity. This points to a conceptual gap.

Further, Kariuki and Mutua (2021) found that green distribution enhances environmental compliance and customer satisfaction among agro-export firms, emphasizing the environmental pillar of sustainability. However, their study neglected the social and financial dimensions, reflecting a trend where most research isolates one sustainability aspect rather than integrating the three. Similarly, while Abdi and Hussein (2024) and Mensah and Owusu (2022) demonstrated improvements in environmental and cost performance, they overlooked social outcomes such as community well-being and equity in value chain participation.

Notably, Makori and Onsongo (2025) provided localized insights from Kisii County, focusing on eco-distribution systems in banana aggregation networks. Their findings affirmed that sustainable transport and community-based logistics can reduce costs and spoilage while fostering local participation. However, the study's qualitative approach limited the statistical generalization of results, exposing a methodological gap. Furthermore, the narrow focus on banana value chains restricted the applicability of findings across other agricultural subsectors, reinforcing a contextual limitation.

The reviewed literature reveals consistent evidence that green distribution positively influences sustainable performance across various contexts. However, three dominant trends emerge. First, most studies prioritize environmental and economic outcomes, with minimal attention to social sustainability. Second, empirical research in developing economies, especially at the county level in Kenya, remains limited, despite the significant role of agriculture in local livelihoods. Third, many studies rely on qualitative or cross-sectional data, limiting the capacity to statistically validate causal relationships. Therefore, this study sought to bridge these conceptual, contextual, and methodological gaps by empirically examining how green distribution

practices influence the sustainable performance of agricultural value chain organizations in Kisii County, Kenya.

2.4 Research Gaps

Based on the reviewed studies, several research gaps exist in the application of Green Supply Chain Management (GSCM) practices within the agricultural sector. Previous research has mainly focused on manufacturing and industrial contexts, with limited attention directed toward agricultural value chains. There is inadequate empirical evidence on how green sourcing, green production, reverse logistics, and green distribution influence sustainable performance in agriculture. Existing studies have placed greater emphasis on environmental compliance, while overlooking the operational integration of these practices that leaves a gap.

Studies by Li and Zhang (2022) and Santos and Costa (2021) on green sourcing were largely quantitative and cross-sectional, focusing on firm-level procurement and supplier evaluation without addressing agricultural value chains in rural or smallholder contexts. Ncube and Mudzonga (2023) and Dlamini and Mabasa (2022) failed to analyze organizational and internal factors, leaving gaps in understanding the drivers of green sourcing. These studies also did not integrate the triple sustainability dimensions, limiting insights into how green sourcing affects economic, social, and environmental performance holistically. Kenyan studies such as Wambua and Chege (2021), Kariuki and Njuguna (2023), and Omari and Okwaro (2024) mainly emphasized environmental outcomes, neglecting social and financial performance indicators. Collectively, these gaps show limited exploration of the integration of reverse logistics, green distribution, and quantitative validation in agricultural value chains.

Chen and Wu (2021) examined green production in Vietnamese firms, focusing on economic and environmental outcomes but neglecting social sustainability. Mwangi and Otieno (2023) and Oduor and Kibet (2022) emphasized urban or horticultural contexts in Kenya, creating contextual gaps for rural agricultural value chains like Kisii. Asamoah et al. (2024) and Koech and Kitur (2022) restricted their scope to sector-specific or economic outcomes, overlooking social equity and community impact. Omari and Okwaro (2024) relied on qualitative analysis with limited performance metrics, pointing to the need for robust quantitative validation. Collectively, these studies reveal inadequate integration of financial, social, and environmental indicators in assessing the broader role of green production.

Agyemang and Boateng (2021) in Ghana and Ahmed et al. (2024) in Egypt focused on export-oriented and urban agribusinesses, neglecting rural and smallholder agricultural contexts. Otieno and Njeru (2022) highlighted reverse logistics benefits but failed to link them to broader social and economic outcomes. Kimani and Wambua (2023) did not apply circular economy approaches, leaving theoretical gaps in sustainability application. Owino and Wafula (2022) emphasized firm-level outcomes but overlooked community-level impacts. Ombati and Nyanchama (2024) in Kisii used qualitative methods with limited scope, lacking quantitative validation and holistic sustainability assessment on reverse logistics.

Green distribution, research largely focused on environmental outcomes without encompassing the full Triple Bottom Line. Studies in Kenya (Kariuki and Mutua, 2021; Njagi and Ndungu, 2023; Mwanzia and Mburu, 2024) and Ghana (Mensah and Owusu, 2022) neglected cooperatives, policy contexts, and economic and social sustainability indicators. Makori and Onsongo (2025) were crop-specific with no statistical validation, limiting generalizability across multiple value chains.

Previous research has explored green supply chain management in agriculture, yet several gaps remain. Mwangi and Njeru (2023) examined green sourcing in Kenyan agro-processing firms, finding improvements in waste reduction and energy efficiency.

Chen and Wu (2021) in Vietnam showed that green production improved cost reduction and environmental compliance but ignored social sustainability, creating conceptual and contextual gaps. Omari and Okwaro (2024) examined banana processing firms in Kisii County and reported environmental benefits from organic inputs and waste recycling. However, their study excluded economic and social performance dimensions. They also relied entirely on qualitative methods without quantitative validation. Overall, research on green production lacks comprehensive integration of financial, social, and environmental indicators, especially in rural agricultural value chains.

Martínez, Fernandez, and Liu (2022) investigated reverse logistics in Spain, focusing on reuse, recycling of agricultural inputs, and proper disposal, which enhanced sustainability performance. However, their study excluded rural and smallholder farming systems in developing countries, creating a contextual gap. Challenges faced by smallholder farmers and the integration of reverse logistics with other green supply chain practices were not examined, leaving methodological weaknesses. Existing research also emphasizes narrow contexts or single sustainability dimensions, resulting in conceptual gaps. Therefore, there is a need for studies in Kisii County that assess comprehensive sustainable performance in terms of environmental, economic, and social aspects while incorporating smallholder contexts through mixed-method approaches.

There were notable instrument gaps across the reviewed literature. For example, Dlamini and Mabasa (2022) and Koech and Kitur (2022) relied exclusively on structured questionnaires

without triangulating with interviews, observation, or document reviews. Similarly, Njeri and Musyoka (2025) did not apply standardized performance measurement tools or indices, which limited the ability to capture sustainability comprehensively. These weaknesses point to the absence of robust methodological approaches that can integrate multiple perspectives and reliable measures. This highlights the need for a study in rural contexts such as Kisii County that employs a mixed-methods design, utilizes varied instruments, and captures economic, environmental, and social dimensions in assessing green supply chain management practices.

TABLE 1 Summary of Research Gaps in Reviewed Studies

Author(s) and Year	Study Title	Methodology	Conceptual Gaps	Gaps
Li and Zhang (2022)	Impact of Green Procurement on Sustainable Performance in Chinese Agribusiness	Quantitative (SEM)	No focus on agricultural value chains	Sector-specific analysis in rural Kenya
Santos and Costa (2021)	Integration of Environmental Standards into Supplier Selection	Cross-sectional survey	Ignored localized agri systems	Contextual focus on smallholder settings
Ncube and Mudzonga (2023)	Green Sourcing in Horticultural Cooperatives in Zimbabwe	Mixed-methods	Lacked organizational/internal factors	Descriptive designs
Dlamini and Mabasa (2022)	Green Input Procurement in South Africa	Descriptive survey	Did not address triple sustainability dimensions	Broader sustainability focus on green sourcing
Wambua and Chege (2021)	Green Procurement in Agro-based SMEs in Kenya	Cross-sectional survey	Excluded value chain firms	Inclusion of larger cooperatives and processing firms using inferential statistics
Kariuki and Njuguna (2023)	Green Sourcing and Environmental	Descriptive survey design	Ignored reverse logistics and green distribution	Integration of green source

	Performance in Nyandarua Dairy Coops			model using OLS
Omari and Okwaro (2024)	Green Sourcing Practices in Tea Firms in Kisii	Case study (qualitative)	Limited performance metrics, small sample	Broader indicators and quantitative analysis
Chen and Wu (2021)	Green Production in Vietnamese Agricultural Firms	Quantitative	Ignored social sustainability	Inclusion of social dimension in performance
Mwangi and Otieno (2023)	Green Manufacturing in Nairobi Agro-processors	Cross-sectional	Urban bias, no rural perspective	Rural agro-value chains in Kisii
Oduor and Kibet (2022)	Green Production in Kenyan Horticulture	Descriptive	Focused only on environmental outcomes	Add economic and social indicators
Asamoah *et al*. (2024)	Green Production and Supply Chain Performance in Ghana	Mixed-methods	Did not assess cost/community impact	sustainability variables
Koech and Kitur (2022)	Green Production in Kericho Tea Factories	Correlational	Narrow sector (tea), no community outcomes	Multiple crop chains, social equity
Wekesa and Muturi (2025)	Green Operations in Western Kenya	Descriptive survey	Did not study smallholder firms	Smallholder-dominated chain inclusion
Omari and Okwaro (2024)	Green Production in Banana Firms in Kisii	Case study (qualitative)	No financial/social indicators; qualitative-only	Quantitative confirmation and social/economic metrics
Agyemang and Boateng (2021)	Reverse Logistics in Ghanaian Agro Exporters	Cross-sectional	Export-only focus, ignored economic/social	Domestic chains with broader metrics
Otieno and Njeru (2022)	Reverse Logistics in	Descriptive	No link to economic/social outcomes	Broader sustainability

	Kenyan Coffee Cooperatives			performance indicators
Kimani and Wambua (2023)	Reverse Logistics in Agri-food Firms in Kiambu	Secondary data, correlation	No circular economy focus	Reverse logistics using primary data
Ahmed *et al*. (2024)	Reverse Logistics in Egyptian Vegetable Firms	Mixed-methods	Ignored smallholder challenges	Descriptive methods of rural smallholder challenges
Owino and Wafula (2022)	Reverse Logistics in Eldoret Agro-SMEs	Case study	Excluded social/community metrics	Community impact indicators using analytical models
Njeri and Musyoka (2025)	Reverse Logistics in Dairy Cooperatives	Descriptive	Descriptive-only, limited value chain variety	Statistical rigor and broader value chain focus
Ombati and Nyanchama (2024)	Reverse Logistics in Kisii Banana Centers	Case study (qualitative)	Lacked quantitative data, limited to operations	Statistical analysis and full sustainability dimensions
Kariuki and Mutua (2021)	Green Distribution in Nairobi Agro-export Firms	Cross-sectional	Focused on environmental outcomes only	Triple Bottom Line indicators
Mensah and Owusu (2022)	Sustainable Distribution in Ghanaian SMEs	Descriptive	Ignored cooperatives and policy context	Rural cooperatives and policy relevance
Njagi and Ndungu (2023)	Green Distribution in Central Kenya Produce Chains	Mixed-methods	Omitted economic and social outcomes	Holistic sustainability and processing firms
Mwanzia and Mburu (2024)	Sustainable Distribution in Machakos Dairy Firms	Correlational	Focused only on economic, ignored social/environmental	Inclusion of full sustainability scope using regression

Abdi and Hussein (2024)	Green Logistics in Somalia Horticulture	Descriptive	Export bias, excluded financial/social indicators	Local chains with broader sustainability
Makori and Onsongo (2025)	Eco-distribution in Kisii Banana Networks	Longitudinal design	No statistical validation, crop-specific only	Quantitative tools and multiple value chains

2.5 Conceptual framework

The conceptual framework for this study illustrates the hypothesized relationship between green supply chain management practices as the independent variable and sustainable performance of agricultural value chain organizations as the dependent variable. The framework suggest that internal green supply chain management practices influence the environmental, social, and economic aspects of sustainable performance.

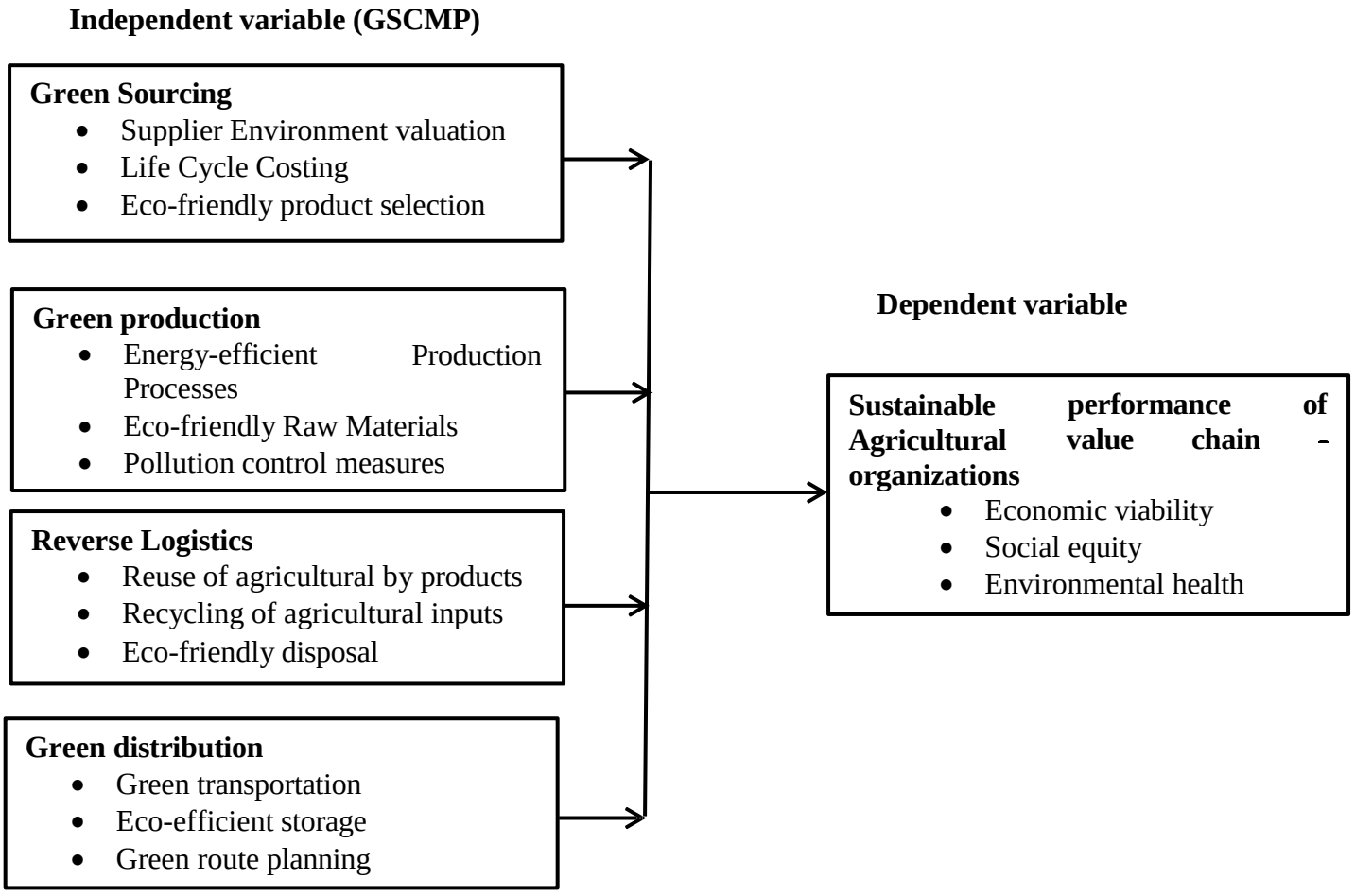

FIGURE 1 Conceptual Framework

Source: (Researcher 2025)

