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Role of Green Supply Chain Management strategies in Environmental Sustainability of sugar Firms in Western Kenya

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Abstract: Organizations are facing mounting pressure to consider the environmental impact of their industrial activities, particularly in high-polluting industries. Supply chain management is therefore being increasingly used to address the environmental pollution challenges that arise due to industrial development. Even though sugar companies in Western Kenya have environmental management policies, they still face disputes with local communities due to pollution caused by their p roduction processes. Experts however propose that incorporating Green Supply Chain Management (GSCM) strategies could be effective in reducing the environmental impact of manufacturing processes. However, the effectiveness of these strategies had not been tested through empirical research. The study therefore sought to examine the effect of GSCM practices on environmental performance of Western Kenya's sugar manufacturing companies. An explanatory design was employed to carry out the survey with respondents drawn from various departments of the sugar companies. The instrument's reliability was evaluated through Cronbach's alpha coefficient. The results revealed that GSCM practices were positive and significant, meaning that GSCM practices explain variance in environmental performance by a bigger proportion. The study concluded that manufacturing companies should integrate (GSCM) as an essential strategy for sustainable initiatives, which can contribute to a company's competitive advantage and overall profitability.

Keywords: Green supply chain, environmental performance, sustainability

1. INTRODUCTION

The rapid advancement of the industry has resulted in significant environmental issues, such as the discharge of greenhouse gases, hazardous pollutants, and accidental chemical spills (Peng and Lin, 2008). To address growing global environmental concerns, green supply chain management (GSCM) has emerged as a concept that looks into sustainability elements and environmental considerations in the upstream and downstream supply chain management of both intra- and inter-firm operations (Walker and Jones, 2012). Manufacturers worldwide, including those in emerging African countries, are under increasing pressure to adopt sustainable practices and eco-friendly products due to the growing awareness of the environmental impact of manufacturing processes.

Managing environmental pressures and meeting stakeholder expectations have become increasingly challenging for businesses, as pointed out by Kassinis and Vafeas (2006). The implementation of environmental management techniques has become a major issue for enterprises, according to Hofer, Cantor, and Dai (2012), who emphasize the importance of addressing stakeholder pressures. Tseng, Wang, Chiu, Geng, and Lin (2013) highlight the need for industrial enterprises to actively engage in environmental management in order to achieve sustainable development goals. De Giovanni (2012) notes that environmental degradation has been a significant concern for businesses, especially since society has become more aware of the harmful effects of unsustainable practices.

The manufacturing industry has significant impacts on society, the environment, and the economy, creating opportunities for individuals to contribute to sustainability efforts. With a highly competitive market, businesses are seeking ways to decrease supply chain expenses and have turned to green supply chain management as a means to achieve this objective. GSCM has been identified as a vital management strategy to help companies attain sustainability in their manufacturing processes by reducing environmental impact and increasing efficiency, (De Giovanni, 2012).

Green supply chain management (GSCM) covers all aspects of supply chain management that are required to comply with environmental regulations (Zhu & Sarkis, 2007). They assert that GSCM can be divided into intra-organizational and inter-organizational environmental practices. It is important for a company to be aware of the practices of other members in the supply chain and meet the expectations of stakeholders (Ashby, Leat, & Hudson-Smith, 2007), as a company is a part of the supply chain. The concepts and practices of environmental and social responsibility are increasingly important and are considered a significant aspect of business requirements today (Ashby *et al*., 2012).

Green Supply Chain Management (GSCM) is the practice of integrating environmental sustainability into all aspects of supply chain management. This includes product design, material selection, manufacturing processes, delivery to consumers, and proper disposal at the end of the product's

useful life. According to Bowersox and Closs (1996), the supply chain encompasses all activities related to the transformation and movement of goods or services from raw materials to end users, both internal and external. Srivastava (2007) further emphasized that GSCM involves taking environmental considerations into account throughout the entire supply chain process, from product design to customer delivery.

Different organizations may adopt varying GSCM practices depending on their operations, characteristics, and industrial sector. According to Liu *et al*. (2013), there is no one-size-fits-all approach to GSCM. Dheeraj and Vishal (2012) identified green purchasing, manufacturing, materials management, distribution, marketing, and reverse logistics as the five major GSCM practices. Similarly, Ninlawan *et al*. (2010) highlighted green procurement, manufacturing, distribution, and reverse logistics as the primary GSCM practices. Likewise, Amemba *et al*. (2013) and Srivastava (2007) listed green procurement, manufacturing, operations, reverse logistics, and waste management as significant parts of GSCM. This research focuses on investigating GSCM practices under the categories of green purchasing, manufacturing, distribution, and reverse logistics.

