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Green Supply Chain Management Practices as Drivers of Environmental Sustainability: An Empirical Study of Manufacturing Firms in Nigeria

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Abstract

Purpose: This research examines how Green Supply Chain Management (GSCM) strategies—Green Purchasing (GP), Environmental Collaboration with Suppliers (ECS), and Reverse Logistics (RL)—affect Environmental Performance (EP) in Nigerian manufacturing companies. Using the Resource-Based View (RBV) and the Institutional Theory, the study explores how internal strengths and external pressures influence sustainable supply chain adoption.

Method: The study employed a purposive sampling technique to select four manufacturing firms in Oyo State: Nigerian Breweries Plc, Nigerian Bottling Company, P&G Plc, and Bond Pharmaceutical Company. Within these firms, simple random sampling was used to select individual respondents. In total, 205 employees participated in the survey, and the research utilised Structural Equation Modelling (SEM) to analyse the connections between these factors.

Result: The findings demonstrate that GP, ECS, and RL all significantly and positively contribute to environmental performance, with green purchasing showing the greatest influence. Furthermore, the study found a high level of awareness of GSCM practices among the surveyed firms, suggesting considerable potential for effective implementation.

This study adds to the current nation's perspective and provides actionable advice for businesses and policymakers aiming to improve sustainability through comprehensive GSCM approaches.

INTRODUCTION

Environmental sustainability has emerged as a crucial global issue in recent years, prompting businesses to adopt eco-conscious practices. This transition has led to the development of Green Supply Chain Management (GSCM), a strategic framework that integrates environmental considerations into supply chain management. GSCM involves strategies such as eco-friendly procurement, environmentally conscious product design, green production processes, reverse logistics, and environmental performance assessment (Afzal & Hanif, 2022). The primary objectives of these strategies are to reduce environmental harm, improve the efficient use of resources, and promote sustainable growth throughout the entire supply chain (Agyabeng-Mensah & Tang, 2021). Nigeria's manufacturing industry is vital for the country's economic progress, contributing to its Gross Domestic Product, creating jobs, and driving industrialization (Fadeyi et al., 2025; Ahmad et al., 2022). Nevertheless, this sector also significantly contributes to environmental damage through inefficient resource use, inadequate waste management, and pollution from industrial operations. Concerns regarding greenhouse gas emissions, water and air contamination, and excessive energy consumption have been voiced by policymakers, environmental advocates, and the general public (Ali et al., 2021). With increasingly stringent global environmental regulations and growing stakeholder pressure, Nigerian manufacturing companies are now under pressure to adopt more sustainable practices.

Green Supply Chain Management aligns environmental goals with business operations. Adopting GSCM can improve environmental, economic, and social outcomes, thereby enhancing sustainable performance (Amjad et al., 2022). For Nigerian manufacturers, this means meeting regulations, lowering costs through efficient resource use, enhancing reputation, and staying globally competitive.

However, implementing GSCM practices in Nigeria faces obstacles, leading to limited and sporadic use. These obstacles include insufficient knowledge, weak regulatory oversight, limited availability of green technologies, substantial initial investment, and inadequate institutional backing. Furthermore, many manufacturing companies continue to favor immediate financial gains over enduring sustainability objectives. In light of these difficulties, there is a growing academic and policy focus on how GSCM practices can foster sustainable performance within Nigeria's manufacturing industry, as highlighted by Yosef et al. in 2023.

Existing research has largely focused on how Green Supply Chain Management (GSCM) influences environmental performance in both developed and developing countries, as evidenced by numerous studies (Rafli et al., 2025; Amjad et al., 2022; Aslam et al., 2018; Awan et al., 2021; Banihashemi et al., 2022; Çankaya & Sezen, 2019; Yosef et al., 2023; Younis et al., 206; Zailani et al., 2015). This research aims to build on this groundwork by examining the extent of GSCM practice awareness and the specific influence of individual GSCM practices—namely, green purchasing, supplier environmental collaboration, and reverse logistics—on environmental performance in Nigeria's manufacturing sector. The study suggests that manufacturing firms experience particularly significant positive outcomes from GSCM practices because their operations are heavily reliant on resources and processes, making environmental enhancements easier to implement, measure, and expand. Moreover, the intricate nature of manufacturing supply chains, combined with growing external regulatory and market demands and internal drives for efficiency, renders GSCM adoption especially beneficial in this industry. This research contributes to the existing literature by providing one of the few empirical investigations into the distinct components of GSCM in the Nigerian manufacturing context, thereby addressing a research gap in which GSCM has typically been treated as a general, undifferentiated concept (Thakur et al., 2018).