TABLE 2 Operationalization of Study Variables

Variable	Indicators	Measurement Items	Scale	Analysis Method
Green Sourcing	Supplier Environment Evaluation	Extent to which environmental criteria are used in selecting suppliers	Likert (1–5)	Descriptive statistics, Correlation, Multiple regression
	Life Cycle Costing	Use of life cycle cost analysis during sourcing decisions	Likert (1–5)	Descriptive statistics, Regression
	Eco-friendly Product Selection	Preference for products with minimal environmental impact	Likert (1–5)	Correlation, Regression
Green Production	Energy-efficient Production Processes	Adoption of low-energy technology in production	Likert (1–5)	Descriptive statistics, Regression
	Eco-friendly Raw Materials	Use of biodegradable or renewable inputs	Likert (1–5)	Factor analysis, Regression
	Pollution Control Measures	Availability of systems to manage waste and emissions	Likert (1–5)	Regression, ANOVA
Reverse Logistics	Reuse of agricultural by products	reusing fertilizers, seed containers, or residual seeds to minimize waste and reduce input costs	Likert (1–5)	Correlation, Regression
	Recycling of agricultural inputs	Packaging materials for processing and reuse	Likert (1–5)	Descriptive, Correlation
	Eco-friendly disposal	The segregation and recycling of both organic and inorganic farm waste	Likert (1–5)	Multiple regression, Path analysis

Green Distribution	Green transportation	Use of fuel-efficient or low-emission vehicles	Likert (1–5)	Regression, ANOVA
	Eco-efficient storage	Use of energy-saving cold storage or environmentally sound storage systems	Likert (1–5)	Descriptive, Multiple regression
	Green Route Planning	Use of digital tools or strategies to reduce delivery distances and emissions	Likert (1–5)	Path analysis, Regression
Sustainable Performance of Agricultural Value Chain Organizations	Economic Viability	Reduces poverty, brand image, cost reduction, ROI	Likert (1–5)	Dependent Variable – Regression Model
	Social Equity	Fair labor practices, community engagement, gender inclusion	Likert (1–5)	Dependent Variable – Regression/ANOVA
	Environmental Health	Reduction in pollution, soil conservation, biodiversity protection	Likert (1–5)	Dependent Variable – Regression

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methodology adopted to guide the study. It describes the research design, target population, sampling techniques, data collection instruments, and data analysis procedures. Ethical considerations relevant to the study are also discussed. The methodology section provides the roadmap for how data was collected, analyzed, and interpreted. These components collectively form the foundation upon which the study was conducted, ensuring the reliability, validity, and credibility of the findings.

3.2 Research Design

A research design is a structured plan that guides how a study is conducted. It determines the type of data required, how it was collected, and from which sources (Maranga, 2025). This study adopted a descriptive research design, which is appropriate for understanding existing conditions and relationships without altering variables. Descriptive designs are particularly suitable for capturing detailed information about a population at a specific point in time. It helps provide a snapshot of practices and outcomes within a natural setting without manipulating the study environment (Creswell & Creswell, 2023).

Descriptive design was chosen because it allows for an in-depth analysis of current practices while identifying patterns or trends in the data. It is time-efficient and cost-effective, especially when resources are limited and data are collected from multiple organizations at once. The design further facilitates objective assessment of associations among study variables, such as environmental conservation, social impact, and economic outcomes (Kumar *et al*., 2022).

3.3 Target Population

According to this study, target population is the complete group of individuals, objects, or events that a researcher is interested in studying (Babbie, 2021). There are 42 agricultural value chain organizations operating in Kisii County. The value chains include bananas, avocados, coffee, dairy products, and chicken based in Kisii County. Therefore, the target population was 84 respondents selected comprise one Value Chain Officer and Agribusiness Officer from each of the 42 organizations employees. Value Chain Officers are typically managing the flow of agricultural products from inputs to consumer markets, making them central to operational efficiency. Agribusiness Officers are responsible for aligning agricultural production with business, facilitating innovation, and promoting sustainable market integration (County Government of Kisii, 2023).

TABLE 3 Target Population

Agricultural Value Chain organizations	**Number of Agricultural Value Chain Organizations**	**Agricultural Value Chain Officers And Agribusiness Officers**	**Percentage (%)**
Bananas	6	12	14.3
Avocados	3	6	7.1
Coffee	10	20	23.8
Chicken	7	14	16.7
Dairy	16	32	38.1
Total	**42**	**84**	**100**

National Agricultural Chain Development Project (NAVCDP 2024) Kisii

3.4 Sample Frame

The sample frame for this study was sourced from the official registry of agricultural value chain organizations maintained by the Kisii County Department of Agricultural and Trade. This registry includes producers, processors, distributors, and retailers operating in sub-sectors such as bananas, avocados, coffee, and chicken. These sub-sectors were selected for their economic contribution and relevance to food security in the county.

The study employed a census method, targeting all active and registered firms within the 84 respondents. This approach is suitable due to the manageable number of organizations involved, allowing full population coverage. It enhances data accuracy, minimizes bias, and ensures the inclusion of all relevant firms. The census facilitated a thorough analysis of the effect of Green Supply Chain Management practices on sustainable performance, enabling the study to produce comprehensive and policy-relevant findings for Kisii County's agricultural sector.

3.5 Sampling and Sampling Procedures

This study adopted a census approach targeting all Value Chain Officers and Agribusiness Officers working within agricultural value chain organizations involved in the production and marketing of bananas, avocados, coffee, dairy, and chicken in Kisii County. The decision to use a census method is informed by the manageable size of the population and the need to ensure comprehensive coverage of all relevant respondents. Unlike sampling techniques that involve selecting a representative portion of the population, a census enables the inclusion of every unit of interest, thereby eliminating sampling error and enhancing the validity and completeness of the research findings.

The total population for this study consists of 84 respondents comprising of one Value Chain Officer and one Agribusiness Officer from each of the 42 agricultural value chain organizations. This number is considered both accessible and practical for complete enumeration, particularly within the geographic boundaries of Kisii County. Conducting a census under these conditions ensures that the data collected reflected the full diversity and complexity of green supply chain management practices across the selected agricultural subsectors.

The relevance of this approach is heightened by the varying characteristics and performance levels of the value chains under study. Each of the selected agricultural sectors including dairy, coffee, chicken, bananas, and avocados has distinct structural dynamics and sustainability challenges. By incorporating views from all qualified officers across these organizations, the research captured a rich spectrum of insights that a sample might overlook. This method supports the study's objective of developing a detailed and accurate profile of how green sourcing, reverse logistics, green distribution, and green production are practiced.

3.6 Instrumentation

This study utilized structured questionnaires as the primary tool for collecting quantitative data. The questionnaire was carefully developed to gather relevant information on the application of green supply chain management practices and their impact on sustainable performance. It was designed in alignment with the study's objectives and the conceptual framework, ensuring that each variable is adequately represented in the data collection process. The structured format promoted uniformity in responses, ease of administration, and consistency across different respondents.

The questionnaire was organized into sections. The opening section focused on capturing demographic and organizational background information. These characteristics are essential for contextualizing the responses and analyzing differences across organizations. Subsequent sections addressed specific green supply chain practices such as green sourcing, green distribution, reverse logistics, and green production. Each practice was assessed using statements rated on a five-point Likert scale, ranging from "strongly disagree" to "strongly agree."

The instrument included items aimed at measuring sustainable performance outcomes in three dimensions: environmental sustainability (waste reduction, energy use, pollution control), economic sustainability (cost efficiency, market access, profitability), and social sustainability (labor practices, community engagement, health and safety). The instrument was developed based on established constructs and adapted from prior empirical studies to enhance its validity and reliability (Mangan *et al.*, 2023).

3.7 Data Collection

Data was collected through self-administered questionnaires and face-to-face interviews with company managers and relevant staff across agricultural value chain organizations in Kisii County. Research assistants assisted in administering the questionnaires to ensure that questions are clearly understood and that responses are complete and accurate. Research assistants received training on the study's objectives, ethical considerations (including informed consent and confidentiality), as well as on how to facilitate the interview process without introducing bias. They were instructed on how to approach respondents, explain the purpose of the study, and secure permission before proceeding.

After the training, Research assistants visited the selected organizations at mutually agreed appointment times. They delivered the questionnaire, provided any necessary clarification, and collected the completed forms. In instances where respondents prefer more detailed engagement, enumerators conducted structured face-to-face interviews, following a standard interview guide that mirrored the questionnaire structure and Likert-scale format. To manage data quality, enumerators reviewed each completed questionnaire on-site to verify that all items have been addressed, prompting respondents to fill any gaps before departing.

3.8 Pilot Test

A pilot test was conducted on 10% of the target population of 84 to assess the validity and reliability of the instruments. A pilot test was conducted on 10 percent of the 84 respondents to assess the validity and reliability of the data collection instruments before the actual fieldwork begins. Given the census sample size of 84 respondents, the pilot test 10% of 84 target population which involved 8 participants from Kisii county. This is to those who were selected from agricultural value chain organizations similar to those in the target population but located in areas that were not included in the main study. This approach helped prevent contamination of the actual study sample.

The pilot test was used to evaluate the clarity, structure, and content of the questionnaire items, as well as to determine the time required to complete the instrument. Feedback from pilot respondents was used to identify any ambiguous or confusing questions and to make necessary modifications to improve the instrument's usability and relevance (Mugenda & Mugenda, 2020).

Results from the pilot test informed final adjustments to the research tools. Only after the instrument has been validated through this process were administered to the larger study population.

3.8.1 Validity of Research Instrument

The researcher ensured the validity of the research instrument; content validity, construct validity, and face validity assessments. Content validity was determined through expert evaluation. University lecturers with expertise in supply chain management and agricultural value chains, alongside practitioners from agricultural cooperatives, were engaged to review the questionnaire. Their input informed revisions aimed at enhancing item clarity and content coverage. The Content Validity Index (CVI) was applied, where each item was rated on a 5-point scale for relevance. Items scoring a CVI of 0.78 or higher was considered sufficiently valid and retained for the final tool (Nunnally & Bernstein, 2023).

Construct validity was assessed using exploratory factor analysis (EFA) following a pilot study. This statistical approach was used to evaluate the underlying factor structure and determine whether questionnaire items align logically with specific constructs such as green production, reverse logistics, green marketing, and waste management. Items demonstrating factor loadings of at least 0.5 were retained as valid indicators of the respective constructs (Hair *et al.*, 2022).

Face validity was addressed through pre-testing the instrument with selected respondents from the target population, namely value chain officers and agribusiness officers within agricultural value chain organizations operating in Kisii County. These individuals provided feedback regarding the clarity, relevance, and overall comprehensibility of the instrument. Their insights guided minor refinements to ensure the tool reflects the practical context and is readily

understandable. This multi-layered approach to validity helped ensure that the instrument accurately captures the constructs under study and is suitable (Taherdoost, 2021).

3.8.2 Reliability of Research Instrument

This is the consistency and stability of the measurements it produces over time. An instrument is considered reliable if it yields the same results under similar conditions whenever it is repeated. In this study, reliability shows the extent to which the instrument is free from random errors and provides dependable data for analysis (Creswell & Creswell, 2023).

The reliability of the research instrument was tested to determine the internal consistency of the questionnaire items. This was achieved through the computation of Cronbach's alpha coefficient, which is a widely accepted statistical measure for assessing the reliability of Likert-scale-based instruments. A reliability coefficient of 0.70 or higher was considered acceptable, as it indicates a satisfactory level of internal consistency among the items measuring the same construct (Tavakol & Dennick, 2022).

The reliability test was conducted using data obtained from which involved a representative sub-sample of the target population. Each section of the questionnaire related to green supply chain practices such as green sourcing, green distribution, green production and reverse logistics as well as sustainable performance indicators, were independently tested to determine whether the items within each category produce consistent results.