Green manufacturing (GM) involves a manufacturing process that is highly efficient, produces minimal waste or pollution, and utilizes inputs with low environmental impact. It has been noted by Ninlawan *et al*. (2010) that GM can lead to decreased raw material costs, enhanced production efficiency, lower costs related to environmental and occupational safety, and an improved corporate image. Green procurement, on the other hand, is responsible purchasing that concentrates on reducing material usage, reusing items, and recycling materials during procurement activities (Ninlawan *et al*., 2010). It includes all activities designed to ensure that the firm's products, equipment, and services have little or no impact on the natural environment. Green procurement was chosen for this research since it is more proactive and covers strategic issues, unlike green purchasing (Dobler & Burt, 1996).

The concept of green distribution pertains to employing environmentally friendly and effective freight distribution techniques and methods (Rodrigue, Comtois & Slack, 2006) in the logistics industry. The transportation of goods to customers is the most significant environmental threat (Wu & Dunn, 1995) due to the release of toxic substances (such as lead and zinc) and gases (like carbon monoxide, carbon dioxide, and methane) into the atmosphere when petroleum products are used as fuel. These modes of transportation also generate a lot of noise and the construction of transportation infrastructure has a significant environmental impact. It is crucial to choose modes of transportation that reduce or eliminate these problems in order to protect the environment.

Reverse logistics refers to the process of returning materials and products from their point of consumption to their original source with the aim of recovering or creating value or disposing of them safely, all while minimizing the negative environmental impact of a company's products. This term was coined by experts such as Carter & Ellram (1998) and Srivastava & Srivastava (2006). According to Alnoor, Eneizan, Makhamreh,& Rahoma,(2018), businesses utilize reverse logistics to reduce expenses, meet evolving consumer demands, protect their aftermarkets, and demonstrate their commitment to environmental responsibility.

1.1 Sugar Industry Environmental Concerns in Kenya

Environmental concerns are gaining importance in the sugar industry due to various factors such as pressure from environmentalists and local communities, increased regulation, and market demands (Solomon, 2005). The sugar industry, along with other intensive agricultural sectors, faces several environmental challenges. Murty, Kumar, and Paul (2006) highlighted the need for sustainable production in the sugar industry, emphasizing the importance of enhancing production systems to optimize water and nutrient usage, conserve soils, and control weeds, pests, and diseases with minimal pesticide impact.

The sugar industry faces numerous sustainability challenges due to its negative environmental impacts like land use change, soil degradation, high water consumption, atmospheric pollution from burning bagasse and trash, and loss of biodiversity from monocultures (Duarte, Gaudreau, Gibson & Malheiros, 2013). According to Eustice *et al*. (2011), cane burning reduces organic carbon in the soil, while green cane harvesting improves it. They propose that to overcome these challenges, an environmental management plan is necessary to control fertilizer use optimization, tillage techniques, soil acidity and compaction, and avoid soil erosion. This plan should also promote the ethical use of chemicals and conserve water and energy. Moreover, sugarcane production has been associated with several significant socioeconomic risks, including rising inequalities in rural areas, poor wages, and worker exploitation (Leal *et al*., 2013).

The production and processing of sugarcane has been linked to harmful effects on the environment and society, including the destruction of natural habitats, excessive water usage, heavy reliance on pesticides, and pollution of air and water (Sugar task force, 2020). Additionally, this industry affects the livelihoods of a significant portion of Kenya's population, with about 25% depending on it and contributing to 15% of the agricultural GDP. Despite these concerns, there have been no efforts made by Kenyan sugar companies to demonstrate their sustainability practices and environmental impact. Therefore, the purpose of this study is to evaluate the impact of GSCM techniques on the environmental performance of sugar enterprises located in western Kenya.

The NEMA report of 2015 revealed that even though sugar mills have implemented solutions like wastewater treatment, environmental contamination caused by these mills is still increasing. Non-governmental organizations such as the World Bank are promoting cleaner production methods in

Western Kenya to address this issue. One such intervention is the LVEMP II project, which started in 2009 and involves the Kenya National Cleaner Manufacturing Center. This project allows companies to voluntarily adopt cleaner production practices to reduce pollution and improve their competitiveness. However, despite these efforts, the environmental performance of sugar companies in Western Kenya continues to decline, according to KSB's report in 2011.

Empirically, Miima, Neyole, Nyongesa, and Akali (2011) conducted a study to investigate the impact of Mumias Sugar's effluent discharge on River Nzoia. They found that the factory treated the effluents from sugar milling activities in six ponds before releasing them into the river. However, the river was still heavily polluted, and the pollution levels were higher than the permitted levels set by NEMA and WHO. The study suggested that despite using recycling as a reverse logistics activity, the sugar factory could not manage water pollution. Therefore, to enhance environmental performance, sugar companies should adopt cleaner production methods, and all supply chain participants must be involved both upstream and downstream. Similarly, Marabu conducted a study in 2011 that revealed the presence of waste generation in sugar production at Mumias Sugar Company. The study pointed out the high levels of chemical emissions in the river Nzoia, excessive water consumption, and limited use of molasses. The study suggested implementing green procurement, which involves disclosing the environmental impact of all manufacturing inputs.

