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GREEN PRODUCTION AND SUSTAINABLE PERFORMANCE OF AGRICULTURAL VALUE CHAIN ORGANIZATIONS IN KISII COUNTY, KENYA

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ABSTRACT

Purpose: 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 production on the sustainable performance of agricultural value chain organizations in Kisii County.

Methodology: 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.

Findings: The study established green production positively and significantly correlated with sustainable performance of agricultural value chain firms in Kisii County. Additionally, the study established that green production positively and significantly affects the sustainable performance of agricultural value chain firms. The study concluded that enhancing the various aspects of green production contributes to enhanced levels of sustainable performance of the firms.

Unique Contribution to Theory, Policy and Practice: The study recommended that the agricultural value chain firms in Kisii County should consistently integrate green production practices to enhance competitiveness, reduce costs, and achieve long-term sustainable performance. This can be achieved through adoption of eco-friendly production practices.

Key Words: *Green Production, Sustainable Performance and Agricultural Value Chain Organizations*

Background of the Study

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).

Statement of the Problem

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

Objective of the Study

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

Theoretical Review

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).

Empirical Literature Review

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.

Conceptual Framework

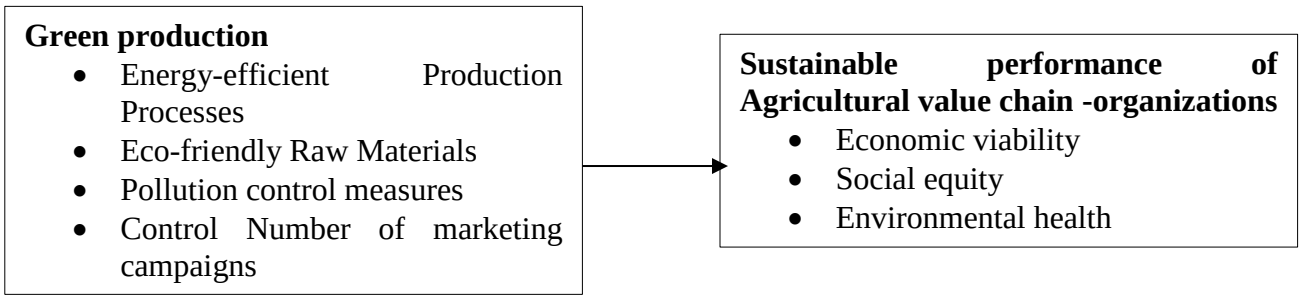

Figure 1: Conceptual Framework

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:

$$Y=\beta_0 + \beta_1 X_1+\varepsilon$$

Where, Y= sustainable performance, β0-constant term, β_1-Regression Coefficient, X_1-Green production 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

Green Production

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 1 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 1 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**

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 showed 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.

TABLE 3 Correlation Results

		Green Production	Sustainable Performance
Green Production	Pearson Correlation	1	
	Sig. (2-tailed)		
Sustainable Performance	Pearson Correlation	.397	1
	Sig. (2-tailed)	.001	
	N	69	69

Regression Analysis

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

Model Summary

The purpose of the model summary in the study was gauge the degree of relationship between green production 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 green production.

TABLE 4 Model Summary

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

a. Predictors: (Constant), Green Production

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), Green Production

Regression Coefficients

The results 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.

TABLE 6 Model Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Predictors	**B**	**Std. Error**	**Beta**	**T**	**sig.**
(Constant)	.450	.228		1.975	.053
Green Production	.339	.032	1.599	10.497	.000

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

Sustainable Performance = 0.450 + 0.339 (Green Production)

Summary of the Findings

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.

Conclusion

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.

Recommendations

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.

References

Achieng, F., & Mokua, R. (2024). Policy Gaps and Sustainability Challenges in Kenya's Agricultural Value Chains. *East African Journal of Agricultural Research, 13*(2), 117–130.

Agyemang, M., Zhu, Q., & Tian, Y. (2022). *Barriers to green supply chain management adoption and its impact on financial performance in developing economies. Journal of Cleaner Production, 364*, 132614.

Ali, H., & Mohamed, S. (2023). *Green innovation and the product life cycle: Sustainability integration across industries. Journal of Sustainable Production and Consumption, 27*(3), 198–210.

