

*Original Research*

# Effect of Green Supply Chain Management Practices on Environmental Performance of Sugar Firms in Western Kenya

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## Abstract

Organizations are facing increasing pressure to consider the environmental impact of their industrial operations, particularly in high-polluting industries. Supply chain management is now being utilized more frequently to address the environmental pollution challenges that arise due to industrial development. Despite the implementation of environmental management policies, sugar companies in Western Kenya are still encountering disputes with local communities due to pollution caused by their production processes. Experts suggest that the incorporation of Green Supply Chain Management (GSCM) strategies may be effective in reducing the environmental impact of manufacturing processes. However, the effectiveness of these strategies had not been examined through empirical research. As a result, this study aimed to investigate the impact of GSCM practices on the environmental performance of Western Kenya's sugar manufacturing firms. A survey was conducted using an explanatory design, with 127 respondents drawn from various departments within the organizations. The reliability of the survey instruments was evaluated using Cronbach's alpha coefficient. The findings revealed that  $R^2$  for GSCM practices was 0.684 ( $p=0.00$ ) and statistically significant, indicating that GSCM practices account for 68.4% of the variance in environmental performance. The study concluded that manufacturing companies should adopt GSCM as a critical strategy for sustainable initiatives, which can contribute to a company's competitive advantage and overall profitability.

**Keywords:** Pollution prevention, Resource conservation, Sustainability.

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## 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). In response to increasing worldwide environmental apprehensions, the concept of Green Supply Chain Management (GSCM) has arisen. GSCM refers to the incorporation of environmentally friendly practices into all aspects of supply chain management. This encompasses product design, material selection, manufacturing processes, delivery to customers, and proper disposal. According to Bowersox and Closs (1996), the supply chain encompasses all processes involved in the alteration and transportation of commodities or provisions from their raw material stage to their final destination with the customers, both within and outside the organization. Srivastava (2007) further highlights that GSCM involves considering environmental factors throughout the entire supply chain process, from product design to customer delivery.

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) pertains to a production process that is exceedingly efficient and generates minimal waste or pollution, utilizing inputs that are environmentally sound. Ninlawan *et al.* (2010) have observed that GM can potentially reduce costs related to raw materials, enhance overall production efficiency, decrease expenses attributed to environmental and occupational safety concerns, in addition to promoting a more favorable corporate image. In contrast, green procurement is centered on responsible purchasing which aims to minimize material usage, promote item reuse, and facilitate the recycling of materials during procurement activities (Ninlawan *et al.*, 2010). This encompasses all operations designed to ensure that the products, machinery, and services produced by a company have minimal impact on the natural environment. The present investigation concentrates on green procurement as it is proactive and addresses strategic matters, in contrast to green purchasing (Dobler & Burt, 1996).

The idea of green distribution refers to implementing eco-friendly and efficient methods and techniques for the shipment of goods in the logistics industry (Rodrigue, Comtois & Slack, 2006). The transportation of products to consumers is a major environmental concern due to the emission of hazardous substances such as lead and zinc, and gases like carbon monoxide, carbon dioxide, and methane when utilizing petroleum-based fuels (Wu & Dunn, 1995). Furthermore, these means of transportation produce excessive noise and the development of transportation infrastructure damages the environment significantly. In order to safeguard the environment, it is critical to opt for modes of transportation that minimize or eliminate these concerns.

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. The term "reverse logistics" was coined by experts such as Carter & Ellram (1998) and Srivastava & Srivastava (2006). Alnoor, Eneizan, Makhamreh & Rahoma (2018) stated that businesses utilize reverse logistics for various reasons,

including reducing expenses, meeting evolving consumer demands, protecting their aftermarkets, and demonstrating their commitment to environmental responsibility.

### *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, despite the implementation of solutions such as wastewater treatment, environmental contamination caused by sugar mills in Western Kenya remains on the rise. Non-governmental organizations like the World Bank have been promoting cleaner production methods to tackle this issue. An example of such intervention is the LVEMP II project, which began in 2009 and is being undertaken by the Kenya National Cleaner Manufacturing Center. This project permits firms to adopt cleaner production practices voluntarily, thereby reducing pollution and enhancing their competitiveness. However, the environmental performance of sugar companies in Western Kenya continues to deteriorate, according to KSBs report of 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.