The preceding information highlights two key points: firstly, sugar companies are an integral part of Kenya's economy; and secondly, these companies still contribute to environmental pollution despite implementing cleaner production methods, which requires a specific approach to address stakeholder concerns. While there is no empirical evidence yet, it is believed that strict adherence to green supply chain management (GSCM) principles can provide a long-term solution to these issues. GSCM involves managing raw materials, components, and processes efficiently to reduce environmental impact from suppliers to customers. Therefore, by adhering to green standards and involving all supply chain participants, sugar companies can improve their environmental performance. The impact of GSCM strategies on the environment performance of sugar companies needs further exploration.

1.2 Environmental Performance

ISO 14001 defines environmental performance as the quantifiable outcomes of an organization's environmental management systems, which are aligned with the organization's environmental policies and goals. Green et al. (2012) assert that the primary goal of environmental performance is to reduce environmental pollution. They suggest that an organization can enhance its environmental performance by minimizing air emissions, decreasing wastewater, reducing solid waste, limiting hazardous substance consumption, and minimizing environmental incidents.

According to Zhu *et al.* (2008), environmental performance as a company's capacity to decrease air emissions, effluent waste, and solid wastes, while also decreasing the use of hazardous and toxic materials, lessening the frequency of environmental accidents, and enhancing the company's environmental condition. Additionally, environmental performance can be seen as a means of reducing substances and emissions that negatively affect the environment. Rao and Holt (2005) suggest that environmental performance can enhance the efficiency and cooperation among business partners, as well as reduce waste, increase environmental presence, generate cost savings, and improve the company's reputation.

In this study, the measures of environmental performance were derived from Epstein & Wisner's (2001) classification of such measures. These measures included categories such as financial, internal process, customer, and learning and growth. Among the specific categories identified in the study were energy consumption, the establishment of an eco-friendly image and reputation, financial savings resulting from environmental efforts, and the generation of hazardous materials.

2. LITERATURE REVIEW

2.1 Review of the Theoretical Literature

This review explores the underlying theories and guiding concepts of the study. The theory that will guide the research is developed, concepts and variables are defined, and variable dimensions are provided.

2.1.1 Stakeholder Theory

In this study, the term "stakeholder" refers to an individual or group that is affected by the financial operations of a firm, as defined by Freeman (2010). Stakeholder theory is one of the most significant theoretical philosophies in environmental management. (Buysse & Verbeke, 2003). Focus has shifted from developing and analyzing the justification for strategic decisions in green supply chains to the systematic coordination of targets by businesses with their stakeholders, including internal business operations, external stakeholders, and suppliers and customers. (e.g., public organizations).

According to the stakeholder approach, environmental management principles are essential to achieving credibility for all parties. (Donaldson &Preston, 1995). Firms need to establish mutual respect with their stakeholders, motivate them, and establish processes that will inspire everyone to take pride in the preservation of the environment. (Sharma & Vredenburg, 1998).In order to better align with stakeholders and enable them to contribute to environmental protection, businesses integrate their environmental monitoring with relevant stakeholders, according to the stakeholder theory. These efforts are successful when integrated mechanisms that support environmental management across concerned parties

are in place. (Donaldson & Preston, 1995; Sharma &Vredenburg, 1988).

The concept of sustainability promotes top management awareness of stakeholder expectations for improved environmental performance because stakeholder pressure encourages businesses to adopt a variety of environmental measures. (Schaltegger, Hörisch, & Freeman, 2019). Stakeholder theory looks at how an organization interacts with its internal and external environments and how this affects the way the organization operates. The public at large are increasingly calling for government and business action in response to the threats of environmental deterioration. As a result, there is an increase in the demand for "green" products and suggestions for tighter environmental regulations. (Delmas & Toffel, 2004)

2.2 The Concept of a Green Supply Chain

Green supply chain management (GSCM) is the integration of environmental practices into supply chain activities, including product design, material sourcing and selection, manufacturing procedures, final product delivery to consumers, and product end-of-life management after its useful life. So it incorporates environmental issues with supply chain management. The integration of internal and external activity, as well as the transformation and flow of goods or services from raw materials to end consumers, are all included in the supply chain. (Bowersox and Closs 1996).

2.3 Empirical Literature Review

The study reviewed literature on the relationship between green supply chain management and environmental performance to enable identification of gaps to be addressed by policy and in the industry of sugar manufacturing in Kenya.

