REVERSE LOGISTICS AND SUSTAINABLE PERFORMANCE OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS IN KISII COUNTY, KENYA

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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 reverse logistics on the sustainable performance of agricultural value chain organizations in Kisii County. 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. Simple regression analysis was used in determining the strength of relationship between variables. The results were presented in Tables. The study established that reverse logistics positively and significantly correlated with sustainable performance of agricultural value chain firms in Kisii County. Additionally, the study established that reverse logistics positively and significantly affects the sustainable performance of agricultural value chain firms. The study concluded that enhancing the various aspects of reverse logistics 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 reverse logistics practices to enhance competitiveness, reduce costs, and achieve long-term sustainable performance.

Key words: Reverse Logistics, Sustainable Performance, and Agricultural Value Chain Organizations.

INTRODUCTION

Background of the Study

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).

Statement of the Problem

Reverse logistics 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 waste reduction, reverse logistics enhances efficiency, reduces carbon emissions, and strengthens competitiveness (Marwa & Nyanchama, 2023). Despite these benefits, the adoption of reverse logistics 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 reverse logistics 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 reverse logistics 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 reverse logistics 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 reverse logistics practices and sustainable performance among agricultural value chain organizations in Kisii County, Kenya.

Objective of the Study

To determine the effect of reverse logistics on sustainable performance of agricultural value chain organizations in Kisii County.

Theoretical Review

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, and inimitable. 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 g 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 the study, the theory highlights how environmental practices, such as 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. 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 reverse logistics 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. Green supply chain practices, including 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).

Empirical Literature Review

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.

Conceptual Framework

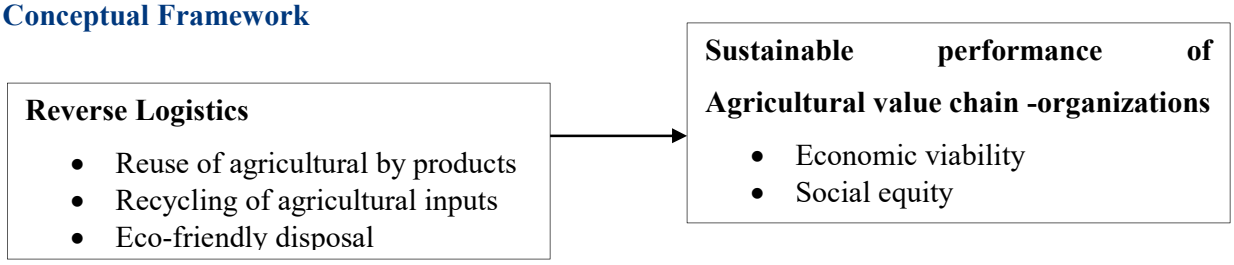

Figure 1 Conceptual Framework

RESEARCH METHODOLOGY

The study adopted a descriptive research design, which is appropriate for understanding existing conditions and relationships without altering variable. The target population was 84 respondents comprising of one Value Chain Officer and Agribusiness Officer from each of the 42 agricultural value chain organizations in Kisii County. 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. This study utilized structured questionnaires as the primary tool for collecting quantitative data. 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. 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. The Simple Linear regression model for the study was:

$$\mathbf{Y=\beta_0 + \beta_1 X_1+\mathcal{E}}$$

Where, Y= sustainable performance, β0-constant term, β_1-Regression Coefficient, X_1-Reverse Logistics and Ɛ-Error term

Results

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.

Descriptive Statistics

Reverse Logistics

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 1 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 1 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**

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 2 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 2 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**

Correlation Analysis

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.

TABLE 3 Correlation Results

		Reverse Logistics	Sustainable Performance
Reverse Logistics	Pearson Correlation	1	
	Sig. (2-tailed)		
Sustainable Performance	Pearson Correlation	.361	1
	Sig. (2-tailed)	.002	
	N	69	69

Regression Analysis

The study conducted a regression analysis aiming at assessing the nature and strength of the relationship between reverse logistics 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.

Model Summary

The purpose of the model summary in the study was gauge the degree of relationship between reverse logistics and sustainable performance. The results displayed in Table 4 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 reverse logistics.

TABLE 4 Model Summary

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

a. Predictors: (Constant), Reverse Logistics

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 5 outlines the ANOVA results.

TABLE 5 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), Reverse Logistics

Regression Coefficients

The results 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.

TABLE 6 Model Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Predictors	**B**	**Std. Error**	**Beta**	**T**	**sig.**
(Constant)	.450	.228		1.975	.053
Reverse Logistics	.183	.028	.952	6.484	.000

The model of the study after fitting the regression results becomes:
Sustainable Performance = 0.450 + 0.183 (Reverse Logistics)

Summary of the Findings

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.

Conclusion

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.

Recommendations

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.

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