



Evaluating the Influence of Eco-design, Green Packaging, Green Warehousing, and Reverse Logistics on Firm Performance: Evidence from Nairobi City County, Kenya

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The logistics sector is an important sector in Kenya, which accounts for 10% of GDP and all formal employment and plays a significant role in tax collection. However, Kenyan logistic businesses' performance has been fluctuating overtime. Kenyan logistics firms operating in Nairobi County are performing poorly as seen by the drop-in growth rate from 5.4% in 2011 to 4.3% in 2018, and from -7.7 % in 2020 to 7.2% in 2021. Therefore, this study seeks to evaluate effects of green logistics practices on the performance of logistics firms in Nairobi City County, Kenya. Specifically, the investigation aims to assess the effects of eco-design, green packaging, green warehousing, and reverse logistics on performance. Stakeholder, resource-based, and game theories were utilized for

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the investigation. A descriptive research approach was utilized. The target population was all four hundred and twenty logistics firms that are members of KIFWA. A sample size of 205 logistics firms was selected by applying the Slovin's formula along with simple random sampling, with managers of the firms serving as respondents. Primary data was utilized and obtained by structured, close-ended questionnaires. A pilot study of ten (10) logistic supervisors of the selected firms was utilized. Validity was conducted with construct and content validity, while reliability was conducted using Cronbach's Alpha internal consistency of 0.70. An approval letter was obtained from the National Commission for Science, Technology, and Innovation by the investigator, and drop and pick later approach was utilized. Descriptive and multi-linear regression analysis was employed with the utilization of SPSS 23.0. All ethical considerations were duly observed. Findings from the study disclosed that eco-design significantly and positively affected these firms' performance. The findings linked to the regression unveiled that green packaging positively affected the firm's performance significantly. Output noted that green warehousing revealed a significant positive effect on the performance of these firms. The outcome displayed that reverse logistics has a positive effect on the performance of these firms significantly. The study recommends that the management of these firms should adopt comprehensive green packaging strategies to enhance their performance. This should include the use of biodegradable, recyclable, and reusable materials, as well as optimizing packaging designs to minimize waste and reduce environmental impact. By implementing these practices, logistics firms can enhance their operational efficiency, reduce costs associated with waste management, and improve their overall market competitiveness.

Keywords: Green practices; performance; logistics firms; Nairobi city county; Kenya.

1. INTRODUCTION

Logistics has evolved into a thriving sector that is rapidly growing internationally and contributes notably to economic performance (Delmonico, 2020). Around 12% of the world's GDP is thought to be spent annually on logistics, which is projected to run between \$8 and \$12 trillion (Ge & Friedrich, 2020). Global logistics spending was estimated by Armstrong & Associates Inc. to be \$9.6 trillion in 2018 (Ritchie, 2020). The logistics industry is crucial to national economies, but it faces distinct challenges globally. In the UK, the sector, which contributes 5% of the GDP (£55 billion) and employs 1.7 million people, has its expansion slowed by lack of training, skill gaps, and labor shortages (Barclays, 2023). In India, logistics companies play a major macroeconomic role by accelerating economic growth, generating national revenue, creating millions of jobs, supporting regional integration, and boosting exports accounting for approximately 14% of its GDP (Jeena, 2024). However, the main concern is high logistics costs, which consume 13% to 14% of GDP, significantly more than the global average of about 8% (Kumar & Ramesh, 2019).

Regionally, In Nigeria, the logistics sector was valued at an estimated \$584 million (250 billion naira) in 2018 (International Trade Administration, 2024), demonstrating rapid

growth. The sector's low 2020 Logistics Performance Index ranking of 110th is a result of numerous systemic challenges, including inefficient seaports and customs, a significant infrastructure deficit, a poor road system, erratic electricity, high corruption, burdensome regulations, and high taxes (Omigie & Kubeyinjie, 2022). South African logistics firms demonstrated mixed but resilient performance during economic challenges exacerbated by COVID-19 as the sector faces constant pressure on margins from competitive transport rates and fluctuating volumes (Chinomona & Bikissa-Macongue, 2022).