### *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.

### *Statement of the Problem*

The sugar industry in Kenya is a crucial contributor to the country's economy. However, the production of sugar has a negative impact on the environment. To address growing concerns about environmental conservation, sugar companies in western Kenya need to adopt green supply chain management (GSCM) practices to minimize their environmental footprint. Nonetheless, implementing GSCM practices in these companies faces various challenges. One of these challenges is a lack of understanding of GSCM practices among management and employees, as most firms stick to traditional manufacturing methods rather than prioritizing environmental impact. Additionally, limited regulatory frameworks enforce the mandatory adoption of GSCM practices by sugar companies. While Kenya has environmental regulations, the enforcement is weak, leading to non-compliance by most industries. Finally, the implementation and maintenance costs associated with GSCM practices have deterred some sugar companies from embracing them. Despite the potential cost savings, these firms are unwilling to risk hurting their bottom line. Against this backdrop, the study aims to examine the impact of GSCM practices on the environmental performance of sugar companies in Western Kenya.

### *Conceptual Framework*

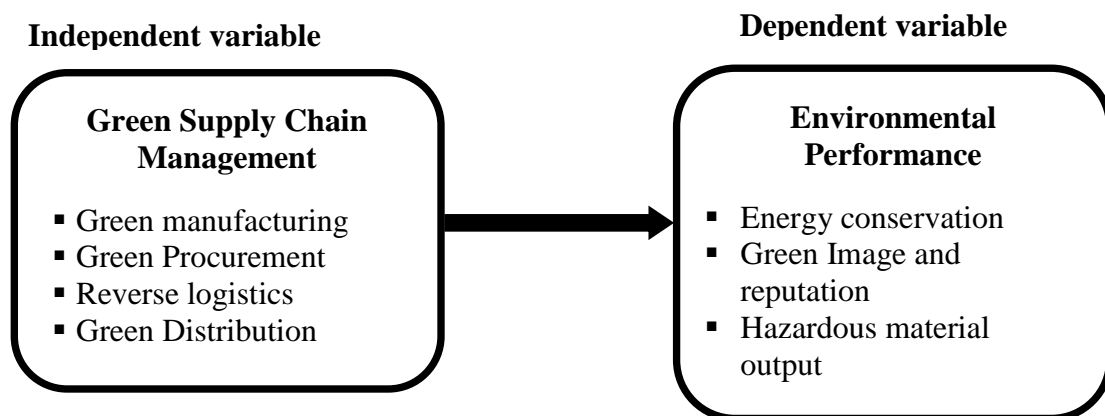


Figure I: Expected link between GSCM and Firm's Environmental Performance  
Source: Adapted from Ninlawan *et al.*, (2010), Zhu & Sarkis(2004) and Epstein & Wisner's (2001)

As Zhu and Sarkis (2004) point out in the figure above, the independent variable, green supply chain management, is expected to predict the dependent variable, environmental performance. This relationship is projected to be moderated by Supply Chain Integration. The constructs of green supply chain management are green manufacturing, green procurement, green distribution, and reverse logistics (Ninlawan *et al* 2010), while supply chain integration is measured by assessing the level of cooperation, coordination and collaboration among supply chain partners.

Environmental performance is projected to improve in terms of energy savings, hazardous material production, green image and reputation, and product safety when supply chain partners work together to coordinate and share information on greener activities. GSCM is also intended to contribute to design for the environment (DFE) or eco-design, which means that corporations will focus on decreasing a product's environmental effects before it is manufactured, distributed, and used. The companies will engage in a continual improvement approach to reduce the environmental impact of their production activities.

## **Literature Review**

### *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.

### **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)

### *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).

### *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.

Ivanova (2020) did research on green procurement management in the context of SMEs in developing nations, with a focus on companies based in Kyiv and the surrounding region. The survey instruments used were subjected to structural equation modelling and factor analysis to evaluate the hypotheses. In light of this, it was determined that green procurement had a positive effect on society, the ecosystem, and SMEs' economic standings. Because it would improve their performance, the report advised SMEs from developing states to give adopting green supply methods top priority.