If the results show any section with a Cronbach's alpha value below the recommended threshold, the respective items were critically reviewed for ambiguity, redundancy, or poor alignment with the intended construct. Revisions were then made to improve clarity and consistency. This iterative process enhanced the instrument's reliability and ensure that it is

suitable for use in the main study. The reliability analysis of this questionnaire, Cronbach's alpha was calculated using the formula:

$$\alpha = [k / (k-1)] * [1 - \Sigma\sigma^2 i / \sigma^2 t]$$

where k is the number of items, $\sigma^2 i$ is the variance of each item, and $\sigma^2 t$ is the total variance of all items combined.

3.8.3 Data Analysis Technique

Data analysis refers to the systematic process of inspecting, cleaning, transforming, and modeling data to discover useful information, draw conclusions, and support decision making. It involves applying statistical or thematic techniques to interpret patterns, relationships, or trends in the collected data (Creswell & Creswell, 2018). The quantitative data collected from the field was coded, cleaned, and analyzed using both descriptive and inferential statistical techniques.

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS v 26) to ensure accuracy, consistency, and efficiency in processing the responses. Descriptive statistics were employed to summarize and describe the basic features of the data. These included frequencies, percentages, means, and standard deviations, which helped to present the distribution and central tendencies of the responses across different variables related to green supply chain management practices and sustainable performance indicators.

Inferential statistics were used to draw conclusions and make generalizations about the population based on the sample data. Specifically, regression analysis was conducted to test the nature and strength of the relationship between green supply chain management practices such as green sourcing, green distribution, reverse logistics, and green production on sustainable performance outcomes. Multiple linear regression was applied to determine how well these

practices predict environmental, economic, and social dimensions of sustainability among agricultural value chain organizations in Kisii County.

The results of the regression analysis were interpreted using standardized coefficients, significance levels (p-values), and the coefficient of determination (R^2) to assess the explanatory power of the independent variables. A 95 percent confidence level was used to test the statistical significance of the relationships. This combination of descriptive and inferential analysis enabled the researcher to identify patterns, assess relationships, and draw meaningful conclusions that address the study objectives.

The study applied diagnostic procedures or assumptions to verify the appropriateness of this model and ensure the reliability of the results between Green Sourcing, Green production, Reverse Logistics practice and Green distribution on sustainable performance.

Simple Linear regression model was ;

$Y=\beta_0 + \beta_1 X_1+\varepsilon$ - Green Sourcing i

$Y=\beta_0 + \beta_2 X_2+\varepsilon$- Green production..... ii

$Y=\beta_0 + \beta_3 X_3+\varepsilon$- reverse logistics..... iii

$Y=\beta_0 + \beta_4 X_4+\varepsilon$- green distribution iv

Multiple regression was $Y=\beta_0 + \beta_1 X_1 +\beta_2 X_2 +\beta_3 X_3 +\beta_4 X_4 +\varepsilon$

Where

Y= sustainable performance

β_0 -constant term,

β_1, β_2 $\beta_2\beta_3$ β_4 Regression Coefficients

X_1 Green Sourcing

X_2 Green production

X_3 Reverse logistics

X_4 Green distribution

Ɛ; Error term

3.9 Diagnostic Tests

Before conducting regression analysis, a series of diagnostic tests were performed to ensure that the assumptions underlying multiple linear regression are satisfied. These tests were necessary to verify the robustness, validity, and reliability of the model estimates.

3.9.1 Normality

The assumption of normality was tested to determine whether the residuals of the dependent variable are normally distributed. This was assessed using graphical methods such as histograms and normal probability plots, as well as statistical tests like the Shapiro-Wilk or Kolmogorov-Smirnov test. Meeting the normality assumption was important for valid hypothesis testing and confidence interval estimation (Gujarati & Porter, 2021).

3.9.2 Multicollinearity

Multicollinearity was tested to detect the presence of high intercorrelations among the independent variables. This was assessed using the Variance Inflation Factor (VIF) and tolerance values. A VIF value greater than 10 or a tolerance value below 0.1 indicated the presence of multicollinearity, prompting corrective actions such as removing or combining variables (Hair *et al*., 2020).

3.9.3 Homoscedasticity

Homoscedasticity was examined to ensure that the variance of residuals is constant across all levels of the independent variables. This was tested through scatterplots of standardized

residuals against predicted values. The presence of homoscedasticity supported the assumption that the error term has equal variance, which is crucial for unbiased estimators.

3.9.4 Heteroscedasticity

Heteroscedasticity refers to a condition in regression analysis where the variability of the error terms is not uniform across all levels of the independent variables. This violates one of the core assumptions of the classical linear regression model, which requires homogeneity of variance. When heteroscedasticity is present, it can lead to inefficient coefficient estimates and inaccurate standard errors, making statistical tests unreliable. In this research, the presence of heteroscedasticity was examined using the Breusch-Pagan test. This test involves taking the squared residuals from the main regression model and regressing them on the explanatory variables. The test statistic derived follows a chi-square distribution, with the degrees of freedom based on the number of independent variables included. A p-value below 0.05 signalled that heteroscedasticity existed. Should this issue arise, the study addressed it by applying robust standard errors to ensure that the results and conclusions drawn remain valid.

3.10 Ethical Considerations

The study adhered to established ethical standards throughout the research process to ensure the protection of participants' rights and the integrity of the research. Ethical approval was sought from the KCA University or ethics committee prior to data collection. This authority letter enabled apply for research permit from the National Commission for Science, Technology and Innovation (NACOSTI) and official authorization was obtained from the County Government to allow access to necessary data and respondents within the county. The research proposal and data collection instruments were submitted for review to confirm that the study design complies with ethical principles related to the research.

Informed consent were obtained from all participants before their involvement in the study. Each respondent received a clear explanation of the study's purpose, the procedures involved, the voluntary nature of their participation, and their right to withdraw at any point without penalty. A signed or verbally recorded consent agreement was secured depending on the preferred mode of participation.

Confidentiality and anonymity was guaranteed to all participants. No identifying information was collected or disclosed in the reporting of results. The data was coded and stored securely in password-protected digital files and locked physical storage where applicable. Participants were also assured that their responses were used solely for academic purposes and that no harm resulted from their involvement. Any concerns raised by participants regarding the study were addressed promptly and respectfully.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter provides an outline of the results of the study. The chapter specifically captures the response rate, the results obtained from pilot study comprising of both reliability and validity and the background information of respondents. The chapter further details the descriptive statistics results of the study as well as the diagnostic tests carried out in the study. This is followed by the inferential statistics comprising of both correlation and regression analysis. The study utilized Tables and figures to display the results of the study.

4.2 Response Rate

The study issued 84 questionnaires to Value Chain Officers and Agribusiness Officers from agricultural value chain organizations operating in Kisii County. 69 questionnaires were fully filled and returned for analysis. This accounted for a response rate of 82.1% and a non-response rate of 17.9%. The response rate was considered adequate for the study. As per Marshall and Rossman (2021), a response rate over 70% is suitable for analysis and making inferences. The significant response rate was largely attributed to the use of a drop and pick data collection method. Figure 2 outlines the results of the study.

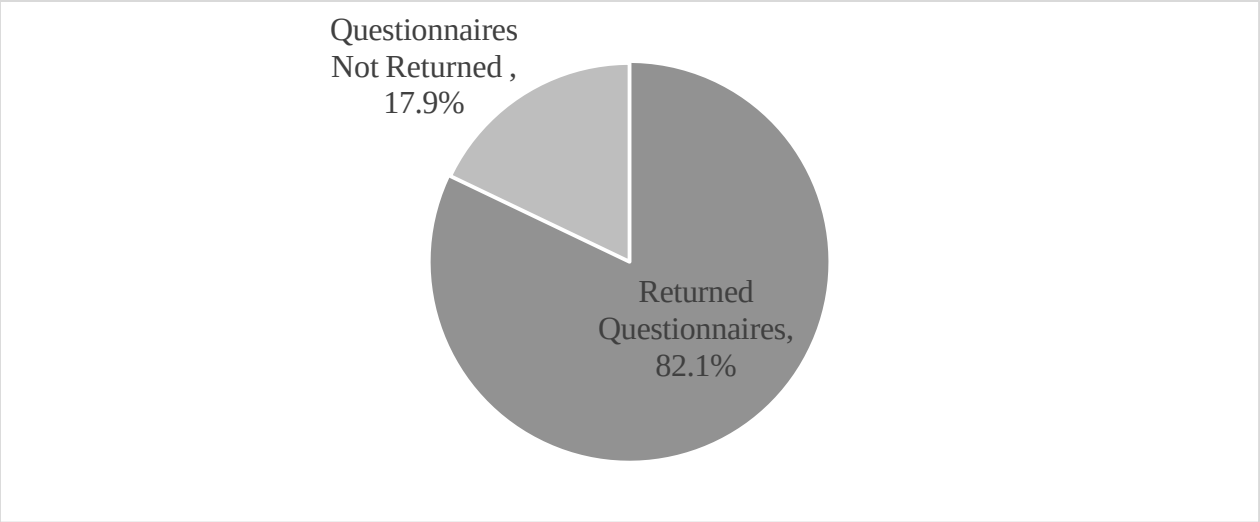

FIGURE 2 Response Rate

4.3 Background Information of Respondents

The background characteristics of the respondents involved in the study comprised of gender, age, education level, position in the organization, years of experience, type of agricultural value chain and size of the organization.

4.3.1 Gender

The results on the gender of the respondents presented in figure 3 shows that male respondents were 41(59.4%) while female respondents accounted for 28 (40.6%). The results shows that male were higher in numbers compared to females. However, there was considerate gender representation in the study implying that the agricultural value chains involved in the study considers gender in various positions.

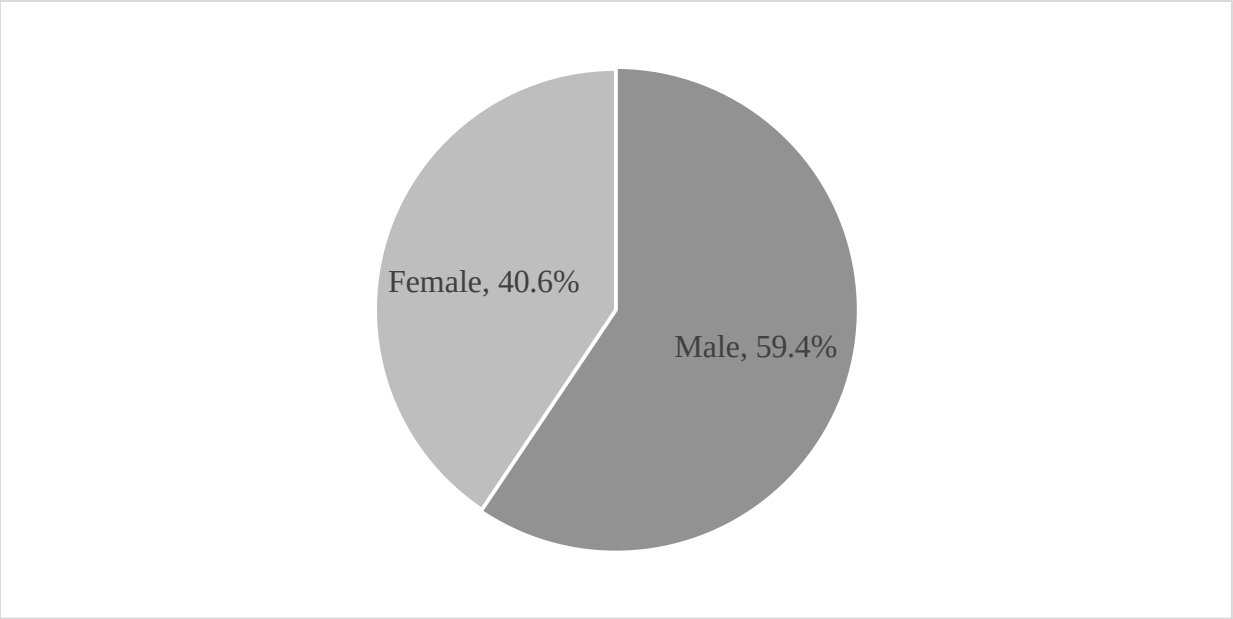

FIGURE 3 Gender

4.3.2 Age

The results on the ages of the respondents displayed in figure 4 shows that respondents with below 25 years were 4(5.8%), between 25 years and 34 years were 19(27.5%), and between 35years and 44 years were 20(29.0%). Those with between 45years and 54 years were 15(21.8%) while those with 55 years and above accounted for 11(15.9%). The results shows that majority of the respondents were more than 35 years old. The results reflect perspectives and experiences of a more mature and experienced workforce, which may enhance the quality of responses on green supply chain practices and sustainable performance.