Kenya's logistics and infrastructure sector is a major economic contributor, having boosted per capita GDP growth by 0.5% yearly over the past decade. The logistics industry contributes about 7.9% of Kenya's GDP demonstrating significant growth (e.g., 9.7% between 2013–2018). Road transportation dominates, generating 62.9% of the sector's output. The market features intense competition among private firms across all freight modes, though it is largely controlled by a few large companies (KNBS, 2023a). Overall, logistics companies are the foundation of Kenya's economic progress (Koskei & Wanjala, 2023), making up 60% of all enterprises, 7% of GDP, and generating 75% of new jobs (Kenya National Bureau of Statistics, 2022).

Organizational performance is generally defined as the achievement of a business's goals using both financial and non-financial measurements (Siagian & Tarigan, 2021). Organizational performance is measured operationally by the speed and quantity of output achieved through improved processes, and by the quality and rising level of final products or services throughout their development cycle. Organizational performance is measured not only by how a firm performs compared to its competitors (Tarigan et al., 2021) and by traditional financial outcomes, but also by diverse non-financial factors. These factors include client satisfaction, value generation, operational efficiency, and organizational development ability (Omanwa, 2020). Key indicators cited in literature encompass productivity, market share, profitability, and reputation. Performance is thus comprehensively assessed through metrics like organizational growth, operational effectiveness, customer relationship management, and sales success (Mutua & Kirui, 2020). This study measured organizational performance in terms of service delivery, cost saving, timeliness and customer satisfaction.

Green practices in this study are defined as a framework that boosts labor efficiency and competitiveness while reducing energy use and environmental effect (Mutua, 2021). Green practices are important because they involve organizing information and product flows in a way that is both environmentally friendly and meets or exceeds customer expectations from point of inception to consumption (Mutua et al., 2020). Green practices have a variety of procedures, including green packaging, reverse logistics, fuel efficiency, route optimization, and monitoring of carbon emissions (Weng & Chen, 2019). The study measured green practices in terms of eco-design, green packaging, green warehousing, and reverse logistics. Eco-design is an approach that integrates sustainability into all aspects of the product lifecycle, from initial raw material selection to reverse logistics (Seroka-Stolk, 2019). It requires organizations to ensure that their products adhere to sustainable design principles, meet manufacturing standards, and incorporate features for recycling or reuse (Blomsma & Brennan, 2019). Green packaging refers to environmentally friendly packaging (Annika & Cheng, 2018), which intrinsically signals a company's financial commitment to environmental and public well-being (Sibel & Bulent, 2019). Green warehousing involves the balanced management and integration of

financial, environmental, and societal inputs and outcomes within storage operations (Kassou & Bourrekadi, 2021). Reverse logistics encompasses all recovery procedures through which a company gains economic benefit, though it is often a more complex and expensive operation than forward distribution (Ourdi et al., 2021).

1.1 Statement of the Problem

The logistics sector, which generates 10% of the nation's GDP and 10% of all formal employment, constitutes one of the most important sectors in the nation (Mutua, 2021). However, they face challenges in implementing green practices that significantly affect their performance. A study found that while about 63% of logistics companies acknowledge the benefits of green logistics, only 24% have fully integrated these practices into their operations (Odock et al., 2024). Furthermore, regulatory pressures exist to adopt greener practices, yet compliance remains low (Kiama, Karanja & Nyang'au, 2024). Approximately 40% of logistics firms report insufficient knowledge regarding environmental management systems, which hampers the effective implementation of green logistics strategies. This lack of understanding contributes to a reluctance to invest in necessary changes, ultimately impacting their competitiveness and environmental footprint in a rapidly evolving market (Kiplimo & Wachiuri, 2024).

Numerous studies on green practices and performance have provided this study with research gaps. For instance, Mutua (2021) examined the impact of green packaging as a green logistics technique on performance in the setting of Kenyan logistics companies and discovered a favorably significant effect. In an investigation on how green warehousing affects business effectiveness in Greece, Trivellas et al. (2020) found no appreciable effects. In Kenya, Yusuf (2020) looked into the performance of manufacturing firms and green packaging companies, with a particular emphasis on manufacturing firms. Rop et al. (2021) evaluated green warehousing and performance linkages in the context of Kenya's commercial state Corporations using the stratified sampling approach. Ademulegun et al. (2022) examined how eco-design impacted the performance of Nigerian Bottling Company (NBC) in Nigeria. In Indonesia, Sunati et al. (2022) used the convenience sampling approach to assess how eco-design affected the operational effectiveness

of textile enterprises. Due to the varying contextual, conceptual, and methodological gaps, this investigation seeks to evaluate the effect of green logistics practices on the effectiveness of logistics companies in Kenya's Nairobi City County.