Li, Xue & Zhao (2021) conducted a global review on the practices of green supply chain management (GSCM) and analyzed their effects on environmental performance. Their study involved a literature review of GSCM and bibliometric analysis of publications, where they observed a significant growth in the literature on GSCM over the course of the last two decades. The review highlighted the various aspects of GSCM such as green purchasing, green logistics, and green innovation. The bibliometric analysis suggested that research on GSCM is widely spread across different disciplines and calls for a multidisciplinary approach to address the issue of green supply chain management.

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.

Le (2020) looked at the connection between GSCM methods and long-term performance in Vietnamese building materials manufacturing companies. For source data, a survey of 218 manufacturers of building materials in Vietnam was conducted. According to the research, green procurement had a positive impact on economic and social performance but no effect on environmental performance, whereas green design and manufacturing had positive and significant benefits on three categories of outcomes. Additionally, the results showed a positive and significant correlation between sustainable distribution and environmental sustainability.

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.

The study by García Alcaraz, *et al.* (2022) aimed to examine how green supply chain management (GSCM) practices affect the environmental performance of manufacturing companies in Mexico. Specifically, the research focused on the maquiladora industry and analyzed the relationship between GSCM practices, environmental impact (EI) and environmental cost savings (ECS). The results showed that the implementation of an environmental management system (EMS) had a significant effect on reducing EI ( $\beta = 0.442$ ) and achieving ECS ( $\beta = 0.227$ ). However, the use of eco-design (ED) did not have a direct effect on EI ( $\beta = 0.019$ ) or ECS ( $\beta = 0.006$ ), which may be attributed to the maquiladora industry's foreign ownership and focus on production rather than product design.

Fianko, Amoah, and Dzogbewu (2021) conducted a quantitative survey research design to evaluate the effects of internal and external green supply chain practices on environmental performance in construction firms. The sample consisted of 217 employees from fifty construction firms, and Structural Equation Modeling was used for data analysis. The results revealed that green design did not have a substantial positive relationship with environmental performance. Nevertheless, green design exhibited a positive effect on external green practices such as green purchasing and green construction, which in turn had a direct positive correlation with environmental performance. Consequently, green design through external green supply chain practices had a significant positive relationship with environmental performance. The study also identified that firm size moderates the relationship between green design, external green supply chain practices, and environmental performance in construction companies.

Tran, Phan, Ha and Hoang (2020) conducted an assessment of the influence of supply chain quality integration on green supply chain management, environmental

performance, and financial performance. The research analyzed data from 568 Vietnamese tourism businesses. Based on the findings, it was observed that supply chain quality integration had a constructive impact on green supply chain management and financial performance. Moreover, green supply chain management had a favorable impact on environment performance and financial performance. In addition, green supply chain management entirely played the role of mediator in the relationship between supply chain quality integration and financial performance. However, the size and institutional pressure did not play any moderating role in the relationship between green supply chain management and financial performance, and environment performance.

In conclusion, empirical studies have presented diverse findings on the influence of green supply chain management (GSCM) on environmental performance. Al-Sheyadi, Muyltermans, and Kauppis (2019) discovered a significant positive relationship between overall GSCM effectiveness and environmental impact. Similarly, Afum et al. (2020) found that green manufacturing and procurement had a significant impact on environmental performance. García Alcaraz et al. (2022) also reported that implementing an environmental management system (EMS) had a notable effect on reducing environmental impact. However, the study revealed a contradiction whereby the use of eco-design (ED) did not have a direct effect on environmental impact or environmental cost savings. Furthermore, Tran et al. (2020) concluded that GSCM had a favorable impact on both environmental performance and financial performance.