Al-Sheyadi, Muyldermans, and Kauppi (2019) investigated the complementarity of green supply chain management practices and its effect on environmental performance of the Omani manufacturing enterprises. With the aim of studying how internal and external GSCM strategies impacted both environmental impact and cost savings, their findings demonstrated a strong correlation between collective GSCM proficiency and associated environmental effect. Supporting the idea that combining GSCM approaches is more beneficial than single best practices, the study suggested that managers should prioritize implementing a bundle of GSCM procedures instead.

Geng, Mansouri, and Aktas (2017) conducted a meta-analysis on the relationship between green supply chain management and performance in Asian emerging economies. They found 50 publications published between 1996 and 2015 that evaluated 11,127 AEE manufacturing companies through a systematic literature review. A conceptual framework was then created and analyzed in a meta-analysis using 130 effects out of 25,680 effect sizes. According to the study, GSCM techniques improved performance in four areas: financial, environmental, operational and social. The relationships between several GSCM practices and performance were found to be moderated by industry type, firm size, ISO certification, and export orientation.

Afum,Agyabeng-Mensah, and Owusu (2020) conducted a study to analyze the impact of green organizational culture in mediating the connection between environmental management practices (EMPs) and environmental performance of Ghanaian manufacturing SMEs. Interview data was collected from 157 manufacturing organizations, and the Partial Least Squares-Structural Equation Modeling approach was utilized to assess all hypothesized relationships. Their findings indicated that green organizational culture and EMPs (green manufacturing and green procurement) had a significant impact on environmental performance. It was also observed that EMPs had a positive effect on green organizational culture, thus providing evidence that EMPs and environmental performance could be mediated by green corporate culture.

Rao and Holt (2005) investigated whether Southeast Asian businesses' economic performance and competitiveness are enhanced by GSCM methods. Utilizing structural equation modeling, the data was analyzed. The findings indicated that GSCM helps to improve environmental performance, reduce waste, and save money in addition to helping to improve efficiency and synergy among business partners and their lead organizations. They suggested that there must be a clear connection between these measures and improved economic performance and competitiveness in order for GSCM techniques to be widely implemented by all businesses in Southeast Asia.

Green Zelbst, Meacha, and Bhadauria (2012) looked at how manufacturing business performance in the United States was affected by GSCM practices. A complete model of GSCM practices and performance was hypothesized and evaluated as part of this study. The idea was expanded to include green supply chain strategies that connect manufacturers with partners in the supply chain. According to the findings, manufacturing companies' adoption of GSCM practices enhances operational performance while also enhancing environmental and economic performance.

Younis, Sundarakani and Vel (2016) examined how supply chain environmental management strategies could help 117 industrial firms in the United Arab Emirates better their corporate performance (CP). In order to examine the relationship between four key GSCM elements: ecological design, sustainable purchasing, environmental collaboration, and reverse logistics and four CP measures—operational performance, environmental performance, financial performance, and social activity.The study developed a research model controlling for three key variables. (company size, company age and environmental management system certificate). The research discovered that various GSCM methods had distinctive effects on CP measures. Environmental protection was not impacted by any of the four GSCM activities, but operational effectiveness was found to

be significantly impacted by green purchasing and environmental cooperation.

Eltayeb, Zailani, and Ramayah (2011) conducted a study on green supply chain strategies and environmental sustainability among Malaysian businesses with ISO-14001 certifications. The study looked at the actual environmental, financial and intangible benefits of implementing green supply chain activities. The hypotheses were tested and the results showed that green supply chain activities have a positive effect on performance. Ecological design was found to have a significant positive impact on all four outcomes (environmental, economic, cost efficiency and intangible outcomes). Only savings were considered to be a major advantage of reverse logistics. However, green purchasing was not shown to have a significant effect on any of the four outcomes. It noted that by making environmentally friendly products and returning products and packaging, companies can improve the environment by reducing waste and improving the use of resources, and achieving financial benefits and savings.

In another study, Jaaffar and Kaman (2020) looked at environmental performance and GSCM techniques. The study focused on employee behavior in the Malaysian chemical industry. Using a theoretical framework of GSCM practices, an empirical study of GSCM practices and environmental sustainability was conducted. The results showed that employees' perceptions of environmental sustainability in terms of green purchasing practices had no significant relationship with product-related green design, packaging-related ecological design, or reverse logistics.

In conclusion, there are divergent findings from empirical study on how green supply chain management affects environmental performance. A significant positive relationship between overall GSCM effectiveness and environmental impact was discovered by Al-Sheyadi, Muyldermans, and Kauppi's (2019) research. Similar findings were made by Zhu and Sarkis (2004), who discovered that Chinese manufacturing companies that were among the pioneers of green supply chain management techniques experienced GSCM practices having a positive and significant impact on their operational and environmental performance. Green Zelbst, Meacha, and Bhadauria (2012) obtained similar results as well as Rao and Holt (2005).