1.2 Objectives of the Study

1.2.1 General objective

The objective was to assess the influence of green practices on the performance of logistics firms in Nairobi City County, Kenya.

1.2.2 Specific objectives

The study's particular goals include to:

- i. Examine the influence of eco-design on the performance of logistics firms in Nairobi City County, Kenya.
- ii. Evaluate the influence of green packaging on the performance of logistics firms in Nairobi City County, Kenya.
- iii. Determine the influence of green warehousing on the performance of logistics firms in Nairobi City County, Kenya.
- iv. Assess the influence of reverse logistics on the performance of logistics firms in Nairobi City County, Kenya

1.3 Research Questions

The inquiries that follow were addressed by the research:

- i. How does eco-design affect the performance of logistics firms in Nairobi City County, Kenya?
- ii. What is the influence of green packaging on the performance of logistics firms in Nairobi City County, Kenya?
- iii. To what extent does green warehousing affect the performance of logistics firms in Nairobi City County, Kenya?
- iv. What is the influence of reverse logistics on performance of logistics firms in Nairobi City County, Kenya?

2. LITERATURE REVIEW

2.1 Theoretical Review

The Stakeholder Theory, propounded by Freeman (1984), asserts that companies should produce externalities affecting a broad range of

internal and external parties. It recognizes that an organization is accountable not only to its shareholders but also to groups or individuals who are significantly impacted by its decisions or who have a clear legal relationship with it. The theory, as supported by Donaldson and Preston (1995), rests on the premise that every legitimate individual or group involved in a business should benefit from its activities, despite potential conflicts in their priorities. Although the theory may appear to divert management's focus from shareholder value, it is a powerful approach for understanding firms within their operating environments (Oakley, 2011). The theory's primary managerial significance lies in guiding leaders to strategically understand and manage these groups, a process critical for the long-term survival and sustainability of organizations. While critics argue the theory implies a firm's interests are merely reflections of its stakeholder relationships (Key, 1999), it remains pertinent because it advocates for an ethical and effective management approach in complex, volatile environments.

The Resource-Based Theory (RBT), introduced by Wernerfelt (1984) and advanced by Barney (1991), proposes that firms are units of unique and imperfectly mobile resources and capabilities. Consequently, a strategy effective for one firm may not be suitable for another. To achieve optimal and sustainable competitive advantage, a firm must possess specific resources and talents that are difficult for competitors to replicate or substitute (Barney, 1991). Hart (1995) argued that a firm's environmental social responsibility (ESR) can be a unique resource or capability that generates a sustainable competitive advantage. For any resource to achieve this, it must adhere to the VRIO criteria (valuable, rare, inimitable, and non-substitutable), as established by Barney (1991). Consequently, practices such as green logistics skills and knowledge are considered strategic resources within this theory because they are difficult to replicate and directly enhance organizational performance and competitiveness. Although critics question the clarity and measurability of defining a "valuable resource," the RBV theory remains applicable to this study as it links firm-specific, unique resources like green logistics practices to the dependent variable of organizational performance.

John Neumann (1944) proposed game theory. According to game theory, horizontal logistics collaboration in terms of order fulfillment and

transportation can reduce overall costs and improve performance (Pan et al., 2014; Cruijssen et al., 2007). In circumstances where numerous people must make decisions that could have an influence on the interests of other players, game theory is the recognized field of research on cooperation and conflict (Xu et al., 2013). Game Theory is applicable when the behaviors of multiple agents such as individuals, groups, or companies are strategically interrelated, providing a framework for organizing and understanding strategic dilemmas (Dai & Chen, 2012). Researchers have applied cooperative game theory to evaluate the effect of logistics efficiency on organizational performance, focusing on inter-firm collaboration to reduce logistics costs (Cruijssen, 2007) and environmental impact (Pan, 2011). Literature confirms that such horizontal collaboration can save transportation costs by 10% or more (Ergun, 2011). Although the theory's interaction procedures can be unclear in practice, it underpins the investigation into how logistics practices, including green packaging, reverse logistics, green warehousing, and eco-design, affect organizational performance.