The strategic adoption of Green Supply Chain Management (GSCM) practices by manufacturing companies is essential for enhancing sustainability outcomes and supporting both domestic and international environmental objectives. Ultimately, incorporating GSCM into Nigeria's manufacturing sector is crucial not just for safeguarding the environment but also for ensuring enduring business viability and a competitive edge in today's fast-changing global marketplace.

To understand the link between green supply chain management practices and environmental performance, it is important to ground the discussion in key organizational theories. Key theories, including the Resource-Based View (RBV), Institutional Theory, Stakeholder Theory, the Natural Resource-Based View, and Contingency Theory, help explain the link between green supply chain practices and environmental performance. This study centers on RBV and Institutional Theory. These offer insight into Nigeria's manufacturing sector, where firms face scarce resources and high external pressures, stressing the importance of both internal strengths and external influences on environmental performance (Schmidt et al., 2016).

Resource-Based View (RBV)

The Resource-Based View (RBV), first proposed by Wernerfelt in 1984 and later developed by Barney in 1991, emphasizes that a company's internal strengths and capabilities, rather than external market dynamics alone, are crucial for gaining and maintaining a competitive edge. RBV suggests that for a resource to confer such an advantage, it must possess four key attributes: it needs to be valuable, rare, difficult to imitate, and impossible to substitute (VRIN). Within the realm of Green Supply Chain Management (GSCM), RBV provides a strategic lens for examining how businesses can cultivate and utilize their environmental competencies to improve sustainability results and long-term market standing. This perspective is especially pertinent to Nigerian manufacturers operating in settings characterized by limited resources and significant environmental impact. By integrating GSCM practices, including eco-friendly procurement, product return management, and supplier collaboration on environmental matters, companies can transform these initiatives into strategic assets that drive exceptional environmental performance.

Nigerian manufacturers are under growing pressure to maintain competitiveness while upholding environmental accountability, as noted by Saad and Siddiqui in 2019. The Resource-Based View (RBV) helps achieve this equilibrium by conceptualizing Green Supply Chain Management (GSCM) capabilities as internal strengths that can deliver both regulatory compliance and competitive advantage, particularly when these capabilities are hard for competitors to imitate. This perspective is echoed by Qalati et al. (2022), who observe that in environments where access to green technology and financial resources is restricted, RBV is especially useful for understanding how companies can leverage their existing assets and cultivate new skills to achieve sustainable outcomes. For instance, adopting green purchasing practices allows businesses to assess their suppliers not only on traditional metrics but also on environmental factors such as their carbon emissions and the recyclability of their materials, thereby developing a valuable and unique capability, according to Li et al. (2021). Kim et al. (2021) and Rizal et al. (2024) further note that RBV also underpins cooperative environmental initiatives, promoting shared eco-innovation and knowledge exchange, which, in turn, become inimitable assets built on mutual trust. Such collaborations result in continuous supply chain improvements and distinct strategic positioning. Additionally, Khan and Qianli (2017) stress that reverse logistics processes, encompassing recycling, remanufacturing, and waste reclamation, represent a sophisticated capability that enhances waste minimization, resource optimization, and regulatory compliance.

Given that manufacturing companies are naturally heavy users of resources and significant polluters, the Resource-Based View (RBV) explains why some companies excel at leveraging Global Supply Chain Management (GSCM) to improve their environmental performance. In essence, the RBV provides a robust theoretical framework for grasping how Nigerian manufacturers can convert their environmental efforts into strategic advantages, thus reframing sustainability not just as a compliance issue but as a pathway to lasting competitive superiority.