In 2016, Khaksar, Abbasnejad, Esmaeili, and Tamoaitien looked into how green supply chain management techniques affected the Iranian cement industry's ability to compete on the basis of both environmental performance and competitive advantage. Using correlation and structural equation modeling, this descriptive investigation was conducted. The GSCM elements that were looked at included the green supplier and the green innovation. Validity was assessed using reflectance data-based diagnostic assessment models, and convergent validity and reliability of those models were utilized to measure reliability. Using Fornell-Larcker criteria, the diagnostic validity was established. The research found a positive and significant relationship between a green supplier, green innovations, and environmental performance.

Korir (2014) conducted research in Nairobi, Kenya, on sustainable supply chain management techniques and business performance in the automotive industry. GM, GD, green procurement, and reverse logistics were examined as GSCM constructs in the study. It looked at three aspects of an organization's performance: economic, environmental, and intangible. The results for environmental performance showed that using GSCM methods increased environmental performance.

Laari, Töyli and Ojala (2018) investigated the impact of competitive strategy and GSCM on the financial and environmental protection of Finnish logistics service providers (LSPs). This paper analyzed the competitive strategy and GSCM of 266 LSPs and tested their relationships with environmental and financial performance using financial reporting information and statistics from the Finnish National Logistics Survey. The results revealed that LSPs with strong brands and operational excellence are more advanced with GSCM than LSPs that do not excel in some of the competitive priorities. Environmental performance was positively related to GSCM practices, but not to financial performance.

Other investigations, on the other hand, contradicted the previous conclusions. Younis, *et al.* (2016) established that GSCM practices have no significant effect on environmental sustainability. Green purchasing habits, eco-related product design, eco-related packaging design, and reverse logistics were not significantly linked with how they viewed their environmental performance, according to Jaaffar & Kaman (2020) in their analysis of GSCM practices and environmental performance of Malaysia Chemical Related Industry. Furthermore, no similar research has been conducted in Kenya's sugar producing firms, despite the fact that it is a major contributor to the country's industrial discharge into Lake Victoria's River basins, which has been a major environmental management issue. The true impact of GSCM methods on sugar companies' environmental performance in Western Kenya is still unknown.

3. RESEARCH METHODOLOGY

3.1 Research Design

The study was anchored on the positivist research philosophy. The main objective of positivist research is to produce causal or explanatory relationships that, in turn, enable prediction and management of the phenomenon under consideration. (Mir, & Greenwood,2021). The current study fits this paradigm because it seeks to establish the relationships that exist between GSCM practices, SCI and environmental performance of firms. According to Park, Konge & Artino, (2020), isolating and limiting the impact of all factors so that only the important variables of interest are investigated is a key objective in positivist experimentation.

Since the purpose of this study is to establish correlations between variables, an explanatory research design was chosen. Explanatory research design is the most appropriate approach for a study that tries to establish both direct and complex indirect causal links among variables, according to Bairagi & Munot (2019). On the other hand, an explanatory study aims to justify and explain the descriptive data. It attempts to answer "why" and "how" questions, whereas descriptive studies may explore "what" questions (Baskerville, & Pries-Heje,2010). It expands on descriptive and exploratory research to pinpoint the true causes of a phenomenon. Explanatory study seeks out causes and motivations and offers data that can be used to confirm or reject an explanation or prediction. It is carried out to identify and document some connections between various components of the phenomenon under investigation. (Rahi, 2017)

3.2 Area of Study

The research was carried out in Western Kenya, where the majority of sugar mills are located. Chemelil Sugar Company, West Kenya Sugar Company, Nzoia Sugar Company, Sony Sugar Company, Kibos Sugar and Allied Industries, Butali Sugar Mills Limited, Sukari Company, and Busia Sugar Company all participated in the study. The sugar mills evaluated were those that are currently milling and have an environmental management program in place. There were eight sugar companies surveyed.

3.3 Reliability Test

A pilot study was done with twenty (20) employees, accounting for 10% of the total responders. A pilot research sample should be 10% of the sample expected for the bigger parent study, according to Johanson & Brooks (2010). Connelly (2008), who also suggested a 10% sample size for the study, agrees. These people were not a part of the study and were left out of the final analysis. The questionnaires were examined for validity and reliability, allowing any necessary adjustments to be made prior to the start of the study.