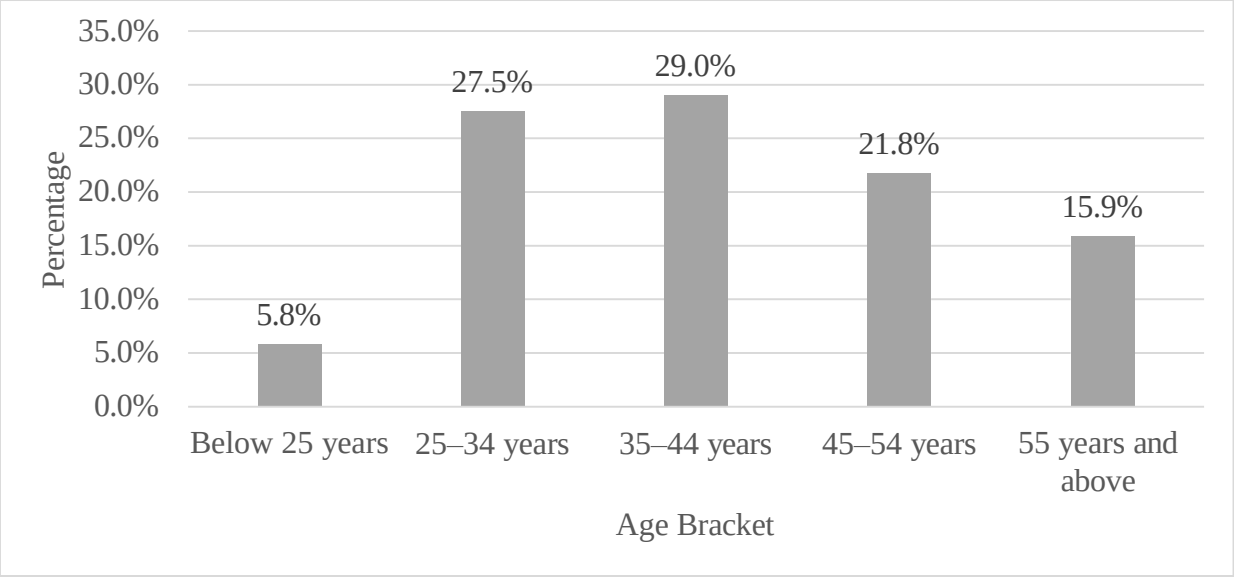

FIGURE 4 Age Bracket

4.3.3 Education Level

The results on respondents level of education presented in figure 5 shows that Diploma/Certificate holders were 21(30.4%), those with Bachelor's Degree were 30(43.5%) while Postgraduates were 18(26.1%). The results shows that majority of the respondents were graduates and postgraduates. However, all the respondents involved in the study were considered educated and in a position to understand the various aspects of green supply chain practices adopted by their respective firms and respond to the posed questions appropriately.

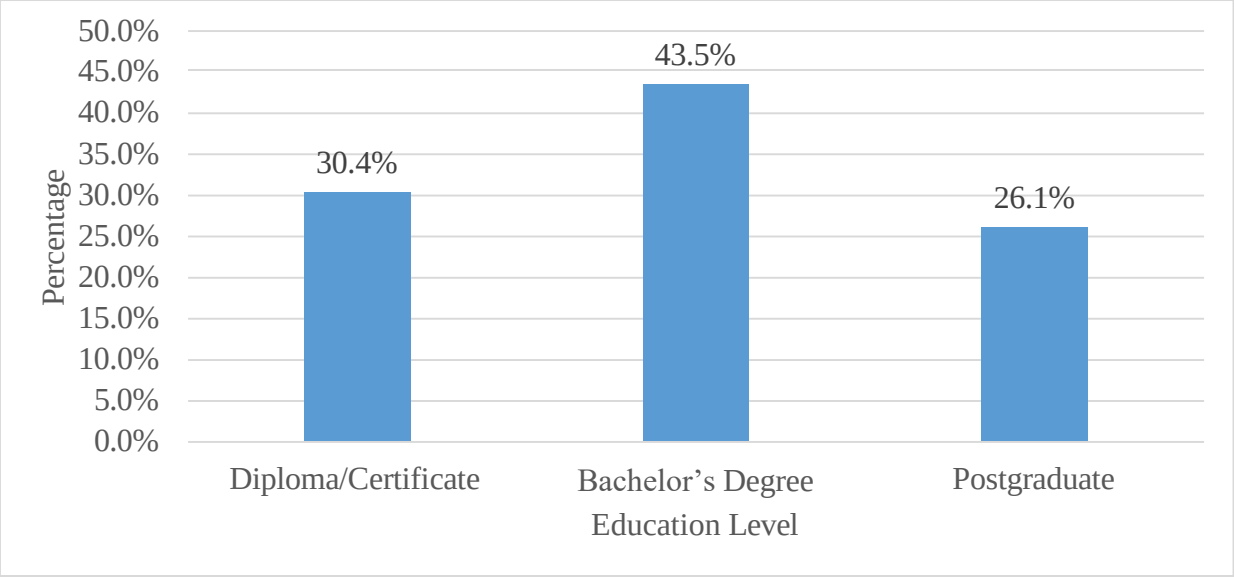

FIGURE 5 Education Level

4.3.4 Position in the Organization

The results on the position held by the respondents in their respective firms outlined in figure 6 shows that agricultural value chain officers were 32(46.4%) while agribusiness officers were 37(53.6%). The study shows significant representation of both agricultural value chain officers and agribusiness officers in the study. This was important as it ensured that the study received diversified responses from different respondents in different position which eliminated bias in the study.

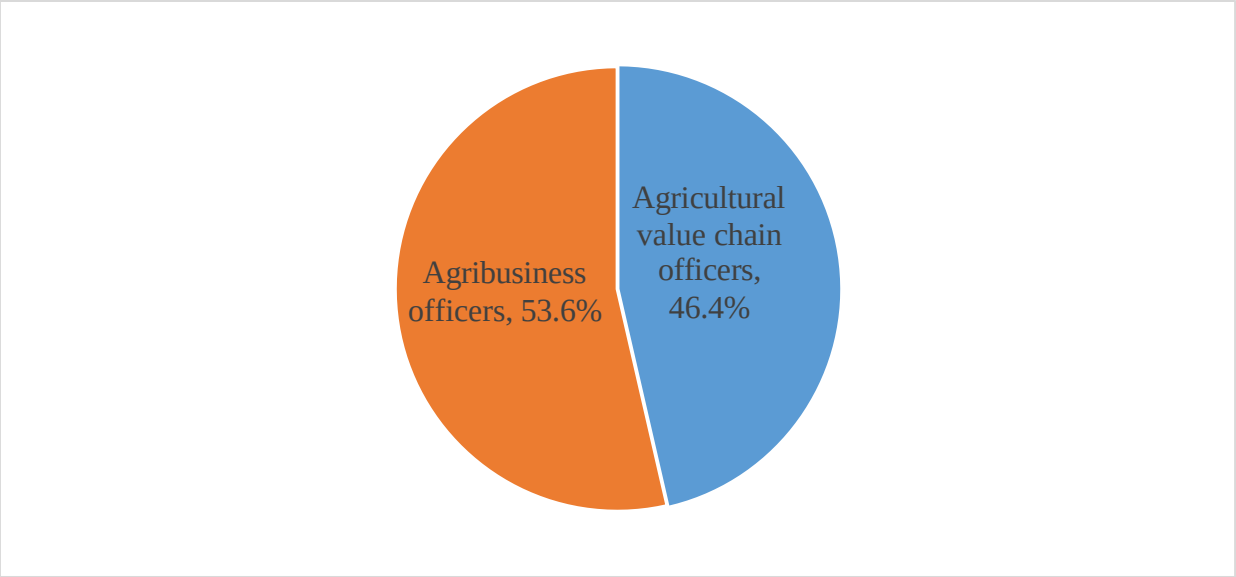

FIGURE 6 Position in the Organization

4.3.5 Years of Experience

The results on the respondents' years of experience presented in figure 7 shows that those with less than 1 year of experience were 12(17.4%), between 1year and 3 years were 16(23.2%), and between 4years and 6 years were 14(20.3%). Those with between 7years and 10 years were 21(30.4%) while those with more than 10 years were 6(8.7%). The results shows that majority of the respondents had more than three years of experience. This bear the implication that they had been with their respective firms for a longer period and had witnessed the various green supply chain practices adopted by the firms and their respective impact on sustainable performance. This enhance the quality of the responses they gave in the questionnaire.

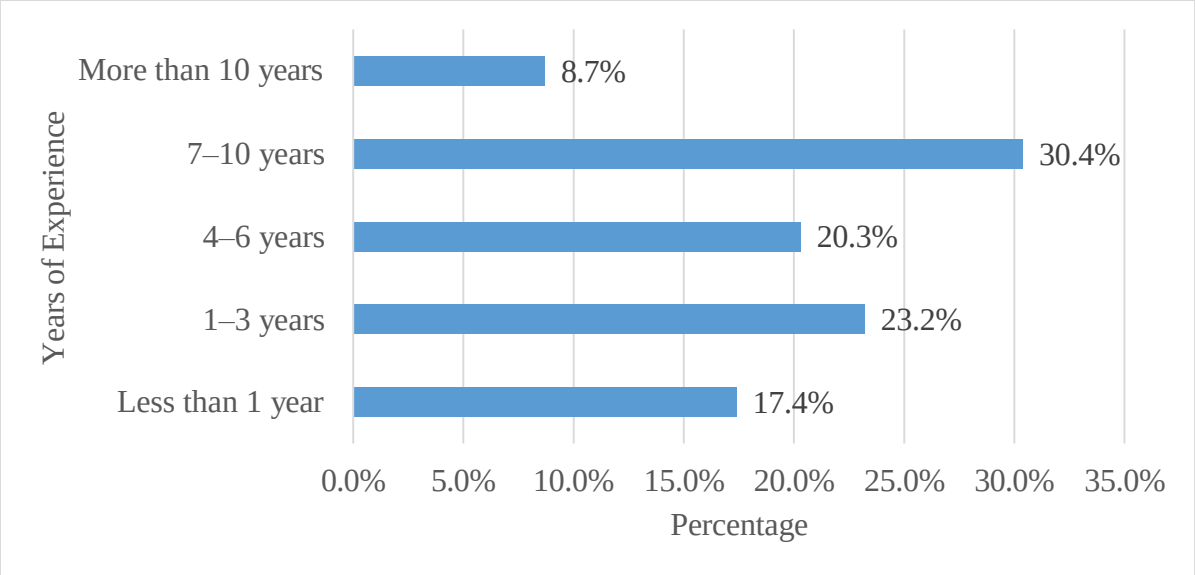

FIGURE 7 Years of Experience

4.3.6 Type of Agricultural Value Chain

The results on the type of agricultural value chain of the respondent presented in figure 8 shows that respondents from coffee value chain were 16(23.2%), those from livestock and dairy were 28(40.6%) while those dealing with avocado were 6(8.7%). Additionally, those dealing with bananas were 9(13.0%) while chicken dealers were 10(14.5%). The results shows that there was representations of the various agricultural value chain in the study. The diversity of the sectors ensured that the findings were more representative and applicable to a wide range of agricultural value chains rather than being limited to a single subsector.

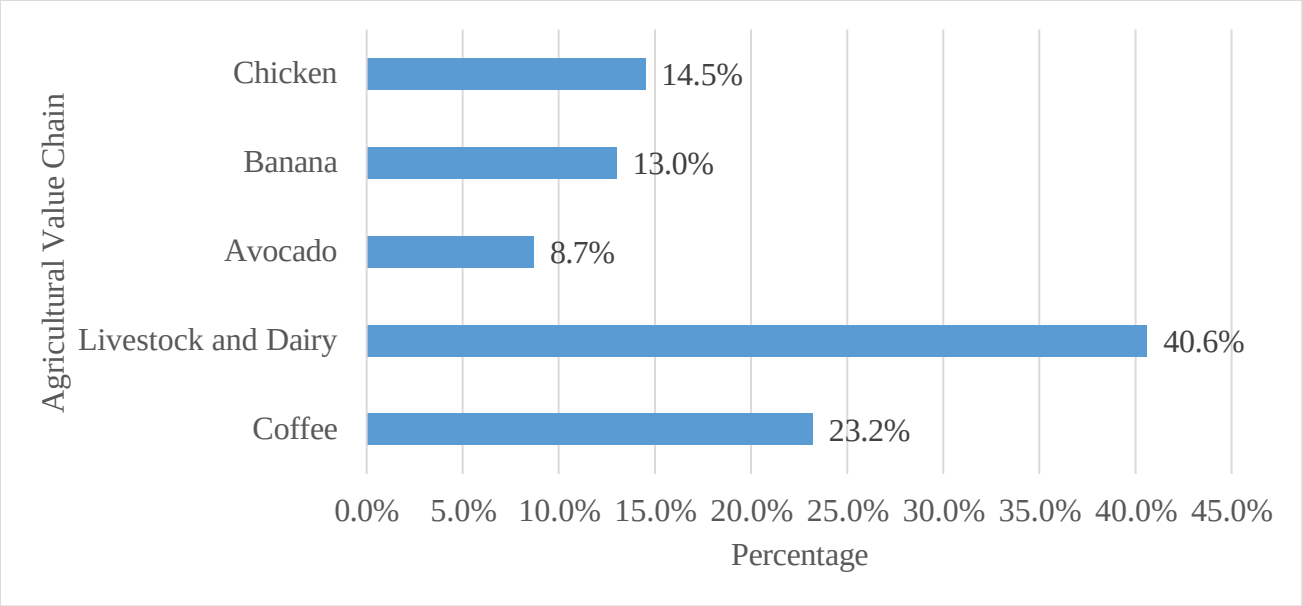

FIGURE 8 Agricultural Value Chain

4.3.7 Size of the Organization

The results on the size of the organization presented in figure 9 shows that respondents from micro(50-200 farmers) organizations were 10(14.5%), those from small (200-300 farmers) organizations were 15(21.7%) while those from medium (300-400 farmers) were 26(37.7%). Those from large (400+ farmers) were however 18(26.1%). The results of the study shows that majority of the respondents were from both medium and large-sized organizations.