Institutional Theory

Institutional Theory explains how organizations shape their behaviors and strategies to align with societal rules, norms, and expectations to secure legitimacy and longevity. Originating in sociology and organizational studies, Meyer and Rowan (1977) introduced the concept of institutional isomorphism, in which organizations become more similar under external pressures. DiMaggio and Powell (1983) identified coercive, normative, and mimetic pressures stemming from regulations, norms, and the imitation of successful competitors, respectively. Khan et al. (2022) emphasize that Institutional Theory shows organizations act in response to institutional settings rather than independently. Organizations adopt new practices to meet external demands and gain legitimacy, even when these actions do not bring immediate financial gain.

Institutional Theory provides a useful perspective for examining how manufacturing companies, particularly within Green Supply Chain Management (GSCM), implement environmental initiatives. This viewpoint is especially important in developing nations like Nigeria, where evolving regulations, active stakeholder engagement, and market expectations are increasingly pushing businesses toward sustainability (Khahro et al., 2021). Manufacturing companies are often driven to adopt eco-friendly procurement methods, such as selecting suppliers with strong environmental credentials, due to regulatory pressures and global trade agreements. Adhering to these mandates enhances a company's credibility, reduces the likelihood of fines, and opens doors to markets that are responsive to environmental concerns (Holling & Backhaus, 2023). Additionally, voluntary pressure from industry groups, non-governmental organizations, and environmentally conscious consumers promotes supplier partnerships. As Kerdpitak (2021) highlights, these collaborations cultivate common sustainability goals, including the sharing of information and joint efforts to resolve issues, ultimately leading to a reduced environmental impact across the supply chain.

Firms are often compelled to implement reverse logistics systems, such as recycling, remanufacturing, and take-back programs, by imitative pressures, especially when industry leaders achieve success with these initiatives. This tendency to follow suit not only helps meet regulatory requirements but also bolsters a company's public image and commitment to sustainable operations, according to Hejazi et al. (2023). The manufacturing industry in Nigeria is under growing pressure from external institutional forces, including more stringent environmental regulations, export compliance requirements, and increasing demands for corporate social responsibility. Institutional Theory explains how these pressures encourage the adoption of green supply chain management (GSCM) practices, even when a company's internal resources are insufficient or financial limitations are present. By addressing these institutional influences, Nigerian manufacturing companies can improve their environmental performance, enhance their credibility, and meet international sustainability benchmarks. In contrast to theories that focus internally, like the Resource-Based View (RBV), Institutional Theory highlights the impact of the social, regulatory, and competitive landscape on how organizations behave. Consequently, it provides a powerful lens through which to understand why companies, particularly those in developing economies, embrace green practices as a component of their supply chain strategies.

Empirical Review and Hypotheses Development

Research repeatedly shows a significant relationship between Green Supply Chain Management (GSCM) methods and a company's environmental performance. For example, Khan et al. (2024) explored how GSCM practices relate to sustainable organisational performance in Pakistan's construction industry. They discovered that eco-design benefits economic, social, and environmental aspects; green purchasing correlates positively with social and environmental results; green production and logistics are linked to better environmental performance; and customer collaboration boosts social performance. These findings support the idea that GSCM practices play a vital role in achieving sustainable organisational outcomes. Likewise, Akhan et al. (2024) showed that GSCM practices notably impact operational performance, with technological innovation acting as a bridge between them. Additionally, Afzal and Hanif (2022)

found that green purchasing, green production, and green logistics positively affect company performance in the manufacturing sector.