2.2 Empirical Review

Chrisostom and Monari (2018) studied the influence of green logistics management (reverse logistics) on registered automotive companies' performance in Kenya. Correlational research design was applied based on a target population of 305 departmental heads which led to a sample size of 170 derived based on Fischers' model. Primary data based on interviews and questionnaires were collected where descriptive and inferential analysis was used in analyzing quantitative data. It was reported that reverse logistics had positive correlation and noteworthy influence on effectiveness, based on correlation and regression analysis respectively. It was recommended that green logistics management deployed and enhanced with a view of improving performance of firms. The study suggested that in order to increase performance, automakers should improve green logistics management. The study focused on Kenya, however despite being in a similar geographical location with the current investigation, correlational research approach was adopted whereas descriptive research approach was adopted in recent study, thus demonstrating a methodological gap.

Yusuf (2020) analyzed the effect of green warehousing on manufacturing companies' performance in Kenya. Explanatory research design was implemented. Positivist approach was used, and data was collected via questionnaires based on a random sample size of 330 that is, for 943 companies in the manufacturing sector in Kenya as registered by the Kenya Association of Manufacturers (2017). Green warehousing was measured in terms of lifecycle assessment analysis. Empirical findings based on regression analysis indicated that green warehousing and performance have positive nexus for manufacturing companies in Kenya. According to the investigation's recommendations, it is critical that businesses use distribution routes with minimal environmental impact. Despite the study contributing immensely to empirical research works in view of green logistics and performance, it centered on firms in the manufacturing sector of Kenya.

To investigate the connections between green warehousing and company performance in Greece, Trivellas et al. (2020) conducted a study. Descriptive method of design was employed. Eight managers from the agri-food supply chain's processing businesses, retailers, and wholesalers tested the survey tool twice. 134 valid surveys were produced as a result of this approach. The use of descriptive statistics and various regression models was made. The findings indicated that logistics networking, transportation, and information exchange have the biggest effects on supply chains, businesses, and sustainable performance. Additionally, there was no connection found between green warehouse and logistics emissions and performance results. The study suggested that executives should look at green supply chain methods since they will improve performance and protect companies in a volatile market.

Mutua (2021) investigated how green packaging as a green logistics practice affects performance in the context of logistics firms situated in Kenya. Based on the prepositions of positivism research, cross-sectional survey research approach was applied and a population of 892 logistics firms was considered. From this population, the study obtained a sample size of 300 and primary data was gathered using structured questions in view of 71 percent response rate. While applying covariance-based structural equation modeling (CB-SEM) for the analysis of data, outcome of the study revealed that green packaging notably

and favorably affects the effectiveness of Kenyan logistics businesses. It was advised that Kenyan logistics companies adopt eco-friendly procedures both internally and throughout the entire supply chain.

Rop et al. (2021) studied green logistics adoption effects on the performance with focus on Kenya's commercial state Corporations. Based on stratified sampling, a sample size of 175 was consequently derived from the population and the investigation utilized descriptive design. Data was primary data which was based on both closed and open-ended questions. Statistics, both descriptive and inferential, were used to analyze the data. The study advised manufacturing companies to completely embrace and execute green procurement practices in accordance with all relevant laws as a supplementary measure. It was reported that reverse logistics had noteworthy effects on effectiveness of public corporations in Kenya.

Ademulegun et al. (2022) looked into how eco-design affected Nigerian Bottling Company's performance. A quantitative research method was employed. 202 employees of NBC who were active in eco-design activities were chosen for the study using a straightforward random sampling method. The study's conclusions showed that the level of eco-design practices in the study area is moderate in terms of design for supplies, shipping, production, product use, and end-of-life practices. The study suggested that in order to improve their performance, businesses should concentrate more on choosing low-impact materials and make an effort to use low-energy products. The aforementioned study took place in Nigeria and utilized a cross-sectional research design.