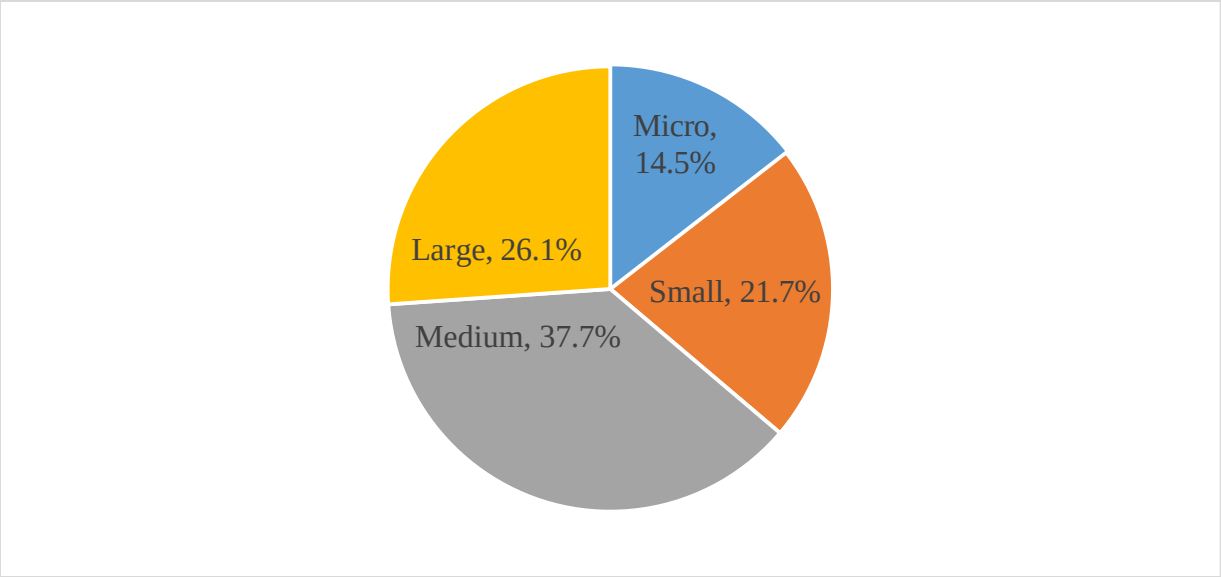

FIGURE 9 Size of the Organization

4.4 Pilot Study Results

A pilot study was conducted before collecting data for the main study. This was aimed at evaluating the clarity, structure, and content of the questionnaire items, as well as to determine the time required to complete the instrument. The test was conducted on 10% of the target population which entailed involving 8 participants from Kisii County. The participants were selected from agricultural value chain organizations similar to those in the target population but located in areas that were not included in the main study. The pilot assessed both validity and the reliability of the questionnaire.

4.4.1 Validity Test Results

The study assessed content, construct, and face validities. Content validity was assessed through Content Validity Index where each item was rated on a 5-point scale for relevance and the composite value assessed. Items scoring a CVI of 0.78 or higher were considered sufficiently valid and retained for the final tool as supported by Nunnally and Bernstein (2023). According to the results displayed in Table 4, the composite Content Validity Index for 6 items assessing green

sourcing, 6 items assessing green production, 6 items assessing reverse logistics, 6 items assessing green distribution practices and 6 items assessing sustainable performance was above 0.78. This implied that the items were valid.

TABLE 4 Composite Validity Index

Variable	Items	Composite CVI
Green Sourcing	6	0.938
Green Production	6	0.833
Reverse Logistics	6	0.917
Green Distribution Practices	6	0.917
Sustainable Performance	6	0.875

The study applied exploratory factor analysis (EFA) to assess the construct validity of the study. Items with factor loadings of at least 0.5 were retained as valid indicators of the respective constructs as per suggestions by Hair *et al*., (2022). The results of the study presented in Table 5 shows that all constructs assessing various aspects of the study had a factor loading value of above 0.5 implying they were valid. This implied that none of the items was removed in the study.

TABLE 5 Factor Loading Values

Green Sourcing	**Factor Loading Values**
Our company environment valuation considers all environmental certifications when selecting suppliers.	0.88
We evaluate suppliers based on their ability to meet sustainability standards.	0.83
Eco-friendly and recyclable products are prioritized in procurement.	0.9
We use Life Cycle Costing (LCC) to evaluate the long-term environmental impact of procured items.	0.92
We engage suppliers in sustainability audits and compliance checks.	0.79
Eco-friendly product selection of suppliers influences our purchasing decisions.	0.9
Green Production	**Factor Loading Values**
Our firm uses renewable or alternative energy sources in its operations.	0.9
Production processes are Eco-friendly using Raw Materials	0.89
Recycling is an integral part of our manufacturing and processing activities.	0.9

Our operations include pollution control technologies.	0.89
Employees are trained on environmentally friendly production practices.	0.82
Our company monitors and reports on the environmental impact of production activities.	0.91
Reverse Logistics	**Factor Loading Values**
Reuse of agricultural by-products has helped reduce our input costs	0.73
Our farm reuses residual fertilizers to minimize waste	0.83
Used packaging materials (sacks, crates) are collected systematically for recycling	0.78
Recycling agricultural inputs contributes to environmental sustainability in our operations	0.79
Eco-friendly disposal practices have improved environmental performance in our value chain	0.88
Our firm segregates organic and inorganic farm waste before disposal.	0.9
Green Distribution Practices	**Factor Loading Values**
Our company uses fuel-efficient or electric transporting for product delivery.	0.92
We implement route optimization software to reduce distribution distances.	0.93
Green packaging is used in our distribution processes.	0.91
Our distribution centers use energy-efficient storage systems.	0.9
Real-time storing and tracking helps reduce idle time and unnecessary transportation.	0.94
Efficient route planning concerns are considered when selecting logistics partners.	0.91
Sustainable Performance	**Factor Loading Values**
The company's operations consistently maximize profits	0.899
Cost savings from energy and resource efficiency are significant.	0.813
Efforts are made to minimize pollution during production and distribution.	0.894
Waste management practices are effectively implemented.	0.828
The company ensures fair treatment and compensation of all employees.	0.883
The company supports local communities and inclusive employment.	0.86

Face validity was addressed through pre-testing the instrument with selected respondents from the target population. The researcher applied the feedback from the respondents to enhance

and refine the questionaires before proceeding to the field to collect data for the main study. This approach ensured that the instrument accurately captured the constructs under study and was suitable (Taherdoost, 2021).

4.4.2 Reliability Test Results

The study assessed the reliability of the questionnaire through computing of Cronbach's alpha coefficient. According to Tavakol and Dennick (2022), the approach is a widely accepted statistical measure for assessing the reliability of Likert-scale-based instruments. In this study, a reliability coefficient of 0.70 or higher was considered acceptable, as it indicated a satisfactory level of internal consistency among the items measuring the same construct. The results outlined in Table 6 shows that 6 items assessing green sourcing, 6 items assessing green production, 6 items assessing reverse logistics, 6 items assessing green distribution practices and 6 items assessing sustainable performance had a Cronbach alpha value of above 0.7. This implied that the items assessing each aspect of the variable were reliable and thus appropriate for the study.

TABLE 6 Reliability Test Results

Variable	Items	Cronbach Alpha Value	Observation
Green Sourcing	6	0.816	Reliable
Green Production	6	0.952	Reliable
Reverse Logistics	6	0.774	Reliable
Green Distribution Practices	6	0.856	Reliable
Sustainable Performance	6	0.870	Reliable

4.5 Descriptive Statistics

The study assessed the nature of responses acquired from the issued questionnaires through descriptive statistics. The following sections presents the descriptive results of each variable.

4.5.1 Green Sourcing

The first objective of the study aimed at assessing the effect of green sourcing on sustainable performance of agricultural value chain organizations in Kisii County. Respondents were presented with various statements on green sourcing and were requested to rate their level of agreement with the statements using a scale of 1-5 where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The results contained in Table 7 shows that respondents agreed with the statement that eco-friendly and recyclable products were prioritized in procurement (mean=3.507, std.dev=1.712). The study further established a neutral response with the statements that the company environment valuation considers all environmental certifications when selecting suppliers (mean=2.768, std.dev=1.699) and that they evaluated suppliers based on their ability to meet sustainability standards (mean=2.594, std.dev=1.547).

Respondents were in disagreement with the statements that the firms used Life Cycle Costing (LCC) to evaluate the long-term environmental impact of procured items (mean=2.435, std.dev=1.548), that they engaged suppliers in sustainability audits and compliance checks (mean=2.406, std.dev=1.375) and that eco-friendly product selection of suppliers influenced the firm's purchasing decisions (mean=2.464, std.dev=1.290). On overall, respondents had a neutral response with the statements on green sourcing as shown by an overall score of 2.696 and standard deviation of 1.528. According to Sharma and Gupta (2023), green sourcing reduced operational waste and improved energy efficiency, enhancing sustainability outcomes However, Osei and Boateng (2022) argued that in developing economies, the adoption of green sourcing often leads to higher procurement costs and supply disruptions, which may discourage firms from fully implementing such practices. This suggests that while green sourcing can improve environmental

performance, its economic feasibility remains a challenge for many agricultural value chain organizations in resource-constrained contexts.

TABLE 7 Descriptive Statistics on Green Sourcing

Green Sourcing	Mean	Std.Dev
Our company environment valuation considers all environmental certifications when selecting suppliers.	2.768	1.699
We evaluate suppliers based on their ability to meet sustainability standards.	2.594	1.547
Eco-friendly and recyclable products are prioritized in procurement.	3.507	1.712
We use Life Cycle Costing (LCC) to evaluate the long-term environmental impact of procured items.	2.435	1.548
We engage suppliers in sustainability audits and compliance checks.	2.406	1.375
Eco-friendly product selection of suppliers influences our purchasing decisions.	2.464	1.290
Overall Score	**2.696**	**1.528**

4.5.2 Green Production

The second objective of the study aimed at assessing the effect of green production on sustainable performance of agricultural value chain organizations in Kisii County. Respondents were presented with various statements on green production and were requested to rate their level of agreement with the statements using a scale of 1-5 where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The results contained in Table 8 shows that respondents agreed with the statements that recycling was an integral part of the manufacturing and processing activities (mean=3.522, std.dev=1.540), that the operations include pollution control technologies (mean=3.536, std.dev=1.623) and that the company monitored and reported the environmental impact of production activities (mean=3.565 and std.dev=1.398.

Respondents however neither agreed nor disagreed with the statements that their firm used renewable or alternative energy sources in its operations (mean=3.464, std.dev=1.614), and that production processes were Eco-friendly using Raw Materials (mean=3.464, std.dev=1.614).

Additionally, there was a neutral response amongst respondents with the statements that employees were trained on environmentally friendly production practices (mean=3.406, std.dev=1.518). The overall score on the statements on green production was 3.493 with a respective standard deviation of 1.551 implying that respondents had a neutral stance with the statements. The results were in tandem with findings from Chen and Wu (2021) who established that green production reduced costs and improved compliance with environmental standards. Zhu and Sarkis (2016) however who argued that the implementation of green production practices can initially reduce short-term profitability, and create resistance among firms due to the high capital investment required for cleaner technologies.

TABLE 8 Descriptive Statistics on Green Production

Green Production	**Mean**	**Std.Dev**
Our firm uses renewable or alternative energy sources in its operations.	3.464	1.614
Production processes are Eco-friendly using Raw Materials	3.464	1.614
Recycling is an integral part of our manufacturing and processing activities.	3.522	1.540
Our operations include pollution control technologies.	3.536	1.623
Employees are trained on environmentally friendly production practices.	3.406	1.518
Our company monitors and reports on the environmental impact of production activities.	3.565	1.398
Overall Score	**3.493**	**1.551**

4.5.3 Reverse Logistics

The third objective of the study aimed at assessing the effect of reverse logistics on sustainable performance of agricultural value chain organizations in Kisii County. Respondents were presented with various statements on reverse logistics and were requested to rate their level of agreement with the statements using a scale of 1-5 where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The results contained in Table 9 shows that

respondents agreed with the statements that reuse of agricultural by-products had helped reduce their input costs (mean=3.580, std.dev=1.547), that recycling agricultural inputs contributed to environmental sustainability in their operations (mean=3.522, std.dev=1.650) and that their firm segregates organic and inorganic farm waste before disposal (mean=3.551, std.dev=1.481).

Respondents were however neutral with the statements that their farm reuses residual fertilizers to minimize waste (mean=3.362, std.dev=1.671), that used packaging materials were collected systematically for recycling (mean=3.406, std.dev=1.630) and that eco-friendly disposal practices had improved environmental performance in the value chain (mean=3.362, std.dev=1.645). On overall, respondents showed a neutral response with the statements on reverse logistics as shown by an overall score of 3.464 and a standard deviation of 1.604. The results are supported by findings from Owino and Wafula (2022) who established that firms applying structured reverse logistics reduced waste disposal costs and improved resource use. However Mwangi and Kiarie (2021) revealed that reverse logistics practices can sometimes lead to logistical inefficiencies, especially for small and medium-sized agricultural firms lacking proper collection infrastructure and recycling technology.

TABLE 9 Descriptive Statistics on Reverse Logistics

Reverse Logistics	**Mean**	**Std.Dev**
Reuse of agricultural by-products has helped reduce our input costs	3.580	1.547
Our farm reuses residual fertilizers to minimize waste	3.362	1.671
Used packaging materials (sacks, crates) are collected systematically for recycling	3.406	1.630
Recycling agricultural inputs contributes to environmental sustainability in our operations	3.522	1.650
Eco-friendly disposal practices have improved environmental performance in our value chain	3.362	1.645
Our firm segregates organic and inorganic farm waste before disposal.	3.551	1.481
Overall Score	**3.464**	**1.604**

4.5.4 Green Distribution Practices

The fourth objective of the study aimed at assessing the effect of green distribution practices on sustainable performance of agricultural value chain organizations in Kisii County. Respondents were presented with various statements on green distribution practices and were requested to rate their level of agreement with the statements using a scale of 1-5 where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The results contained in Table 10 shows that respondents were neutral with the statement that their company uses fuel-efficient or electric transporting for product delivery (mean=2.536, std.dev=1.587). Respondents were further in disagreement with the statements that they implemented route optimization software to reduce distribution distances (mean=2.478, std.dev=1.614), that green packaging was used in the distribution processes (mean=2.478, std.dev=1.614) and that their distribution centers used energy-efficient storage systems (mean=2.420, std.dev=1.649).