Green logistics practices have a notable effect on social and financial outcomes, as indicated by Agyabeng-Mensah and Tang (2021). Ahmad et al. (2022) further confirmed that Green Supply Chain Management (GSCM) practices are crucial indicators of sustainability performance. Amjad et al. (2022) and Aslam et al. (2018) also found that GSCM practices substantially boost firm performance and contribute to sustainability. Awan et al. (2021) showed that GSCM mediates the link between lean manufacturing and sustainable performance. Within construction, Balasubramanian and Shukla (2017) and Banihashemi et al. (2022) identified GSCM as a critical factor in environmental performance. Çankaya and Sezen (2019) and Chun et al. (2015) observed a positive correlation between GSCM and sustainability outcomes in the sector. Cousins et al. (2019) and Gera et al. (2022) also linked GSCM to improved environmental results. This shows that implementing GSCM leads to better environmental outcomes by reducing waste, emissions, and energy consumption, enhancing resource efficiency, and integrating sustainability across procurement, manufacturing, and distribution.

Relationship Between Green Purchasing and Environmental Performance

Green purchasing (GP) refers to an organisation's efforts to source products, materials, and services that minimise negative environmental impacts throughout their life cycle. This includes selecting suppliers that comply with environmental standards, using eco-friendly materials, and prioritising products with reduced emissions, lower waste generation, and higher recyclability (Afzal & Hanif, 2022). From a theoretical standpoint, the Resource-Based View (RBV) and the Natural Resource-Based View (NRBV) suggest that environmentally responsible procurement practices can serve as strategic resources that enhance organisational outcomes (Gera et al., 2022). By adopting green purchasing, firms can reduce material waste, improve resource efficiency, and minimise pollution (Awan et al., 2021). These improvements naturally enhance a firm's environmental performance (EP), typically measured through reduced emissions, waste reduction, compliance with environmental regulations, and improved sustainability indicators. Empirically, previous research consistently reports that firms implementing GP practices achieve better environmental outcomes (Khan et al., 2024; Ahmad et al., 2022). Studies in environmental management and supply chain sustainability have shown that organisations that prioritise environmentally friendly inputs tend to experience significant improvements in environmental performance because the environmental impact of products and processes is often determined by early procurement decisions (Gera et al., 2022; Agyabeng-Mensah & Tang, 2021). Therefore, based on theoretical expectations, existing empirical findings, and logical cause-and-effect reasoning that environmentally conscious purchasing reduces ecological footprints, the hypothesis was formulated:

H1: Green Purchasing (GP) has a positive effect on Environmental Performance (EP).

Relationship Between Environmental Collaboration with Suppliers and Environmental Performance

Environmental Collaboration with Suppliers (ECS) means firms and suppliers work together to meet environmental goals. These actions include sharing environmental information, co-developing eco-friendly products, providing green practice training, jointly reducing waste, and complying with environmental regulations. The Natural Resource-Based View (NRBV) and Stakeholder Theory hold that firms achieve better environmental performance when they involve suppliers in sustainability efforts (Aslam et al., 2018). Suppliers influence the environmental impact of the supply chain, including material extraction, transport, and production. Collaboration fosters knowledge sharing, innovation, and common environmental goals, leading to improved environmental outcomes. Research on green supply chain management shows that firms that work closely with suppliers on environmental issues achieve better results (Amjad et al., 2022) because collaboration increases innovation, improves compliance, supports cleaner procurement, and reduces resource consumption and pollution (Gera et al., 2022). A firm's environmental

performance depends on supplier cooperation, as suppliers account for much of the supply chain's footprint. Collaboration creates synergy and leads to tangible gains in emissions reduction, waste management, and eco-efficiency. Based on theory, evidence, and supply chain dynamics, the hypothesis is as follows:
H2: Environmental Collaboration with Suppliers (ECS) positively affects Environmental Performance (EP).

Relationship Between Reverse Logistics and Environmental Performance

Reverse logistics covers returns, recycling, remanufacturing, material reuse, waste recovery, and safe disposal. These actions help firms reduce waste, save resources, and comply with environmental rules. Under the resource-based view (RBV) and ecological modernization theory, reverse logistics is a strategic asset that improves resource efficiency and shrinks the ecological footprint (Ahmad et al., 2022). By reclaiming materials and reusing waste, companies limit environmental harm and improve sustainability. Studies show that firms using reverse logistics generate less pollution, reduce landfill waste, improve handling, and use resources and energy more efficiently, all of which boost environmental performance (Aslam et al., 2018). Therefore, based on theory and evidence, firms using reverse logistics are positioned to achieve better environmental performance. Thus, the hypothesis is as follows:
H3: Reverse Logistics (RL) has a positive effect on Environmental Performance (EP).