However, several other studies yielded varied outcomes, rendering it difficult to arrive at any definite conclusions. Notably, Fianko, Amoah, and Dzogbewu (2021) established that green design did not have a considerable positive connection with environmental performance. Le (2020) studied the relationship between GSCM techniques and long-term performance in Vietnamese manufacturing companies that produced building materials. As per the analysis, green procurement had a constructive impact on economic and social performance, but it had no effect on environmental performance. Conversely, green design and manufacturing had positive and noteworthy benefits across three outcomes categories. Furthermore, the findings indicated a positive and notable correlation between sustainable distribution and environmental sustainability. Moreover, there has not been any analogous research carried out in sugar manufacturing firms in Kenya. Despite the fact that it plays a significant part in the discharge of industrial waste into the river basins of Lake Victoria, which has led to a major environmental management problem in the country. The actual effect of GSCM practices on the environmental performance of sugar firms in Western Kenya remains uncertain.

## **Methodology**

### *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)

### *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.

### *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	

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.

### *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.

### *Regression Models*

The proposed model for objective one is as below:

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i}$$

Where:

- X<sub>1</sub> = Green Manufacturing,
- X<sub>2</sub> = Green procurement
- X<sub>3</sub> = Reverse Logistics
- X<sub>4</sub> = Green Distribution
- ε = Error Term

### *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

### *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

## Results and Discussion

### *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

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.

### *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		
	Z score (GM)	.296	.034	.440	8.627	.000	.995	1.005
	Z score (GP)	.296	.035	.439	8.522	.000	.973	1.028
	Z score (RL)	.258	.035	.383	7.453	.000	.978	1.022
	Z score (GD)	.155	.035	.231	4.503	.000	.987	1.013

a. Dependent Variable: Performance

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,  $\beta$ , which are the degrees to which the independent variables each explain the dependent variable, are positive and significant. The standardized  $\beta$  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	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.827 <sup>a</sup>	.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										

$R^2$  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:

$$\text{Sugar firms' EP} = 0.804 + 0.296\text{GM} + 0.296\text{GP} + 0.258\text{RL} + 0.155\text{GD}$$

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<sub>1</sub>:** 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

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 implementers 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. Jermisittiparsert *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.

## **Summary, Conclusions and Recommendations**

### *Summary of the Findings and Conclusion*

In summary, the study established that green supply chain management practices used by sugar firms in Western Kenya have a positive and significant effect on their environmental performance meaning that when the firms enhance the use of GSCM practices, their environmental performance while improve with the same intensity. Consequently, the null hypothesis for the objective was rejected.

In conclusion, this study provides an overview of how Green Supply Chain Management can enable businesses to maximize their environmental performance. By adopting sustainable practices, businesses can reduce their carbon footprint, enhance operational efficiency and create a competitive edge while complying with regulatory obligations. As companies opt to become environmentally responsible, Green Supply Chain Management will remain a critical tool in managing environmental impact and achieving sustainability goals.

### *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.

### *Contributions of the Study to academia*

The research offers a platform for academic deliberations, which can serve as a starting point for further investigations. It allows scholars to comprehend how the integration of environmental concerns in supply chain management has evolved into a distinct research and business field. The study highlights green supply chain management (GSCM) as an essential strategy for sustainable initiatives, which can contribute to a company's competitive advantage and overall profitability. It is crucial for future researchers to recognize that implementing green supply chains requires comprehensive and collaborative best practices, from product inception to end-of-life recycling. Ultimately, the study confirms that a company's long-term survival is contingent on greening its supply chains, which can lower operating costs and increase business sustainability.

### *Limitations of the Study*

Numerous shortcomings in this study were found during the research process. First, the study's use of selective sampling may have omitted participants whose viewpoints would have considerably benefited in the formulation of theories and the testing of hypotheses. However, the acquired data was examined and cleaned beforehand to analysis, taking into account non-responses and outlier responses, in order to increase the accuracy and validity of the results.

Second, the study concentrated on sugar producer firms in western Kenya since it would have been expensive to cover the whole country. However, the results are transferable to other production sectors. Lastly, the instrument for gathering data comprised structured questions only that were administered purposively to respondents by research assistants who were experts in the area. This may have left out important opinions of other employees in the firms. Nevertheless, the sampling method used is assumed to be representative enough to make valid generalizations according to Creswell (2013).

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