Sunati et al. (2022) evaluated the effects of eco design on the operational effectiveness of Indonesian textile companies. Descriptive research design was adopted. Convenience sampling was the method employed for sampling. A total of 520 questionnaires were given out to the respondents, and 394 of those were actually useful and used for data analysis. 74% of respondents responded. The data was imported into the Excel program after it had been collected. As a result, PLS-SEM was employed to analyze the data acquired. Data were gathered via convenience sampling. The study's conclusions showed that internal management of the environment and eco-design greatly

influenced the performance of the organization. The investigation recommended that organizations should focus more on selecting minimally disruptive materials to improve their efficiency.

3. RESEARCH METHODOLOGY

3.1 Research Design

Research design relates to the framework or road map that guides an investigation. Because of the interest in determining the effect of green logistics practices on the performance of logistics companies, a descriptive research design was chosen for the investigation. The descriptive research design considers respondents' characteristics, organizations' beliefs, opinions, and knowledge of the people under study (Saunders, 2012). The investigation collected data on green practices that are also found in other peer organizations (Mugenda, 2010). As a result, the investigation was directed by a descriptive research design, which collected data from participants and analyze it from their point of view.

3.2 Target Population

As opined by Mugenda and Mugenda (2013), the population target can be best explained as the entirety of an object or people set needed for a research based on the presence of certain noticeable characteristics. A target population is also viewed as any collection of organizations, individuals, or items that share at least one common trait (Kombo and Tromp, 2006). For the purpose of this study, the target population was specifically composed of all logistics firms in Kenya that are registered members of the Kenya International Freight and Warehousing Association (KIFWA). According to KIFWA (2023), this population totals 420 logistics companies.

3.3 Sampling Design

Sampling is a process or strategy used to choose a predetermined number of participants from a given population to represent that population. Choosing a group of subjects for a study in a way that ensures their selection is representative of the broader group from which it was made is known as sampling (Mugenda and Mugenda, 2013). The firms studied were chosen using a simple random sampling technique. The sample consisted of a subset of the 420 KIFWA member

companies. As Adopted from Mutua (2021), Slovin's formula was used to determine the size.

$$C = N / [1 + Ne^2]$$

Where,

C = sample size the sample size

N= total population

e= error tolerance.

According to Ariola (2006), the error tolerance in Slovin's formula typically ranges from 0.01 to 0.05, with 0.05 being a commonly accepted threshold for studies requiring moderate levels of precision. In this study 0.05 was adopted.

$$C = 420 / [1 + 420(0.05)^2]$$

$$C = 204.8$$

$$C = 205.$$

3.4 Data Collection Instrument

A structured close-ended questionnaire was utilized as the primary data collection instrument in this study to solicit respondents' opinions. A data collection instrument is a tool used in the data collection process for research purposes (Hair et al., 2015). A questionnaire is a tool for gathering data that consists of a list of closed- or open-ended questions designed to elicit responses on a topic under investigation (Sekaran & Bougie, 2016). Respondent demographic data was obtained first, followed by data on the independent and dependent variables. The questionnaires was designed with closed-ended questions to ensure efficient and timely responses from respondents. A structured questionnaire with closed-ended 5-point Likert scale questions was utilized because compared to higher-point scales, it is easier to comprehend and requires less time and effort to complete. Questionnaires was divided into two sections. The first section contained the respondent's background information, while the second section contained questions pertaining to independent and dependent variables.

3.5 Data Analysis and Presentation

After the field data collection process is completed, the data was cleaned, organized, and

fed into data processing software for analysis. SPSS was the primary software used by the researcher for recording raw data, cleaning, and more advanced data analysis. Inspection, cleansing, transformation, and modeling of data are steps in the data analysis process which is used in establishing valuable outcomes, draw conclusions and aid in making decisions. In order to characterize the respondents' and the organization's demographic features, descriptive statistics were used to compute mean scores, standard deviation, percentages, cross tabulation, and frequency distributions. The connections between independent and dependent variables and their importance was determined using multi-linear regression analysis. The regression model revealed the link amongst these variables:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + e$$

Where:

Y= Performance of Logistics Firms

β_0 = Constant

β_1 to β_4 =Variable Coefficients

X_1 = Eco Design

X_2 = Green Packaging

X_3 = Green Warehousing

X_4 = Reverse Logistics

E= Error

4. RESULT AND DISCUSSION

4.1 Regression Analysis of Findings

Regression analysis is a statistical method used to examine the relationship between one dependent variable and one or more independent variables, allowing researchers to understand how changes in the independent variables affect the dependent variable. The study deployed regression techniques to quantify the strength and direction of eco design, green packaging, green warehousing and reverse packaging on organizational performance of logistics firms in Nairobi County. Given this, the findings from the model summary, analysis of variance and coefficients are obtained in Tables 1, 2 and 3, respectively.