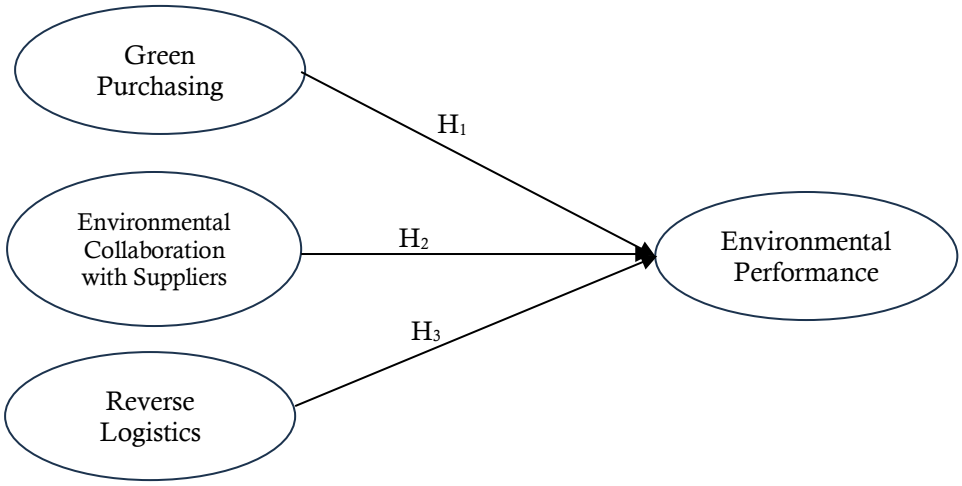

Figure 1.
Conceptual Model

Figure 1 illustrates the conceptual model developed for forecasting environmental performance, which incorporates three central Green Supply Chain Management (GSCM) strategies: green procurement, cooperative environmental efforts with suppliers, and the management of returned products. This section outlines the proposed framework and establishes hypotheses regarding the connections between these elements. Within the manufacturing industry, GSCM strategies offer a means to harmonize environmental objectives with operational effectiveness. It is expected that their implementation will not only improve environmental outcomes but also positively impact the economic and social aspects of sustainability, collectively known as sustainable performance. The framework highlights the crucial function of GSCM in promoting environmental sustainability in manufacturing, suggesting that green purchasing, supplier partnerships, and reverse logistics directly and beneficially influence environmental performance.

RESEARCH METHODS

The study adopted a purposive sampling technique to define the sampling frame by selecting four manufacturing firms located in Oyo State, Nigeria: Nigerian Breweries Plc, Nigerian Bottling Company, Procter & Gamble (P&G) Plc, and Bond Pharmaceutical Company. These firms were deliberately chosen due to their diverse product portfolios, ranging from beverages to personal care, household, and pharmaceutical products, which facilitated a comparative analysis of Green Supply Chain Management (GSCM) practices across different product categories within a shared geographical environment. In addition, the operations of these firms are resource- and energy-intensive, requiring substantial inputs of raw materials, water, packaging, and logistics services. As a result, they exert considerable environmental impacts through emissions, waste generation, and water consumption, making them appropriate contexts for examining the adoption and effectiveness of GSCM practices. The sampling frame comprised employees occupying roles directly related to supply chain and environmental management, including logistics, procurement, operations, and environmental compliance units. Within each organization, simple random sampling was used to select individual respondents from this defined group to reduce selection bias and enhance representativeness. Data were collected through in-person administration of structured questionnaires, with the assistance of two trained researchers who targeted employees in logistics and environmental management functions to ensure relevance and data quality. Of the 205 questionnaires administered, 198 were fully completed and returned, resulting in a 96% response rate. The exceptionally high response rate is attributable to prior engagement with departmental managers and potential respondents, during which the study's objectives and significance were clearly communicated, and consent was obtained before questionnaire distribution.