Remarkably, the respondents disagreed with the statements that real-time storing and tracking helped reduce idle time and unnecessary transportation (mean=2.377, std.dev=1.544) and that efficient route planning concerns were considered when selecting logistics partners (mean =2.493, std.dev=1.501). On overall, respondents disagreed with the statements on green distribution practices as shown by an overall score of 2.464 with a respective standard deviation of 1.585. According to Nyagadza *et al*., (2022), the adoption of green distribution practices significantly enhances supply chain reliability and ensured the maintenance of product quality from the point of production to the end consumer. However, Olayeni and Adeleke (2021) revealed that in some developing economies, the implementation of green distribution practices may not immediately translate into improved performance due to lack of supportive infrastructure, and

limited technological capacity, which often discourage firms from adopting such initiatives despite their long-term sustainability benefits.

TABLE 10 Descriptive Statistics on Green Distribution Practices

Green Distribution Practices	Mean	Std.Dev
Our company uses fuel-efficient or electric transporting for product delivery.	2.536	1.587
We implement route optimization software to reduce distribution distances.	2.478	1.614
Green packaging is used in our distribution processes.	2.478	1.614
Our distribution centers use energy-efficient storage systems.	2.420	1.649
Real-time storing and tracking helps reduce idle time and unnecessary transportation.	2.377	1.544
Efficient route planning concerns are considered when selecting logistics partners.	2.493	1.501
Overall Score	**2.464**	**1.585**

4.5.4 Sustainable Performance of Agricultural Value Chain Organizations

Respondents were presented with various statements on sustainable performance and were requested to rate their level of agreement with the statements using a scale of 1-5 where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The results contained in Table 11 shows that respondents agreed with the statements that cost savings from energy and resource efficiency were significant (mean=3.522, std.dev=0.994), that efforts were made to minimize pollution during production and distribution (mean=3.551, std.dev=0.948) and that waste management practices were effectively implemented (mean=3.565, std.dev=1.007).

Additionally, respondents were in agreement with the statements that the company ensured fair treatment and compensation of all employees (mean=3.580, std.dev=0.930) as well as the fact that the company supported local communities and inclusive employment (mean=3.551, std.dev=0.718). However, there was a neutral stance on the statement that the company's operations consistently maximized profits (mean=3.275, std.dev=1.069). On overall, respondents

agreed with the statements on sustainable performance of agricultural value chain organizations as shown by an overall Score of 3.507 and a respective standard deviation of 0.944. The results concurs with Gomez and Rodriguez (2023) who noted that sustainable performance in agricultural value chains can be achieved through adopting eco-friendly farming practices, reducing greenhouse gas emissions, and implementing water conservation technologies. However, these findings contrast with those of Agyemang et al. (2022), who argued that while green practices enhance environmental sustainability, they often impose high operational complexities that may initially reduce financial performance.

TABLE 11 Descriptive Statistics on Sustainable Performance

Sustainable Performance	Mean	Std.Dev
The company's operations consistently maximize profits	3.275	1.069
Cost savings from energy and resource efficiency are significant.	3.522	0.994
Efforts are made to minimize pollution during production and distribution.	3.551	0.948
Waste management practices are effectively implemented.	3.565	1.007
The company ensures fair treatment and compensation of all employees.	3.580	0.930
The company supports local communities and inclusive employment.	3.551	0.718
Overall Score	**3.507**	**0.944**

4.6 Diagnostic Tests

The study conducted diagnostic tests prior carrying out the regression analysis to ensure that the assumptions of the regression were not violated. The diagnostic tests incorporated in the study comprised of normality, multicollinearity, homoscedasticity and heteroscedasticity.

4.7.1 Normality Test Result

The study assessed the normality aiming at establishing that whether the residuals of the dependent variable are normally distributed. The Shapiro-Wilk /Kolmogorov-Smirnov test was carried out and results presented in Table 12. According to the results, the dependent variable had

insignificant Shapiro Wilk values and Kolmogorov Smirnov values greater than 0.05 implying that the null hypothesis is not rejected hence the variables are normally distributed. Since the data set was normally distributed, it was hence suitable to conduct an ordinary least square regression analysis since there were no violations of the assumptions of classical linear regression.

TABLE 12 Kolmogorov-Smirnov test of Normality

	Kolmogorov-Sminorv			Shapiro-Wilk		
	Statistic	**Df**	**Sig.**	**Statistic**	**df**	**Sig.**
Sustainable Performance	.119	68	.093*	.398	68	.064

*. This is a lower bound of the true significance.
. Lilliefors Significance Correction

4.7.2 Multicollinearity

The study assessed the levels of multicollinearity aiming at establishing whether there existed a high degree of intercorrelations among the independent variables. The study utilized Variance Inflation Factor (VIF) and tolerance values. The adopted rule of thumb for the study was that a VIF value greater than 10 or a tolerance value below 0.1 indicated the presence of multicollinearity as supported by Hair *et al*., (2020). The results presented in Table 13 shows that the independent variables had VIF values of less than 10 and tolerance values of above 0.1. This implied that there was no multicollinearity problem.

TABLE 13 Multicollinearity Results

	Collinearity Statistics	
	Tolerance	**VIF**
Green Sourcing	0.966	1.05
Green Production	0.890	1.06
Reverse Logistics	0.868	1.05
Green Distribution Practices	0.839	1.09

4.7.3 Homoscedasticity

The study assessed homoscedasticity through scatterplots of standardized residuals against predicted values. The results revealed that the residuals for green sourcing, green production, reverse logistics and green distribution practices were randomly dispersed around the horizontal axis. This indicated that the variance of the residuals was constant across all levels of the predicted values. Therefore, the assumption of homoscedasticity was met, confirming that the regression model did not suffer from heteroscedasticity and that the results obtained were reliable.

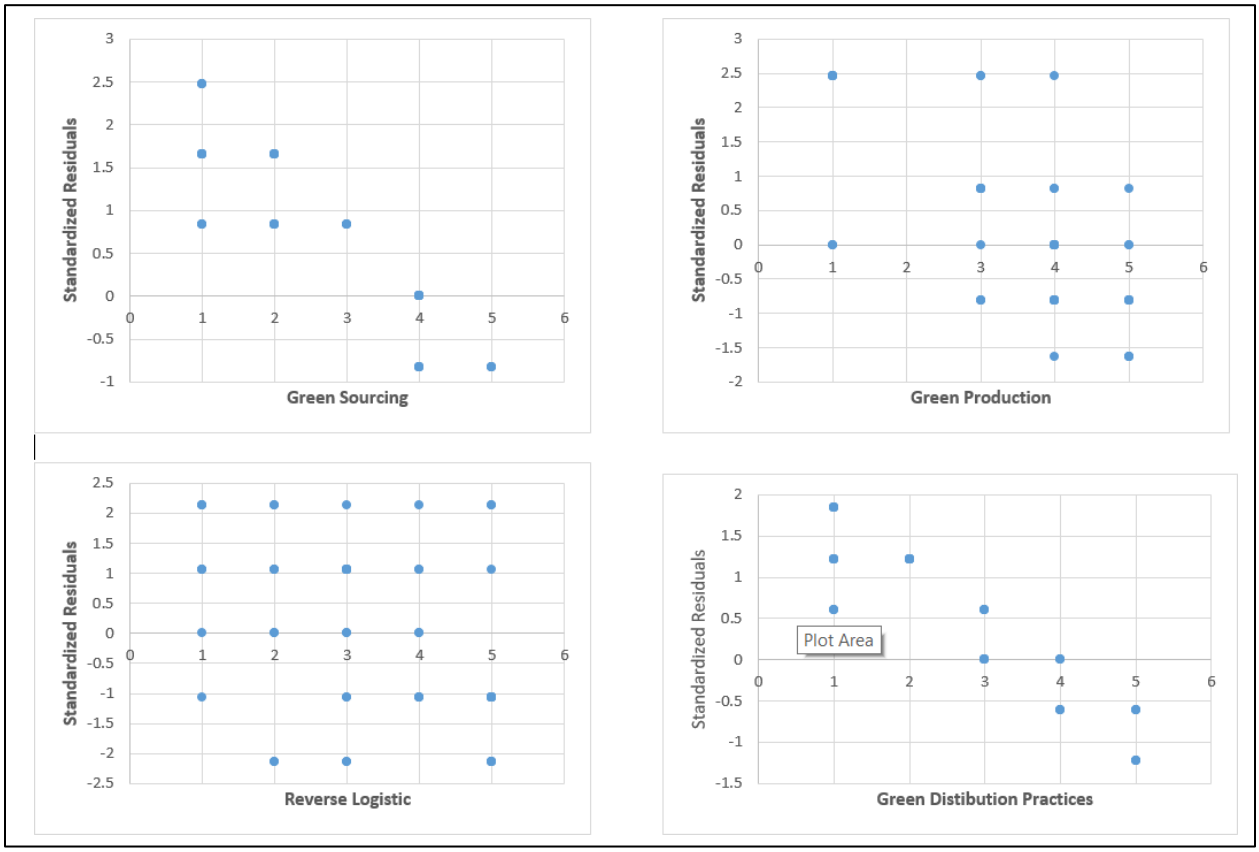

FIGURE 10 Homoscedasticity

4.7.4 Heteroscedasticity

The study assessed the presence of heteroscedasticity using the Breusch-Pagan test. A p-value below 0.05 signaled that heteroscedasticity exists. According to the results presented in Table 14, the p-value was 0.101 which was greater than 0.05. This implied existence of a constant variance of residuals implying absence of heteroscedasticity.

TABLE 14 Breusch-Pagan Test of Homoscedasticity

Breusch-Pagan / Cook-Weisberg test for Homoscedasticity
Ho: Constant variance
chi2(3) = 0.213
Prob > chi2 = 0.101

4.7 Correlation Analysis

The study sought to establish the extent to which independent variables correlated with the dependent variable. This was achieved through a correlation analysis as presented in Table 15. According to the results, there exists a positive and significant correlation between green sourcing and sustainable performance of agricultural value chain organizations in Kisii County. This is shown by a correlation coefficient value of 0.454 and a significant value of 0.000. The results implies that enhancing aspects of green sourcing in the operations of the agricultural value chain firms leads to enhanced levels of sustainable performance of the firms. The results affirms the findings from Sharma and Gupta (2023) who established that green sourcing reduces operational waste and improves energy efficiency, thus enhancing sustainability outcomes. Li and Zhang (2022) however argued that the adoption of green sourcing can initially increase procurement costs

and reduce short-term profitability, particularly in developing economies where green suppliers are limited.

The results additionally shows that there exists a positive and significant correlation between green production and sustainable performance of agricultural value chain organizations in Kisii County. This is shown by a correlation coefficient value of 0.397 and a significant value of 0.001. The results implies that enhancing aspects of green production in the operations of the agricultural value chain firms leads to enhanced levels of sustainable performance of the firms. The results are in tandem with findings from Asamoah *et al*. (2024) who established that green production improved brand image, customer satisfaction, and environmental performance. In contrast, Nguyen and Bui (2021) contended that green production processes often require expensive technological adjustments, staff retraining, and equipment upgrades that may not be economically sustainable for small agricultural enterprises.

The results consequently revealed that there exists a positive and significant correlation between reverse logistics and sustainable performance of agricultural value chain organizations in Kisii County. This is shown by a correlation coefficient value of 0.361 and a significant value of 0.002. The results implies that enhancing aspects of reverse logistics in the operations of the agricultural value chain firms leads to enhanced levels of sustainable performance of the firms. The results resonates with findings from Ahmed et al. (2024) who established existence of a strong correlation between reverse logistics and sustainability outcomes such as reduced carbon emissions, cost savings, and improved product lifecycle management. Nonetheless, Chowdhury and Rahman (2022) found contrasting evidence suggesting that reverse logistics systems can create operational inefficiencies in agricultural value chains, especially where there is lack of adequate infrastructure for waste collection, storage, and recycling.

The results also established that there exists a positive but significant correlation between green distribution practices and sustainable performance of agricultural value chain organizations in Kisii County. This is shown by a correlation coefficient value of 0.098 and an insignificant value of 0.418. The results implies that enhancing aspects of green distribution practices in the operations of the agricultural value chain firms leads to enhanced levels of sustainable performance of the firms though to insignificant levels. The results are consistent with Akinyemi *et al*., (2023) who noted that though green distribution practices significantly enhances supply chain reliability and ensured the maintenance of product quality, critical limitations exists. The limitations noted comprised of underdeveloped transport infrastructure, inconsistent access to stable electricity, and insufficiently established cold chain systems. Conversely, Osei and Boateng (2023) reported that even in resource-constrained environments, green distribution initiatives such as route optimization, eco-packaging, and the use of renewable energy for transport can substantially improve environmental and economic performance.

TABLE 15 Correlation Results

		Green Sourcing	**Green Production**	**Reverse Logistics**	**Green Distribution Practices**	**Sustainable Performance**
Green Sourcing	Pearson Correlation	1				
	Sig. (2-tailed)					
Green Production	Pearson Correlation	-.241	1			
	Sig. (2-tailed)	.046				
Reverse Logistics	Pearson Correlation	.107	.0178	1		
	Sig. (2-tailed)	.382	.883			
Green Distribution Practices	Pearson Correlation	.006	-.408	-.263	1	
	Sig. (2-tailed)	.961	.000	.030		
Sustainable Performance	Pearson Correlation	.454	.397	.361	.098	1
	Sig. (2-tailed)	.000	.001	.002	.418	

N	69	69	69	69	69

4.8 Regression Analysis

The study conducted a regression analysis aiming at assessing the nature and strength of the relationship between green supply chain management practices (green sourcing, green distribution, reverse logistics, and green production) and sustainable performance outcomes. A 95 percent confidence level was used to test the statistical significance of the relationships. The output of the regression analysis comprised of Model Summary, ANOVA and Regression Coefficients.