Table 1. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.680 ^a	.462	.450	.46533

Source: Field Survey (2025)

Table 1 demonstrates that the value of R is 0.680, indicating a strong positive correlation between green practices and organizational performance of logistics firms in Nairobi County, Kenya. This value suggests that there is a substantial relationship between the adoption of sustainable practices such as eco design, green packaging, green warehousing and reverse logistics and the performance of these firms. The model's R-squared value of 0.462 was discovered. This implies that 46.2% of the variance in organizational performance of the firms is explained by these green practices, suggesting a substantial relationship between sustainability initiatives and business outcomes in the logistics sector. The study went further to discuss the joint significance of the model, and the outcomes are recorded in Table 2.

Given the outcome of the model joint significance in Table 2, the results unveiled that a significant F-statistic of 35.916, as further confirmed by the model, is statistically significant ($p < 0.001$). This outcome reinforces the importance of integrating green practices into logistics operations to achieve better performance results in Nairobi County, Kenya. As such, the green practices components adopted in the study jointly have a significant effect on the performance of the studied firms in Kenya. To further determine the individual effect of the explanatory factors on the firms' performance, the individual effects of the factors' outcomes are recorded in Table 3.

Table 3 disclosed the constant valued at 0.499, which represents the expected level of organizational performance when all independent variables—eco design, green packaging, green warehousing and reverse logistics—are set to zero. This implies that in the absence of the

explanatory variables employed in the study, the performance of these firms would still be positive.

Eco design, with an unstandardized coefficient of 0.166 ($p < 0.001$), also positively influences organizational performance in a significant manner. This implies that as eco design increases by a unit, it would amount to an increment in organizational performance of these firms in Nairobi County, Kenya. The outcome with a p-value of 0.000 again is less than the 0.05 significance level. Thus, the null hypothesis is rejected, concluding that eco design significantly influences organizational performance positively. This indicates that integrating environmental considerations into product design not only contributes to sustainability but also enhances operational outcomes for logistics firms by fostering innovation and meeting consumer demand for eco-friendly products. This could be because the firms have adopted eco design that encourages innovation in product development, enabling the firms to meet regulatory requirements and consumer demand for sustainable products, thereby enhancing their competitive advantage. The outcome is in agreement with the findings of Wakulele et al. (2016) disclosed that eco-design approaches have a favorable influence on the effectiveness of a company, with the financial and environmental performance areas seeing the most effects. Ademulegun et al. (2022) showed that the level of eco-design practices in the study area is moderate in terms of design for supplies, shipping, production, product use, and end-of-life practices. Sunati et al. (2022) showed that internal management of the environment and eco-design greatly influenced the performance of the organization.

Table 2. Model Summary

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31.107	4	7.777	35.916	.000 ^b
	Residual	36.160	167	.217		
	Total	67.268	171			

Source: Field Survey (2025)

Table 3. Regression Coefficients Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.499	.299		1.668	.097
	Eco Design	.166	.040	.248	4.191	.000
	Green Packaging	.235	.066	.226	3.569	.000
	Green Warehousing	.277	.069	.301	4.013	.000
	Reverse Logistics	.191	.079	.199	2.412	.017

Source: Field Survey (2025)

Green packaging has a significant positive effect on organizational performance, with an unstandardized coefficient of 0.235 ($p < 0.05$). This indicates that for every unit increase in green packaging practices, organizational performance increases by approximately 0.235 units. Since the p-value is less than 0.05, the null hypothesis is rejected, indicating that green packaging has a statistically significant effect on organizational performance. This implies that logistics firms that adopt sustainable packaging solutions are likely to experience improved operational efficiency and enhanced customer satisfaction, thus contributing positively to their performance. This could be due to green packaging ability to improve customer perception and brand loyalty by aligning with consumer preferences for sustainable and environmentally friendly products. The findings are consistent with those from Mogeni and Kiarie (2016) indicated that green packaging had strong effects on performance of multinational organizations in Kenya. Yusuf (2020) recommended that it is important for the firms to adopt distribution channels that are characterized by a low impact on the environment. Mutua (2021) revealed that green packaging notably and favorably affects the effectiveness of Kenyan logistics businesses. Rop et al. (2021) disclosed that green packaging had significant effects on the effectiveness of public corporations in Kenya.