The high participation rate was further bolstered by the support of research assistants who were available to clarify any ambiguous questions. This research encompassed four key areas: green purchasing behavior, collaborative environmental efforts with suppliers, reverse logistics management, and environmental performance, which was assessed using several questions on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). To ensure the measurement model's validity, Exploratory Factor Analysis (EFA) was performed, confirming that each item accurately represented its intended construct and thereby enhancing the precision and dependability of the subsequent path analysis. Furthermore, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy registered a strong 0.888, and Bartlett's Test of Sphericity proved statistically significant at the 1% level, collectively affirming that the data were indeed suitable for factor analysis. This study adhered to the ethical standards of behavioural science research. Respondents' confidentiality was strictly maintained throughout the research process.

To test the hypothesis, a quantitative study was conducted using a structured questionnaire. Green purchasing behavior was measured using a scale developed and validated by Afzal and Hanif (2022), consisting of six items in statement format, Sample items include: 1) our company gives preference to suppliers that provide environmentally friendly materials and components, 2) environmental criteria are considered alongside cost and quality when selecting suppliers, 3) We purchase raw materials and inputs that are recyclable or biodegradable whenever possible, 4) our purchasing department avoids suppliers whose operations cause significant environmental harm, and 5) environmental certifications (e.g., ISO 14001) influence our purchasing decisions, and 6) our organization prioritizes suppliers that demonstrate the use of eco-friendly materials in their production processes.

Collaborative environmental efforts with suppliers were measured using a scale developed and validated by Agyabeng-Mensah and Tang (2021). This scale also uses six items in statement form, Sample items include: 1) our company works closely with suppliers to reduce the environmental impact of production processes, 2) we share environmental goals and sustainability standards with our key suppliers, 3) suppliers are involved in joint initiatives to reduce waste and emissions, 4) our company provides guidance or support to suppliers on environmental improvement practices, and 5) environmental performance is discussed regularly with suppliers

during partnership meetings, 6) We offer technical advice or training to suppliers on improving their environmental performance.

Reverse logistics management was assessed using a scale developed and validated by Ahmad et al. (2022). Sample items include: 1) our company has systems in place to collect used or defective products for reuse or recycling, 2) returned products and materials are systematically processed to minimize environmental impact, 3) we actively engage in recycling and reuse of packaging materials and production waste, 4) reverse logistics activities are integrated into our overall supply chain management, 5) our company encourages customers or distributors to return end-of-life products, 6) Collection systems for returned products are well-coordinated and consistently implemented, and 7) the company applies standardized processes to ensure environmentally safe treatment of returned products.

Environmental performance was measured using a scale developed and validated by Gera et al. (2022). Sample items include: 1) our company has significantly reduced waste generation over the past few years, 2) energy consumption in our manufacturing operations has decreased due to environmental initiatives, 3) our company has achieved reductions in air, water, or soil pollution, 4) compliance with environmental regulations has improved in our operations, and overall, 5) our company's environmental performance has improved compared to competitors, 6) environmental initiatives provide our company with a competitive advantage, 7) regulatory inspections and audits show improved environmental compliance, and 8) cleaner production technologies have contributed to lower pollution levels.

RESULTS & DISCUSSION

The data collected were analyzed using descriptive statistics, including frequency counts and simple percentages, to summarize the demographic characteristics. Path Analysis Structural Equation Modeling (PA-SEM) was then employed to test the study's hypotheses. Path analysis within the Structural Equation Modeling (SEM) framework was employed because it is well-suited for examining complex causal relationships involving multiple dependent variables. The choice of SEM is further justified by the moderate sample size (n = 198), which meets the minimum requirements for variance-based SEM approaches and supports robust parameter estimation without imposing excessively strict distributional assumptions. In addition, preliminary diagnostics indicated deviations from multivariate normality, making robust SEM approaches particularly appropriate.