Appiah, K., & Odartey, D. (2021). Green procurement practices and environmental performance of food processing firms in Sub-Saharan Africa. *Sustainable Production and Consumption, 28*, 1335–1345.

Asamoah, E., Kumi, E., & Nyarko, J. (2024). *Green production and supply chain performance in Ghana's agribusiness sector. Journal of Agricultural Sustainability, 10*(1), 17–33.

Asamoah, J., Ofori, D., & Nketia, M. (2024). *Green production and supply chain performance of agricultural exporters in Ghana. African Journal of Sustainable Agricultural*, 10(1), 33–48.

Asamoah, K., Boateng, R., & Mensah, E. (2024). Green production and supply chain performance of agricultural exporters in Ghana. *West African Journal of Supply Chain Sustainability, 3*(1), 33–48.

Chen, H., & Wu, Y. (2021). The role of green production in enhancing sustainable performance of agricultural firms in Vietnam. *Journal of Sustainable Agribusiness, 4*(2), 70–85.

Chen, L., & Wu, J. (2021). *Green production in Vietnamese agricultural firms: A sustainability approach. Asia-Pacific Journal of Environmental Economics, 6*(4), 205–220.

County Government of Kisii. (2023). *Agricultural development strategic plan 2023–2027*. Kisii: Department of Agricultural, Livestock, and Fisheries.

Dlamini, N., & Mabasa, T. (2022). *Effect of green input procurement on agribusiness sustainability in South Africa. Southern African Journal of Supply Chain and Sustainability*, 6(3), 97–113.

Gomez, M., & Rodriguez, C. (2023). Sustainable value chains in global agricultural: Challenges and strategies. *Sustainability*, *15*(4), 2042.

Kamau, J., & Chege, S. (2021). *System theory and sustainable supply chains: Challenges in developing economies. International Journal of Logistics Research and Applications, 24*(4), 512–528.

Koech, C., & Kitur, P. (2022). *Green production in Kericho tea factories and its implications for sustainability. Tea and Agribusiness Journal, 9*(4), 202–219.

Koech, D., & Kitur, E. (2022). *Applicability of product life cycle theory in agri-food value chains in Sub-Saharan Africa. African Journal of Business and Economic Research, 17*(2), 93–106.

Koech, J., & Kitur, S. (2022). *Green production and sustainable performance of tea factories in Kericho County, Kenya. Tea Research and Agribusiness Review, 8*(2), 42–60.

Koech, S., & Kitur, D. (2022). Green production and sustainable performance of tea factories in Kericho County, Kenya. *East African Journal of Environmental Studies, 9*(2), 92–107.

Kumar, A., Singh, R. K., & Modgil, S. (2022). Green supply chain management practices and sustainable performance: An empirical investigation of Indian agricultural sector. *Journal of Cleaner Production, 347*, 131256.

Li, H., & Zhang, X. (2022). *Impact of green procurement on sustainable performance in Chinese agribusiness. Asian Journal of Agricultural Economics and Sustainability, 11*(1), 19–35.

Li, X., & Zhang, Y. (2022). Green sourcing and firm competitiveness: Evidence from developing markets. *Journal of Cleaner Production, 334*, 130219.

Liu, Y., & Zhang, H. (2024). Green supply chain practices and environmental performance in Chinese agriculture. *Journal of Cleaner Production, 412*, 137654.

Makori, J., & Onsongo, C. (2025). *Eco-distribution in Kisii banana networks: A longitudinal assessment in Kisii. Journal of Agricultural Research, 5*(1), 76–91.

Marshall, C., & Rossman, G. B. (2021). *Primary data collection methods designing qualitative research.* Sage.

Marwa, B., & Nyanchama, J. (2023). Barriers to Green Supply Chain Practices Among Smallholder Agricultural Firms in Kisii County, Kenya. *Journal of Sustainable Value Chains, 11(3), 78–93.*

Ministry of Agricultural. (2023). *Kisii County Agricultural Annual Performance Report*. Nairobi: Government Printer.

Mkhize, T., Ndlovu, L., & Dlamini, P. (2023). Waste-to-energy in South African agricultural: A case study of Durban. *Renewable Energy and Environmental Sustainability, 8*(1), 17–27.