Green warehousing showed a significant and positive effect on organizational performance with an unstandardized coefficient of 0.277 ($p < 0.05$). This indicates that when green warehousing is increased by a unit, organizational performance would be enhanced by 0.277 units. Given that this p-value is significantly lower than 0.05, the null hypothesis is rejected, suggesting that green warehousing practices have a substantial positive effect on organizational performance. This finding underscores the critical role of sustainable warehousing solutions in enhancing logistics efficiency, reducing operational costs, and ultimately improving overall firm performance in Nairobi County. The outcome could be attributed to the fact that green warehousing incorporates sustainable practices that lower energy consumption and waste, resulting in cost savings and increased operational effectiveness of the firms. The outcomes are in agreement with those from Yusuf (2020) indicated that green warehousing and performance have a positive nexus for manufacturing companies in Kenya. The findings are inconsistent with Trivellas et al.

(2020), who found no connection between green warehouse and logistics emissions and performance results. Rop et al. (2021) documented that green warehousing and performance of public corporations in Kenya had significant relationships. The variance experienced in the studies could be a result of the uniqueness of the contextual differences as well as the methodologies deployed.

Reverse logistics also demonstrated a positive and significant effect on organizational performance, as evidenced by an unstandardized coefficient of 0.191 ($p < 0.05$). This suggests that as reverse logistics increase by a unit, organizational performance would improve by 0.191 units. This p-value is also below the 0.05 threshold, allowing for the rejection of the null hypothesis and concluding that reverse logistics significantly affects organizational performance. The implication is that effective management of reverse logistics practices such as recycling and waste management can lead to greater operational effectiveness and cost savings for logistics firms, reinforcing the importance of sustainability in their operations. The finding could be linked to the fact that reverse logistics enhances operational efficiency through effective waste management and resource recovery, leading to reduced costs and improved service delivery of the firms. The findings are in alignment with those from Mogeni and Kiarie (2016) reported that reverse logistics and performance had significant relationships concerning Multinational Organizations in Kenya. Chrisostom and Monari (2018) reported that reverse logistics had a positive correlation and noteworthy influence on effectiveness. Mutua (2021) revealed that reverse logistics had a noteworthy influence on the effectiveness of logistics businesses in Kenya. Rop et al. (2021) reported that reverse logistics had noteworthy effects on the effectiveness of public corporations in Kenya.

5. CONCLUSION

The analysis and findings of the research was on the effect of green practices on logistics firms' performance in Nairobi County, Kenya. Specifically, regarding the effect of eco design on the performance of logistics firms in Nairobi County, Kenya, the survey uncovered that eco design has a positive and significant effect on the performance of these firms. In conclusion, eco-design has an influential and positive impact on logistics firms' performance. Therefore, the

adaptation of the environmental issues into the process of the product lifecycle, such as recycling, remanufacturing the product and doing lifecycle assessments of the products, has given rise to innovation, meeting regulatory standards and adhering to the changes in market demands. The evidence therefore validates the contention that eco-design does improve environmental performance, in addition to playing the role of a driver of an organization, as well as its futuristic sustainability in the logistics industry.

The survey investigated the effect of green packaging on the firms' performance, with the findings noting that green packaging has a significant positive effect on the firms' performance. The study concludes that the green packaging has a significant and favorable effect on the logistics firms' performance within the Nairobi County. Environmentally responsible packaging has also significantly led to reduced wastage, but also greater efficiency and reduced cost of operation, as well as client satisfaction through the use of quality, recyclable and reusable materials, sizing, and appropriate design of packaging. These findings highlight the strategic nature of practicing sustainable packaging solutions in logistics activities since it brings about real achievements not only in environmental care but also in terms of achieving a competitive edge.