Table 1.
Demographic Characteristics of Respondents

No.	Demographic variables	Grouping	Frequency	Percentage
1.	Gender	Male	102	51.5
		Female	96	48.5
2.	Age	< 30	25	12.62
		31- 40	59	29.79
		41- 50	48	24.24
		51 and above	66	33.33
3.	Marital status	Single	30	15.15
		Married	150	75.75
		Divorce	10	5.05
		Widowed	8	4.04
4.	Academic Qualification	National Diploma	28	14.14
		HND/B.Sc	129	65.15
		Masters	41	20.70
5.	Years of experience	1to 5 years	22	11.11
		6-10 yrs	38	19.19
		11-15yrs	40	20.20
		16 – 20yrs	48	24.24
		21 above	50	25.25

From Table 1, the demographic characteristics of the respondents reveal a balanced and diverse group of participants. The gender distribution shows that males and females were almost equally represented in the study, minimizing gender bias and ensuring the findings reflect both male and female perspectives. In terms of age, most respondents were aged 31 years and older, with the highest proportion in the 51 and above category. This suggests that the majority of participants are mature adults with likely extensive workplace experience. Respondents under 30 years old constituted the smallest group, indicating fewer young employees in the sample. Regarding marital status, about three-quarters of respondents were married, implying a predominantly stable and mature workforce; single, divorced, and widowed individuals were present in much smaller proportions. The educational qualifications showed that the majority held an HND or a B.Sc degree, followed by those with Master's degrees, with a few possessing qualifications below the first-degree level. This indicates that respondents are generally well educated, thereby enhancing the quality and comprehension of the information they provided. Concerning years of experience, nearly half had worked for 16 years or more, denoting a highly experienced workforce. Only a few had less than 5 years of experience. This distribution suggests that the study's data originate from individuals with deep knowledge of organizational processes and practices.

The demographic profile indicates that the data collected are reliable and credible, as they come from a well-educated, experienced, and mature group of respondents. Their level of exposure and understanding of workplace activities positions them to provide informed responses on environmental practices, operational efficiency, and organizational performance. The balanced gender representation and rich professional experience strengthen the validity of the study's findings and enhance the generalizability of the results within similar organizational contexts.

Table 2.
Factor Loadings, Reliability and Convergent Validity

Constructs Variable	Items	Loadings	Cronbach's Alpha	CR	AVE
Green Purchasing	GPQ1	.869	0.888	0.858	0.791
	GPQ2	.832			
	GPQ3	.821			
	GPQ4	.841			
	GPQ5	.858			
	GPQ6	.811			
Environmental Collaboration with Suppliers	ECSQ1	.863	0.859	0.867	0.789
	ECSQ2	.782			
	ECSQ3	.851			
	ECSQ4	.807			
	ECSQ5	.819			
	ECSQ6	.798			
Reverse Logistics	RL Q1	.778	0.838	0.827	0.815
	RL Q2	.831			
	RLQ3	.789			
	RL Q4	.838			
	RLQ5	.812			
	RLQ6	.799			
	RLQ7	.809			
Environmental Performance	EPQ1	.815	0.869	0.827	0.803
	EPQ2	.872			
	EPQ3	.781			
	EPQ4	.727			
	EPQ5	.786			
	EPQ6	.801			
	EPQ7	.720			
	EPQ8	.805			

The results in Table 2 show that all the items measuring the four constructs—Green Purchasing, Environmental Collaboration with Suppliers, Reverse Logistics, and Environmental Performance- loaded strongly on their respective factors. All factor loadings were above 0.70, indicating that each question clearly represents the construct it was designed to measure. This means the items are good indicators of their underlying concepts. The reliability results further strengthen this conclusion. The Cronbach's Alpha values for all the constructs were above 0.80, showing a high level of internal consistency among the items in each scale. In simple terms, the questions within each construct are closely related and consistently measure the same idea. Similarly, the Composite Reliability (CR) values were also above the acceptable minimum of 0.70. This confirms that each construct is reliable and can be depended upon for further statistical analysis. The Average Variance Extracted (AVE) values were all well above 0.50, indicating strong convergent validity. This means that the items within each construct share substantial common variance and effectively capture the concept they are intended to measure. Overall, these results show that the measurement model is statistically sound. The items are valid, reliable, and suitable for further analysis. This provides confidence that any conclusions drawn from the study's constructs, such as their relationships and effects, are based on strong and credible measurement tools.