4.8.1 Model Summary

The purpose of the model summary in the study was gauge the degree of relationship between the combined independent variables (green sourcing, green distribution, reverse logistics, and green production) and the dependent variable (sustainable performance). The results displayed in Table 16 shows that the R-Value was 0.870 implying existence of a strong relationship between independent and dependent variables. Additionally, the coefficient of determination shown by R-square value was 0.757 implying that 75.7% of sustainable performance of agricultural value chain firm in Kisii County can be attributed to green sourcing, green distribution, reverse logistics, and green production.

TABLE 16 Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.870[a]	.757	.742	.3095

a. Predictors: (Constant), Green Sourcing, Green Production, Reverse Logistics, and Green Distribution Practices

4.8.2 Analysis of Variance (ANOVA)

The main purpose of the ANOVA in the study was to assess the statistical significant of the model assessing the relationship between the independent and the dependent variables. The assessment was conducted through comparing the value of critical from F-statistics Table with the value of F-calculated from the ANOVA results. From the F-statistics Table at 0.05 and (4,64), the F-critical value was 2.53 while the F-Calculated value was 49.895. The F-calculated value exceeds the F-Critical value. This implies that the model linking the dependent variable of the study with the independent variables was statistically significant. Table 17 outlines the ANOVA results.

TABLE 17 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	19.116	4	4.779	49.895	.000[b]
	Residual	6.130	64	.096		
	Total	25.246	68			

a. Dependent Variable: Sustainable Performance
b. Predictors: (Constant), Green Sourcing, Green Production, Reverse Logistics, and Green Distribution Practices

4.8.3 Regression Coefficients

The results on the regression coefficients of the study outlined in Table 18 shows that green sourcing positively and significantly affects sustainable performance of agricultural value firms in Kisii County. This was shown by a beta value of 0.261 and significant value of 0.000<0.05. The results bear implications that increasing aspects of green sourcing with one unit results to an increase of 0.261 units in the levels of sustainable performance of the agricultural value chain firms. The results resonates with Santos and Costa (2021) who showed that firms applying green sourcing standards achieved higher environmental compliance and improved market access. However, Osei and Boateng (2022) argued that in developing economies, the adoption of green

sourcing often leads to higher procurement costs and supply disruptions, which may discourage firms from fully implementing such practices.

The results additionally established that green production positively and significantly affects sustainable performance of agricultural value firms in Kisii County. This was shown by a beta value of 0.339 and significant value of 0.000<0.05. The results bear implications that increasing aspects of green production with one unit results to an increase of 0.339 units in the levels of sustainable performance of the agricultural value chain firms. The results concurs with Mwangi and Otieno (2023) who revealed that green production, especially the use of energy-efficient machines and clean energy, led to reduced operational costs and higher compliance with regulatory requirements. Zhu and Sarkis (2016) however who argued that the implementation of green production practices can initially reduce short-term profitability, and create resistance among firms due to the high capital investment required for cleaner technologies.

The results further established that reverse logistics positively and significantly affects sustainable performance of agricultural value firms in Kisii County. This was shown by a beta value of 0.183 and significant value of 0.000<0.05. The results bear implications that increasing aspects of reverse logistics with one unit results to an increase of 0.183 units in the levels of sustainable performance of the agricultural value chain firms. The results tallies with Owino and Wafula (2022) findings which established that firms applying structured reverse logistics reduced waste disposal costs and improved resource use. However Mwangi and Kiarie (2021) revealed that reverse logistics practices can sometimes lead to logistical inefficiencies, especially for small and medium-sized agricultural firms lacking proper collection infrastructure and recycling technology.

The results also revealed that green distribution practices positively and significantly affects sustainable performance of agricultural value firms in Kisii County. This was shown by a

beta value of 0.218 and significant value of 0.000<0.05. The results bear implications that increasing aspects of green distribution practices with one unit results to an increase of 0.218 units in the levels of sustainable performance of the agricultural value chain firms. The findings corresponds with those of Mwanzia and Mburu (2024) who established that green distribution reduced operational costs, improved brand loyalty, and boosted profitability. However, contrary findings by Kilonzo and Njoroge (2023) revealed that the adoption of green distribution practices can initially increase logistical costs and complexity, particularly for small and medium-sized agricultural firms that lack economies of scale and advanced infrastructure, thereby constraining short-term performance gains.

TABLE 18 Model Coefficients

	Unstandardized Coefficients		**Standardized Coefficients**		
Predictors	**B**	**Std. Error**	**Beta**	**T**	**sig.**
(Constant)	.450	.228		1.975	.053
Green Sourcing	.261	.029	1.308	9.113	.000
Green Production	.339	.032	1.599	10.497	.000
Reverse Logistics	.183	.028	.952	6.484	.000
Green Distribution Practices	.218	.030	1.168	7.165	.000

The model of the study after fitting the regression results becomes:

Sustainable Performance = 0.450 + 0.339 (Green Production) + 0.261 (Green Sourcing) + 0.218 (Green Distribution Practices) + 0.183 (Reverse Logistics)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter outlines the summary of the findings of the study. The chapter summarizes the findings per research variable and provides the conclusions derived from the findings. This is followed by an outline of the recommendations of the study as well as areas of further studies.

5.2 Summary

The central focus of the study was to examine the effect of green supply chain management practices on sustainable performance of agricultural value chain organizations in Kisii County, Kenya. The green supply chain management practices focused in the study were green sourcing, green production, reverse logistics, and green distribution practices. The research design adopted in the study was descriptive with target population comprising of agricultural value chain organizations in Kisii County. Targeted respondents for the study comprised of agricultural value chain officers and agribusiness officers. Questionaires formed the main data collection tool for the study and the data acquired was analyzed quantitatively through both descriptive and inferential statistics. The following subsections outlines the summary results per objective.

5.2.1 Green Sourcing and Sustainable Performance

The study assessed the effect of green sourcing on sustainable performance of agricultural value chain organizations in Kisii County. Descriptive findings revealed that although firms showed some effort in prioritizing eco-friendly and recyclable products in procurement, there was limited emphasis on key practices such as supplier sustainability evaluations, life cycle costing, and sustainability audits. Respondents demonstrated a neutral stance on the adoption of green

sourcing practices. This suggested that while the concept is recognized, its implementation remains at an early or inconsistent stage within the organizations. This aligns with Sharma and Gupta (2023), who emphasize that green sourcing contributes to reducing operational waste and enhancing energy efficiency, but its impact depends on the level of adoption and integration into procurement decisions.

The correlation and regression results further demonstrated that green sourcing significantly influences sustainable performance among the agricultural value chain organizations. The findings established that firms that integrate green sourcing practices experience improved sustainability outcomes, including environmental compliance and better performance. The positive association between green sourcing and sustainability implies that increasing the adoption of eco-friendly sourcing strategies could yield long-term benefits for the agricultural sector in Kisii County. These findings are consistent with Santos and Costa (2021), who found that firms adopting green sourcing standards achieve greater environmental compliance and market advantages, underscoring the importance of embedding sustainability in supply chain practices.

5.2.2 Green Production and Sustainable Performance

The findings of the study revealed that agricultural value chain organizations in Kisii County were moderately engaged in green production practices. Respondents generally agreed that recycling, pollution control technologies, and monitoring of environmental impacts were part of their operations. The adoption of renewable energy sources, eco-friendly raw materials, and employee training on environmental production practices however remained less embraced. The results suggested a neutral stance towards green production, indicating that while some practices are being integrated into production processes, significant gaps still exist in fully adopting green production initiatives. These findings align with Chen and Wu (2021), who noted that green

production supports cost reduction and compliance with environmental standards, though implementation levels often vary across organizations.

Further correlation and regression analysis established that green production has a positive and significant relationship with sustainable performance among agricultural value chain firms in Kisii County. The results showed that enhancing aspects of green production contributes to improvements in sustainability outcomes, including environmental, social, and operational performance. This implies that greater commitment to green production practices can enhance firms' long-term competitiveness and compliance. The findings are consistent with Asamoah et al. (2024), who found that adopting green production improves brand image, customer satisfaction, and environmental performance, thereby reinforcing its strategic value for agricultural organizations.

5.2.3 Reverse Logistics and Sustainable Performance

The study set out to assess the effect of reverse logistics on sustainable performance of agricultural value chain organizations in Kisii County. Descriptive results showed that respondents generally acknowledged the importance of reverse logistics practices such as reusing agricultural by-products, recycling inputs, and waste segregation in enhancing cost efficiency and environmental sustainability. However, the responses were largely neutral on practices such as reusing residual fertilizers, systematic collection of packaging materials, and adoption of eco-friendly disposal measures. This suggested that while reverse logistics is recognized, its application remains partial and inconsistent across firms. These findings align with Owino and Wafula (2022), who observed that structured reverse logistics enhances efficiency by lowering waste disposal costs and promoting better utilization of resources.

Correlation and regression results further confirmed that reverse logistics significantly contributes to sustainable performance in agricultural value chain organizations. The analysis revealed a positive association between the two variables, demonstrating that improvements in reverse logistics practices are linked to better sustainability outcomes such as cost savings and environmental stewardship. Regression analysis affirmed this effect by showing that reverse logistics plays a meaningful role in improving sustainability levels within the agricultural value chain. These findings are consistent with Ahmed et al. (2024), who emphasized that effective reverse logistics enhances sustainability by minimizing carbon emissions, extending product lifecycle, and improving overall organizational performance.

5.2.4 Green Distribution Practices and Sustainable Performance

The study set out to assess the effect of green distribution practices on the sustainable performance of agricultural value chain organizations in Kisii County. The descriptive results showed that most organizations had not fully embraced practices such as fuel-efficient transport, route optimization, green packaging, or energy-efficient storage systems. Respondents largely disagreed that their firms were consistently applying real-time tracking systems or integrating efficiency concerns when selecting logistics partners. This pointed to limited adoption of sustainable distribution initiatives. These findings align with Nyagadza et al. (2022), who observed that despite the potential of green distribution practices to enhance supply chain reliability and product quality, their actual adoption remains limited in many contexts.

Further analysis revealed that while there was a positive relationship between green distribution practices and sustainable performance, the correlation was weak and statistically insignificant, indicating that improvements in distribution practices alone may not directly translate into substantial performance gains. However, regression results highlighted that green

distribution practices significantly influenced sustainable performance. This suggested that incremental adoption of these practices could enhance efficiency, reduce costs, and strengthen competitiveness. This resonates with Mwanzia and Mburu (2024), who found that green distribution practices, when effectively integrated, reduce operational costs, improve brand image, and contribute to long-term profitability.

5.3 Conclusions

5.3.1 Green Sourcing

The findings of the study led to conclusions that green sourcing plays a significant role in enhancing sustainable performance of agricultural value chain organizations in Kisii County. Although the organizations demonstrated some efforts in adopting eco-friendly and recyclable products in procurement, the implementation of comprehensive green sourcing practices such as supplier sustainability evaluations, life cycle costing, and sustainability audits remains limited and inconsistent. This indicates that while the concept of green sourcing is recognized, it is still at an early stage of integration within the organizations. The study further concluded that firms that effectively adopt and integrate green sourcing practices achieve better sustainability outcomes, including improved environmental compliance and overall organizational performance. Therefore, increased adoption and consistent implementation of eco-friendly sourcing strategies would yield long-term benefits for agricultural value chain organizations, strengthening their competitiveness and sustainability within the sector.

5.3.2 Green Production

The findings of the study led to conclusions that agricultural value chain organizations in Kisii County have made moderate progress in embracing green production practices, with

recycling, pollution control, and environmental monitoring forming part of their operations. However, the limited adoption of renewable energy sources, eco-friendly raw materials, and employee training on environmentally friendly practices highlights gaps that need to be addressed for full integration of green production. The study further concluded that green production has a significant and positive influence on sustainable performance, suggesting that strengthening these practices can enhance environmental, social, and operational outcomes. Furthermore, the study concluded that a greater commitment to green production not only supports compliance with sustainability standards but also strengthens long-term competitiveness and organizational resilience within the agricultural value chain.

5.3.3 Reverse Logistics

The findings of the study led to conclusions that reverse logistics plays a vital role in enhancing the sustainable performance of agricultural value chain organizations in Kisii County. The results revealed that practices such as reusing agricultural by-products, recycling inputs, and waste segregation are acknowledged by firms as important in achieving cost efficiency and promoting environmental sustainability. However, the study also concluded that the adoption of other reverse logistics practices, such as reusing residual fertilizers, systematic collection of packaging materials, and embracing eco-friendly disposal measures, remains inconsistent and only partially applied across organizations. Furthermore, the study concluded that reverse logistics significantly contributes to sustainability outcomes by strengthening cost-saving measures and promoting environmental stewardship. The positive correlation and regression results confirmed that improving reverse logistics practices directly enhances the sustainability of agricultural value chain organizations.

5.3.4 Green Distribution Practices

The findings of the study led to conclusions that green distribution practices have not been fully embraced by agricultural value chain organizations in Kisii County, as most firms have yet to adopt measures such as fuel-efficient transport, route optimization, green packaging, or energy-efficient storage systems. Limited use of real-time tracking and the lack of sustainability considerations in partner selection further highlight gaps in distribution efficiency. Although the relationship between green distribution practices and sustainable performance was found to be positive, it was weak and statistically insignificant, suggesting that isolated improvements in distribution may not guarantee substantial performance gains. However, the regression analysis revealed that green distribution practices significantly influence sustainable performance, implying that gradual and consistent adoption of these practices can reduce operational costs, enhance efficiency, and improve competitiveness.

4.4 Recommendations

Based on the findings on green sourcing, the study recommended that agricultural value chain organizations in Kisii County should enhance their commitment to adopting comprehensive green sourcing strategies by integrating supplier sustainability evaluations, conducting regular sustainability audits, and applying life cycle costing in procurement decisions. The organizations not only strengthens their compliance with environmental standards by doing so but also foster long-term competitiveness, reduce costs, and improve their reputation in the market through consistent and eco-friendly sourcing practices.