The degree to which an experiment, test, or any measuring process provides the same results in multiple trials is referred to as reliability. The goal of reliability is to determine the consistency and accuracy of replies. The optimum motivation is to double-check the instrument's stability by giving it to survey respondents twice. When working with top executives, like in this study, this is more difficult (Sekaran, 2016). Cronbach's Alpha was utilized to determine the instrument's reliability in this investigation (Cronbach, 1951). According to Ercan, *et al*,(2007), a study is considered appropriate if the dependability coefficient is more than 0.7. Each of the independent, and dependent variables were tested for reliability. The results are displayed in the table below:

Table 1: Cronbach's Alpha Reliability Test Statistics

Item	Cronbach's Alpha	Cronbach's alpha based on standardized items	No. of items
Green manufacturing	.941	.940	5
Green procurement	.916	.915	5
Reverse logistics	.789	.791	5
Green distribution	.740	.742	5
Environmental performance	.837	.836	5
Average	**0.8446**	**0.8448**	

Source: Survey Data,(2021)

Because all Cronbach's alpha coefficients were over 0.70, the data collecting tool provided a highly satisfactory score, as shown in **table 1.** Alpha coefficients greater than 0.70, according to Ercan *et al*., (2007), imply that the acquired data have a relatively high level of internal consistency and can be extrapolated to reflect the opinions of respondents in the target group. To determine if the instrument had any flaws, the data was cross-checked. As a consequence of the pilot study's findings, the majority of queries were clear and relevant.

3.4 Data Analysis

A blend of descriptive and inferential statistics was used to analyze the data. Frequencies and percentages were used in descriptive analysis. When applicable, the study used measures of central tendency like mean, mode, and median, as well as measures of dispersion like range and standard deviation. The extent to which sugar firms adopt supply chains that are environmentally friendly as well as their level of environmental performance, was assessed using descriptive analysis of source data. To measure the link between environmentally friendly supply chain management techniques and performance, as well as test the hypotheses, inferential statistics were used. With environmental performance as the dependent variable, GSCM practices as the independent, multiple linear regression was used. Individual significance was determined using the t-test. The null hypothesis was rejected in both situations above if the p-value < 0.05; otherwise, the null hypothesis was not rejected.

3.5 Regression Models

The proposed model for objective one is as below:

$$Y= \beta_0+\beta_1X_{1i} + \beta_2X_{2i}+ \beta_3X_{3i} +\beta_4X_{4i}$$

Where:

X_1= Green Manufacturing,
X_2=Green procurement
X_3=Reverse Logistics
X_4=Green Distribution
ε =Error Term

3.6 Normality Testing

Normality was determined using skewness and kurtosis. The distribution was considered normal if the skewness and kurtosis values were within the range of -2.0 to 2.0 (George, & Mallery, 2010). According to Table 4, the skewness and kurtosis values for each variable were within the acceptable range. The normality assumptions were therefore satisfied.

Table 2: Testing for Normality Requirements

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Green manufacturing	127	3.0958	1.01564	-.096	.215	-.849	.427
Green procurement	127	3.1549	.88321	-.077	.215	-.570	.427
Reverse logistics	127	3.1798	.94202	-.197	.215	-.688	.427
Green distribution	127	3.4646	.85104	-.273	.215	-.563	.427
Environmental performance	127	3.4252	.87532	-.278	.215	-.640	.427

***Source**: Survey Data (2021)*

3.7 Homogeneity of Variances Testing

The uniformity of variance was determined through Levene's test for similarity in variances. The p-value for Levene's test should be greater than 0.05 in order to satisfy the requirement of uniformity of variance, according to Glass (1966) and Ho (2013). The homogeneity of variance assumption is violated if the p-value < 0.05. The idea of homogeneity of variance makes sure that each independent group's distribution of outcomes is comparable to or equal to another. If independent groups are not similar to one another in this way, it might lead to false findings. According to the p-values found for Levene's test, the homogeneity of variance has not been violated, so the proportions of the outcome measures in each independent group are similar and comparable.

Table 3: Homogeneity of Variances test Results

	Levene Statistic	**df1**	**df2**	**Sig.**
Green manufacturing	.823	19	105	.675
Green distribution	1.034	19	105	.430
Reverse logistics	1.034	19	105	.430
Green distribution	.915	19	103	.566

Source: Survey Data, (2021)

4. RESULTS AND DISCUSSION

4.1 Assessing the significance of Green Supply Chain Management Practices

Green distribution, reverse logistics, green production, and green purchasing were the four constructs that were used to assess the GSCM as an explanatory variable. A paired sample T-test study was used to determine the significance of the GSCM practice constructs, with the following findings:

Table 4: Paired samples correlations

		N	Correlation	Sig.
Pair 1	GM & Environmental Performance	127	.468	.000
Pair 2	GP & Environmental Performance	127	.516	.000
Pair 3	RL & Environmental Performance	127	.480	.000
Pair 4	GD & Environmental Performance	127	.293	.001

Source: *Survey data, (2021)*

The table above shows that, at a significance level of $p<0.05$, there was a positive and significant correlation between all indicators of green supply chain management strategies and environmental performance.

4.2 Effect of GSCM practices on Environmental Performance of Sugar Firms

Assessing how green supply chain management practices impacted the environmental performance of sugar companies in Western Kenya was the study's main objective. Reverse

logistics, green distribution, green manufacturing, and green procurement were taken into account in the research as a function of the GSCM practices by sugar companies. The average score of all items for each instance was used to compute the construct scores, which were then used to create a multiple regression model.