Mwangi, A., & Makori, D. (2023). *Green logistics outsourcing and transaction cost economics in Kenya's horticultural sector. East African Business Review, 9*(1), 101–117.

Mwangi, B., & Otieno, J. (2023). Adoption of green manufacturing technologies and sustainable performance among agro-processors in Nairobi, Kenya. *Journal of African Industrial Ecology*, *6*(3), 109–123.

Mwangi, L., & Njeru, B. (2023). Adoption of green sourcing and environmental performance of agro-processing firms in Kenya. *International Journal of Sustainable Supply Chain Management, 8*(2), 45-57.

Mwangi, L., & Otieno, P. (2023). *Evaluating internal resources and sustainable practices in agribusiness: A resource-based view approach. Journal of African Management Studies, 15*(2), 63–78

Mwangi, M., & Otieno, S. (2023). *Green manufacturing in Nairobi agro-processors: A sustainability analysis. Journal of Manufacturing Studies, 8*(2), 123–137.

Mwangi, P., & Kiarie, D. (2021). *Challenges of Implementing Reverse Logistics Practices in Agro-Based Firms in Kenya. International Journal of Supply Chain and Logistics*, 5(2), 45–58.

Nguyen, T., & Bui, H. (2021). Barriers to green production adoption among small agricultural firms in Asia. *Asia-Pacific Journal of Business and Environment, 9*(4), 205–222.

Oduor, L., & Kibet, N. (2022). The effect of green production practices on environmental sustainability in Kenyan horticultural farms. *Horticulture and Sustainability Review, 5*(4), 58–73.

Okoth, J., & Kirui, R. (2022). *Integrating life cycle thinking in agricultural value chains: Toward circular and green economies. International Journal of Agri-Sustainability, 10*(1), 26–39.

Omari, A., & Okwaro, J. (2024). *Green production in banana firms in Kisii County: Insights from qualitative research. Kisii Journal of Green Economy, 5*(2), 117–132.

Otieno, D., & Kerubo, V. (2023). *Adoption of Eco-Innovation in Agricultural Cooperatives in Western Kenya*. African Journal of Agribusiness and Sustainability, 14(1), 42–56.

Otieno, D., & Njeru, B. (2022). *Reverse logistics practices and operational efficiency in Murang'a County agricultural cooperatives*. *African Journal of Agricultural Logistics*, 6(1), 95–110.

Otieno, L. A. (2024). Influence of green supply chain practices on sustainable performance of agri-enterprises in Western Kenya. *African Journal of Sustainable Agricultural and Development, 6*(1), 45–60.

Porter, A., & Reay, M. (2023). Eco-certification and resilience in U.S. agricultural value chains. *Agribusiness, 39*(1), 102–118.

Singh, A., Kumar, R., & Rathi, R. (2023). Integrating reverse logistics and green information systems for sustainable agricultural: Evidence from India. *Sustainable Computing: Informatics and Systems, 38*, 100832.

Vernon, R. (1966). International investment and international trade in the product cycle. *The Quarterly Journal of Economics*, *80*(2), 190–207

Wang, Y., Chen, L., Zhang, H., & Li, P. (2023). Green supply chain strategies and reverse logistics: An empirical analysis of agri-food sectors. *International Journal of Production Economics, 255*, 108689

Wang, Y., Chen, Z., & Johnson, L. (2022). Innovations in agricultural distribution logistics in North America. *Journal of Sustainable Logistics*, *12*(3), 113–127.

Wekesa, M., & Muturi, H. (2025). Effect of green operations on sustainable value chain performance in Western Kenya. *Journal of Business and Environmental Studies, 8(1), 41–55*

Wilson, L., & Harper, M. (2023). *Sustainable agricultural practices and green production in Australia. Journal of Environmental and Agricultural Sustainability*, *15*(2), 134–149.

Zhang, L., Li, Y., & Chen, H. (2022). Digital supply chain integration and post-harvest loss reduction in developed economies. *Computers and Electronics in Agricultural, 98*-107

Zhu, Q., & Sarkis, J. (2016). Green supply chain management and sustainable performance: Moderating effects of organizational learning. *Journal of Cleaner Production, 134*, 216–227

Zhu, Q., Sarkis, J., & Lai, K. H. (2023). Integrating environmental management into supply chains: A review and future directions. *International Journal of Production Economics, 256*, 108678.