From the findings on green production, the study recommended that organizations prioritize the use of renewable energy sources, increase investment in eco-friendly raw materials, and provide regular training to employees on environmentally sustainable production practices.

Such measures enables agricultural value chain organizations to reduce their environmental footprint, meet sustainability standards more effectively, and strengthen their resilience and competitiveness by ensuring that production processes are both efficient and environmentally responsible.

In line with the findings on reverse logistics, the study recommended that agricultural value chain organizations establish systematic and structured approaches for reusing residual fertilizers, collecting and recycling packaging materials, and implementing eco-friendly waste disposal mechanisms. Firms can achieve significant cost savings, enhance resource efficiency, and promote environmental stewardship, thereby improving their sustainable performance by consistently applying these practices while simultaneously contributing to broader environmental conservation efforts.

Based on the findings on green distribution practices, the study recommended that agricultural value chain organizations progressively adopt green distribution strategies such as route optimization, fuel-efficient transport, green packaging, and energy-efficient storage systems. Furthermore, integrating sustainability considerations in partner selection and embracing advanced tracking technologies not only reduces operational inefficiencies but also enhance competitiveness, lower costs, and improve sustainability outcomes in the long term.

5.5 Areas of Further Studies

The study focused on green supply chain management practices on sustainable performance of agricultural value chain organizations in Kisii County, Kenya. There is a need for another study on green supply chain management practices in other sectors apart from the agricultural value chain firms. This was crucial for comparative analysis of results from different sectors. The study further established that green supply chain management practices comprising

of green sourcing, green production, reverse logistics, and green distribution practices accounted for 75.7% of variations in sustainable performance of agricultural value chain firm in Kisii County. There is therefore a need for another study focusing on other green supply chain management practices not included in the study and accounting for 24.3%.

5.6 Contribution of the Study to Practice, Policy and Theory

The study practically provides actionable insights for agricultural value chain organizations by demonstrating that integrating green supply chain management practices—particularly green sourcing, production, and reverse logistics—can significantly enhance sustainable performance, reduce costs, and improve competitiveness. From a policy perspective, the findings necessitate the need for county and national governments to formulate and enforce sustainability-oriented policies, such as incentives for adopting renewable energy, green procurement guidelines, and waste management regulations, to promote widespread implementation of green supply chain initiatives within the agricultural sector. Theoretically, the study extends the application of the resource-based view (RBV) by illustrating how internal capabilities (green sourcing and production) and external pressures (regulatory and stakeholder expectations) jointly shape sustainable performance outcomes.

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APPENDIX I INTRODUCTORY LETTER

Dear Respondent,

I am a masters student at KCA conducting a research study titled **"***the effect of Green Supply Chain Management practices on the sustainable performance of agricultural value chain organizations in Kisii County, Kenya***"**. The purpose of this questionnaire is to collect data that will assist in understanding how various aspects of green supply chain management. The information gathered through this questionnaire will be treated with strict confidentiality and will be used solely for academic purposes. Your participation is entirely voluntary, and you are free to withdraw at any point without any consequences. There are no right or wrong answers; kindly answer all questions as honestly as possible.

Thank you for your valuable time and input.

APPENDIX II RESEARCH QUESTIONNAIRES

This questionnaire is designed to collect data for a study investigating the effect of Green Supply Chain Management (GSCM) practices on the sustainable performance of agricultural value chain organizations in Kisii County, Kenya. It focuses on assessing the role of green sourcing, green production, reverse logistics, and green distribution in enhancing economic viability, environmental health, and social equity. Participation is entirely voluntary, and all information provided will be kept strictly confidential and used solely for academic research. Respondents are encouraged to answer all questions honestly. Completing the questionnaire should take approximately 15–20 minutes.

Section A: Demographic Information

(Please tick or fill in the appropriate response)

1. **Gender:**

   Male ( )

   Female ( )

   Prefer not to say ( )

2. **Age Bracket**

   Below 25 years ( )

   25–34 years ( )

   35–44 years ( )

   45–54 years ( )

   55 years and above ( )

3. **Education Level:**

Diploma/Certificate ( )

Bachelor's Degree ( )

Postgraduate ( )

4. **Position in the Organization:**

Agricultural value chain officers ( )

Agribusiness officers ( )

Other (Specify): _____

5. **Years of Experience in the Agricultural Value Chain Sector:**

   Less than 1 year ( )

   1–3 years ( )

   4–6 years ( )

   7–10 years ( )

   More than 10 years ( )

6. **Type of Agricultural Value Chain Involved In:**

   Coffee ( )

   Livestock and Dairy ( )

   Avocado ( )

Banana ( )

Chicken ( )

7. **Size of the Organization:**

Micro (50-200 farmers) ( )

Small (200-300 farmers) ( )

Medium (300-400 farmers) ( )

Large (400+ farmers) ( )

Instructions:

Please indicate the extent to which you agree with the following statements regarding your company's Green Supply chain management. Use the scale :1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Section A: Green Sourcing

Use the scale 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree to give extent of agreement with the following

Statement	**1**	**2**	**3**	**4**	**5**
1. Our company environment valuation considers all environmental certifications when selecting suppliers.					

2. We evaluate suppliers based on their ability to meet sustainability standards.					
3. Eco-friendly and recyclable products are prioritized in procurement.					
4. We use Life Cycle Costing (LCC) to evaluate the long-term environmental impact of procured items.					
5. We engage suppliers in sustainability audits and compliance checks.					
6. Eco-friendly product selection of suppliers influences our purchasing decisions.					

Section B: Green Production

Use the scale 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree to give extent of agreement with the following.

Statement	**1**	**2**	**3**	**4**	**5**
1. Our firm uses renewable or alternative energy sources in its operations.					
2. Production processes are Eco-friendly using Raw Materials					
3. Recycling is an integral part of our manufacturing and processing activities.					
4. Our operations include pollution control technologies.					
5. Employees are trained on environmentally friendly production practices.					

6. Our company monitors and reports on the environmental impact of production activities.					

Section C: Reverse Logistic

Use the scale 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree to give extent of agreement with the following.

Statement	**1**	**2**	**3**	**4**	**5**
1. Reuse of agricultural by-products has helped reduce our input costs					
2. Our farm reuses residual fertilizers to minimize waste					
3. Used packaging materials (sacks, crates) are collected systematically for recycling					
4. Recycling agricultural inputs contributes to environmental sustainability in our operations					
5. Eco-friendly disposal practices have improved environmental performance in our value chain					
6. Our firm segregates organic and inorganic farm waste before disposal.					

Section D: Green Distribution Practices

Use the scale 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree to give extent of agreement with the following.

Statement	1	2	3	4	5
1. Our company uses fuel-efficient or electric transporting for product delivery.					
2. We implement route optimization software to reduce distribution distances.					
3. Green packaging is used in our distribution processes.					
4. Our distribution centers use energy-efficient storage systems.					
5. Real-time storing and tracking helps reduce idle time and unnecessary transportation.					
6. Efficient route planning concerns are considered when selecting logistics partners.					

Section E: Sustainable Performance of Agricultural Value Chain Organizations

Please indicate the extent to which you agree with the following statements regarding your company's sustainable performance. Use the scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

Economic Viability Statement	1	2	3	4	5
The company's operations consistently maximize profits					
Cost savings from energy and resource efficiency are significant.					
Environmental Health					
Efforts are made to minimize pollution during production and distribution.					

Waste management practices are effectively implemented.					
Social equity					
The company ensures fair treatment and compensation of all employees.					
The company supports local communities and inclusive employment.					

APPENDIX III LIST OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF KISII

NAVCDP

NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT (NAVCDP

1.DAIRY FARMER PRODUCER ORGANISATIONS (FPOs)

S/NO	Name of Farmer Producer Organization (FPO)
1.	Kericha Borabu Dairy FCS Ltd
2.	Kenyenya Dairy FCS Ltd
3.	Kisii South Dairy FCS Ltd
4.	Kitutu Chache South Dairy FCS Ltd
5.	Nyamarambe Safe Milk FCS Ltd
6.	Matibo Dairy FCS Ltd
7.	Misesi Multi Value Chain
8.	Gesusu Fcs Ltd FCS Ltd
9.	Bomabobo Dairy FCS Ltd
10.	Kikoto Farmers Coop Society FCS Ltd
11.	Marani Dairy FCS Ltd
12.	Nyamache Dairy FCS Ltd
13.	Mamboleo Gesusu FCS Ltd
14.	Bomachoge Chache Dairy FCS Ltd
15.	Etago Dairy FCS Ltd
16.	Ukarimu Dairy FCS Ltd

2.CHICKEN FARMER PRODUCER ORGANISATIONS (FPOs)

S/No.	FARMERS PRODUCER ORGANISATION
1	Highlands poultry FCS Ltd
2	Misese Zone poultry FCS Ltd
3	Etago poultry FCS Ltd
4	Marani poultry FCS Ltd
5	Kisii South poultry FCS Ltd
6	Nyakoboki poultry FCS Ltd
7	Getembe chicken FCS Ltd

3.BANANA FARMER PRODUCER ORGANISATIONS (FPOs)

S/No.	NAME OF Farmer Producer Organization (FPO)
1	Kisii county Banana Prod and Marketing Coop Society Ltd
2	Bomachoge Borabu Banana Prod and Marketing Coop Society Ltd
3	Bomachoge Chache Banana Prod and Marketing Coop Society Ltd
4	Bonchari Banana Prod and Marketing Coop Society Ltd
5	Nyaribari Chache Banana Prod and Marketing Coop Society Ltd
6.	Magenche CV Hort Coop society Ltd

4.AVOCADO FARMER PRODUCER ORGANISATIONS (FPOs)

S/No.	NAME OF Farmer Producer Organization (FPO)
1	Geticha Avocado Farmers Cooperative Society Ltd
2	Riana Avocado Farmers Cooperative Society Ltd
3	Kisii County Avocado Farmers Cooperative Society Ltd

5.COFFEE FARMER PRODUCER ORGANISATIONS (FPOs)

S/No.	NAME OF Farmer Producer Organization (FPO)
1	Nyamonya FCS Ltd
2	Mogonga FCS Ltd
3	Nyamache FCS Ltd
4	Kenyenya FCS Ltd
5	Riasuta FCS Ltd
6	Gesarara FCS Ltd
7	Marani FCS Ltd
8	Nyaturubo FCS Ltd
9	Nyosia FCS Ltd
10.	Gakero FCS Ltd

Kennedy Monyancha
County Agribusiness Development Officer
NAVCDP
KISII COUNTY

APPENDIX IV WORKPLAN

Activity	**Description**	**June to October 2025**
Topic Approval	Getting approval for the research topic	1 week
Literature Review	Review of relevant theories and empirical studies	2 weeks
Methodology	Developing and piloting data collection tools	1 week
Data Collection	Administering questionnaires and gathering data	3 weeks
Data Analysis	Coding, entry, and statistical analysis	2 weeks
Drafting Research project	Writing chapters 1 to 5	1 weeks
Review and Editing	Proofreading and supervisor review	3 days
Final Submission	Submission of the final report	1 day

APPENDIX V RESEARCH BUDGET

Item	**Description**	**Projected Cost (KS)**
Typing and Printing	Drafting, printing chapter 1-3, questionnaires and final proposal	24,000
Transport	Travel to and from data collection sites	16,000
Communication	Phone calls, emails, and internet	2,000
Stationery	Pens, notebooks, files, envelopes	1,500
Research Assistant Support (if any)	Allowances for assistants during data collection in the field	20,000
Data Analysis	SPSS/Excel services/software subscription and installation	33,000
Miscellaneous	Unforeseen costs	5,500
Total Estimated Cost		**102,000**

APPENDIX VI NACOSTI Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **798964**

Date of Issue: **15/September/2025**

RESEARCH LICENSE

This is to Certify that Mr.. EMMANUEL MASESE MOMANYI of KCA University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in on the topic: GREEN SUPPLY CHAIN MANAGEMENT PRACTICES AND SUSTAINABLE PERFORMANCE OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS IN KISII COUNTY, KENYA for the period ending : 15/September/2026.

License No: **NACOSTI/P/25/4179682**

798964

Applicant Identification Number

Ag. Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

APPENDIX VII KCAUSERC Approval

Thika Road, Ruaraka
P.O. Box 56808-00200 Nairobi Kenya
Pilot Line: +254 20 8070408/9

Tel: +254 20 3537842
Fax: +254 20 8561077
Mobile: +254 734 888022, 710 888022
Email: kcau@kca.ac.ke
Website: www.kca.ac.ke

KCA UNIVERSITY SCIENTIFIC & ETHICS REVIEW COMMITTEE

REF: KCAU/SERC/SOB0289 Date: 8TH SEPTEMBER, 2025

TO: MOMANYI EMMANUEL MASESE (24/02758)

Dear Sir/Madam,

RE: GREEN SUPPLY CHAIN MANAGEMENT PRACTICES AND SUSTAINABLE PERFORMANCE OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS IN KISII COUNTY, KENYA

This is to inform you that the KCA University Scientific Ethics Review Committee (KCAUSERC) has reviewed and approved your research proposal. Your application approval number is ***KCAUSERC/SOB0289***. The approval period is ***8th September, 2025 – 8th September, 2026.***
This approval is subject to compliance with the following requirements.

i. Only approved documents, including informed consents, study instruments, and MTAs, will be used.
ii. All changes, including (amendments, deviations, and violations), are submitted for review and approval by ***KCAUSERC***.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events, whether related or unrelated to the study, must be reported to KCAU***SERC*** within 72 hours of notification.
iv. Any changes, anticipated or otherwise, that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KCAUSERC*** within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days before expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KCAUSERC***.

Before commencing your study, you will be expected to obtain a research license from the National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

Dr. Caroline Ntara,
Chairperson,
KCA University Scientific & Ethics Review Committee.

Advancing Knowledge, Driving Change