The study went on to determine whether GSCM constructs had an effect on the environmental performance of the surveyed sugar firms in western Kenya after testing the assumptions of multiple regression and ensuring that the measures of GSCM practices were reliable and could be validly used to measure what they were intended to measure. The findings were summarized as shown below:

Table 5: Effect of GSCM practices on EP of sugar firms in Western Kenya

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.804	.034		23.555	.000		
	Zscore(GM)	.296	.034	.440	8.627	.000	.995	1.005
	Zscore(GP)	.296	.035	.439	8.522	.000	.973	1.028
	Zscore (RL)	.258	.035	.383	7.453	.000	.978	1.022
	Zscore(GD)	.155	.035	.231	4.503	.000	.987	1.013
a. Dependent Variable: Performance								

Source: *Survey data, 2021*

Multicollinearity is the term used to describe the presence of a strong correlation between two or more independent variables in a regression model. This is a potential problem in multiple linear regression that needs to be addressed. Multicollinearity is problematic because it lessens the statistical significance of an independent variable. Low levels of collinearity pose no threat to the regression model. The multicollinearity assumption, however, states that the VIF threshold value should be 10 or less (Paul, 2006), and it was used to test for non-dependence of the independent variables because it is challenging to ascertain the precise contribution of individual predictors when independent variables are highly correlated. To evaluate multicollinearity, VIF and its inverse, the tolerance, were used. The tolerance shown in the regression table above fluctuated between 0.97 and 0.99, according to Yu, Jiang, and Land (2015), implying that there was no multicollinearity between the independent variables. Similarly, the result of the regression model showed no autocorrelation; the Durbin Watson statistic was 2.006. The general rule is that the suggested Durbin Watson statistic should lie between 1.5 and 2.5.

The results show that green manufacturing (GM), green procurement (GP), Reverse logistics (RL) and green distribution (GD) had beta standardized coefficients and p values of $\beta = 0.440$, $p < .05$; $\beta = 0.439$, $p < .05$ and $\beta = 0.383$, $p < .05$ and $\beta = 0.231$, $p < .05$ respectively. These means all the beta coefficients, β, which are the degrees to which the independent variables each explain the dependent variable, are positive and significant.

The standardized β coefficient of green manufacturing shows that a unit standard deviation of GM causes 0.440 standard deviations in environmental performance of the firms while a unit standard deviation of green procurement, reverse logistics and green distribution causes 0.439, 0.383 and 0.231 standard deviations in environmental performance of the sugar firms.

Similarly for the un-standardized coefficients, a unit % age change in green manufacturing is likely to result in a change in sugar firm's environmental performance by 0.296% in the positive direction while a unit % age change in green procurement is likely to lead to change in environmental performance of sugar firms by 0.296 % in the positive direction. Additionally, a unit % age change in reverse logistics activity and green distribution by the sugar firms is likely to lead to change in their environmental performance by 0.258% and 0.155% respectively in the same direction. The model summary statistics is shown in the table below:

Table 6: Summary statistics of Effect of GSCM on Environmental performance

Model	R				Change Statistics	

		R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.827[a]	.684	.674	.38483	.684	66.115	4	122	.000	2.006
a. Predictors: (Constant), Zscore(GD), Zscore(GM), Zscore(RL), Zscore(GP)										
b. Dependent Variable: Environmental Performance										

Source: *Survey data, (2021)*

R^2 is 0.684 and is significant. Similarly, the adjusted R^2 is 0.674 and also significant. The shrinkage in this case is 0.01 (0.684-0.674) which is below the level of 0.5 recommended by Field (2013). This indicates that the model is valid, has good predictability, and predicts variance of performance at 68.4 percent, insinuating that green manufacturing (GM), green procurement (GP) reverse logistics (RL) and green distribution (GD) all together explain 68.4 percent of the sugar firms' environmental performance. The analytic model that may be developed from this cause-and-effect situation is as follows:

Sugar firms' EP = 0.804+ 0.296GM+0.296GP+0.258RL+0.155GD

Where:
EP = Environmental performance
GM = Green manufacturing
GP = Green procurement
RL = Reverse logistics
GD = Green distribution

A hypothesis testing was carried out on the constructs of green supply chain management using Friedman's two-way analysis of variance at a significance level of 0.05. This test was used because the data was ordinal (Likert scale). The test can also be used to determine if there are statistically significant differences for comparisons of multiple groups. The results in the table below were obtained. The null hypothesis was rejected.

$H0_1$: There is no significant effect of green supply chain management practices on environmental performance of sugar firms in western Kenya.