Concerning the effect of green warehousing on the performance of logistics firms in Nairobi County, Kenya, the findings noted that green warehousing positively and significantly affects these firms' performance. Given this outcome, the study concludes that the practice of green warehousing plays a leading role in providing high performance in organizations. Efficient energy technologies, eco-friendly storage systems, along with flexible supply of materials, have led to better storage conditions, effectiveness within distribution, and lower eco-impact. The results confirm the fact that green warehousing plays a crucial role in ensuring operational excellence, cost efficiency, and corporate responsibility and therefore, the necessity of logistics institutions to invest in green warehousing technology.

Pertaining to the effect of reverse logistics on the performance of logistics firms in Nairobi County, Kenya, findings unveiled that reverse logistics significantly affects the logistics firms' performance. Thus, the study concludes that the

integration of reverse logistics, sturdy-regulated waste systems, effective management of product recalls, the deployment of alternative means of delivery and other virtues have worked out together to bring about cost savings, drive resource utilization and better operational streamlining. The fact that the relationship between reverse logistics and performance is positive and statistically significant demonstrates the need to have logistics companies institutionalize reverse logistics as a critical part of their sustainability and operational policies.

6. RECOMMENDATIONS

Following the outcomes of the investigation, a number of recommendations are put forward. The study recommends that the management of these firms should systematically incorporate eco-design principles into their product development processes. This should involve conducting thorough assessments of materials and manufacturing methods to ensure that products are designed for sustainability, including considerations for recyclability, energy efficiency, and minimal environmental impact throughout their lifecycle. By prioritizing eco-design, logistics firms can enhance their operational efficiency, reduce costs associated with waste and resource consumption, and improve their overall market competitiveness.

The management of these firms should adopt comprehensive green packaging strategies to enhance their performance. This should include the use of biodegradable, recyclable, and reusable materials, as well as optimizing packaging designs to minimize waste and reduce environmental impact. By implementing these practices, logistics firms can enhance their operational efficiency, reduce costs associated with waste management, and improve their overall market competitiveness.

The management of these firms should invest in the development and implementation of energy efficient warehouse designs. This should include the adoption of sustainable technologies such as solar panels for energy generation, energy efficient lighting systems, and advanced inventory management systems to optimize space and reduce waste. Through prioritizing these green warehousing practices, logistics firms can enhance their operational efficiency, reduce their environmental footprint, and improve overall business performance.

The management of these firms should implement structured reverse logistics systems that focus on efficient returns management. This should include establishing clear processes for product returns, refurbishing, recycling, and remanufacturing, which will not only enhance operational efficiency but also contribute to sustainability goals and customer satisfaction. By prioritizing these practices, logistics firms can optimize their resource utilization and reduce costs associated with waste management, ultimately improving their overall performance.

7. CONTRIBUTION TO KNOWLEDGE & SUGGESTIONS FOR FUTURE RESEARCH

This study significantly enhances the existing body of knowledge regarding sustainable logistics by empirically demonstrating the effects of eco-design, green packaging, green warehousing, and reverse logistics on the performance of logistics firms in Nairobi County, Kenya. The findings contribute to theory, policy, and practice by providing a comprehensive framework that explicitly links environmental sustainability practices with operational efficiency and business performance.

The study offers valuable depth for policymakers in Kenya by highlighting the significant impact of eco-design, green packaging, green warehousing, and reverse logistics on firm performance. It advocates for supportive policies such as tax breaks, R&D grants, and mandatory regulations that incentivize logistics firms to adopt these sustainable practices.

The practical implications of this study are significant for logistics firms in Nairobi County, offering actionable recommendations to boost operational performance through sustainability. By systematically adopting practices like eco-design, green packaging, green warehousing, and reverse logistics, firms can improve efficiency, reduce costs, and meet growing consumer demand for environmental responsibility. This study serves as a guide for practitioners to foster a culture of sustainability that enhances their competitive advantage and aligns with global market trends.

Following this study on green practices and logistics firm performance in Nairobi County, future research should include other elements of green practices and their effects. Also, comparative studies across different economic

sectors could determine if these effects are consistent elsewhere. Furthermore, similar studies should be conducted in other counties in Kenya to compare regional variations in the impact of green practices on logistics firm performance.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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