Table 7: Hypothesis testing on the relationship between GSCM practices & EP

	Null Hypothesis	Test	Sig	Decision
1	The distribution of GM, GP, RL, GD and Environmental performance are the same	Related Samples Friedman's Two-Way Analysis of Variance by Ranks	.000	Reject the null hypothesis

Source: Survey Data, (2021)

The findings that GSCM practices were positive and significant predictors of environmental performance of sugar firms are in line with those of Khaksar, *et al* (2016), who conducted an investigation into how strategies of GSCM affect environmental performance Iran's the cement industry and discovered that there was a positive and significant correlation. Al-Sheyadi, Muyldermans, and Kauppi (2019) also found a strong positive correlation between environmental impacts and collective GSCM competency. According to Afum *et al*. (2020), green organizational culture, green manufacturing, and green procurement were also important indicators of environmental performance. Zhu and Sarkis (2004) found that GSCM practices have a positive and significant impact on environmental and operational performance in their investigation into the associations between operational processes and performance among early implementors of environmentally friendly supply chain management techniques in Chinese manufacturing firms.

In their investigation into whether GSCM practices contribute to competitiveness and economic performance in South East Asian firms, Rao and Holt (2005) reported that GSCM practices increase efficiency and synergy among business partners while also contributing to the improvement in environmental aspects of performance. Green *et al*. (2012) were in agreement that adopting GSCM practices by manufacturing firms improves environmental and economic performance, which has a positive impact on operational performance.

In addition, Geng, Mansouri, and Aktas (2017) concur that GSCM approaches enhance performance in four areas: social, operational, environmental, and economic. Jermsittiparsert *et al* (2019) confirmed that environmental performance is

significantly and positively linked to GSCM strategies. In a similar vein, Korir (2014) discovered by applying GSCM techniques, Nairobi's automobile industry improved its environmental performance. Finally, Laari, Töyli, and Ojala (2018) discovered that Finnish logistics service providers' financial and environmental performance were positively correlated with GSCM practices, but not with financial performance. They also found out that these outcomes were influenced by a competitive strategy and sustainable supply chain management. Despite the fact that this study's findings are in line with those of previous ones, There is no doubt that none of the four GSCM practices that were used in the current study—green manufacturing, green procurement, green reverse logistics, and green distribution were examined in the earlier ones.

The study's findings also indicate some Contradictions. Green procurement has an impact on economic and social performance but has no impact on environmental performance, according to Le, (2020), whereas Younis, *et al.,* (2016) established that green purchasing and reverse logistics have no significant impact on environmental performance of firms in the UAE manufacturing industry. This can be explained by the fact that the research was conducted in a variety of settings.Another contradiction was by Eltayeb, Zailani, and Ramayah (2011) who found that green purchasing had no significant impact on the environmental performance of ISO-14001 certified enterprises in Malaysia. This means that green procurement may not always lead to improved environmental performance, and in certain situations, it may not even predict environmental performance at all, or possibly have a negative impact.

Another reason for the contraction could be the sampling method utilized in these investigations. Earlier research employed single constructs of a variable on the sample, however, the current study used census and was robust in constructs for each variable. A study by Jaaffar and Kaman (2020) found that reverse logistics was not significantly correlated with the environmental performance of Malaysian chemical-related industries. This could be due to the fact that Malaysian companies are more focused on eco-design, which reduces the need for recycling materials by designing products in such a way that their environmental consequences are considered before final production.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

Multiple regression results of the effect of GSCM on environmental performance of sugar firms in Western Kenya showed a positive significant coefficient for all the four measures of GSCM (Green manufacturing, green procurement, reverse logistics and green distribution). As a result, it was confirmed that GM, GP, RL and GD are positive and significant predictors of environmental performance of the firms surveyed. Consequently, the null hypothesis for the objective was rejected

5.2 Conclusions

The study concluded that sugar companies in western Kenya have adopted GSCM strategies, however the extent to which each green practice has been implemented varies from one company to the next. GSCM practices are also good and substantial determinants of sugar firms' environmental performance in western Kenya. Individually or in combination, these activities can explain environmental performance in a variety of ways. It can also be argued that sugar companies value GSCM practices and use them extensively.

5.3 Study's Recommendations

The study recommends that Kenyan sugar firms keep employing environmentally conscious practices throughout their operations, from the procurement of raw materials through the process of development of products up until they are delivered to the final consumer. This would guarantee that manufacturing enterprises' negative environmental effects, such as the acceleration of global warming brought on by greenhouse gas emissions, are kept to a minimum. Additionally, sugar firms have to continue to work toward regional and global environmental recognition like ISO 14001, which will help them compete in both domestic and foreign markets. In the current or any other manufacturing context, future study should focus on moderation or mediation in the interaction between GSCM, lean management, and firm environmental performance. This will help to clarify the theories that underpin this research, particularly the stakeholder theory. Corporate policy should also be aligned with initiatives that address global warming and foster environmental sustainability.

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