The multicollinearity results in Table 3 indicate that all independent variables meet acceptable thresholds, indicating the absence of collinearity problems in the model. The tolerance values range from 0.389 to 0.657, exceeding the minimum recommended level of 0.20, while the VIF values, which range from 1.549 to 2.733, are well below the conventional cut-off of 5.0 and the more conservative 3.3 benchmark often applied in PLS-SEM studies. Specifically, Green Purchasing (VIF = 1.734), Reverse Logistics (VIF = 2.289), and Environmental Performance (VIF = 1.549) demonstrate very low collinearity, suggesting that each construct contributes unique explanatory value to the model. Although Environmental Collaboration with Suppliers records the highest VIF (2.733) and the lowest tolerance (0.389), these values remain within acceptable limits and do not threaten the reliability of the estimates. Substantively, the results imply that green purchasing, supplier environmental collaboration, and reverse logistics are distinct yet complementary environmental management practices that each contribute to environmental performance. This enhances the clarity of managerial implications, as firms can implement each practice without concern about overlapping or redundant effects. Within the PLS-SEM framework, the findings further support the appropriateness of the technique, confirming that the model meets the assumption of predictor independence and enabling the analysis to proceed confidently to evaluate structural paths and predictive relevance.

Table 3.
Multicollinearity Test

Variables	Collinearity Statistics	
	Tolerance	VIF
Green Purchasing	.632	1.734
Environmental Collaboration with Suppliers	.389	2.733
Reverse Logistics	.437	2.289
Environmental Performance	.657	1.549

Table 4, Respondents in the manufacturing industry demonstrate a mean awareness score of 3.42 on a 5-point Likert scale regarding Green Supply Chain Management (GSCM) practices. This suggests that these individuals possess a notably high level of understanding concerning environmental sustainability efforts within their operational frameworks. Statistical analysis, specifically a one-sample t-test, yielded $t(222) = 12.315$, $p < 0.001$, confirming that the average awareness score significantly exceeds the neutral midpoint of 3. Such heightened awareness serves as a promising precursor to the adoption and implementation of GSCM practices across the industry. Consequently, both companies and governing bodies can capitalize on this existing awareness by implementing targeted training initiatives and development programs to enhance knowledge and practical application. While this considerable awareness lays groundwork for

advancing environmental performance through GSCM, it is crucial to direct efforts toward transforming this awareness into sustained, practical implementation.

Table 4.
Level of Awareness of GSCM Practices

N	Mean	Std. Deviation	T	Df	Mean Difference
223	3.4241	.51426	12.315	222	.42409

This study's structural model evaluates the influence of three Green Supply Chain Management (GSCM) practices—Green Purchasing (GP), Environmental Collaboration with Suppliers (ECS), and Reverse Logistics (RL)—on Environmental Performance (EP). The findings in Table 5 show that GP has the strongest effect on EP, with a beta coefficient of 0.5506. A p-value of 0.000 indicates a highly significant relationship and confirms that GP positively and significantly enhances environmental performance; thus, the corresponding hypothesis is accepted. ECS also demonstrates a significant positive effect on EP, with a beta coefficient of 0.5260. The significance of this relationship is further supported by a t-value of 7.30 and a p-value of 0.000, indicating that the hypothesis that ECS is related to EP is accepted. RL, in turn, positively impacts EP, as evidenced by its beta coefficient of 0.4781, t-value of 5.78, and p-value of 0.000. Consequently, the hypothesis that RL positively affects EP is accepted. Altogether, these results show that all three GSCM practices significantly and positively contribute to environmental performance.

Table 5.
Results of the Structural Equation Model with Environmental Performance

Predictor	β (Beta Coefficient)	Z-value	p-value	Significance
GP → EP	0.5506	7.98	.000	Significant
ECS → EP	0.5260	7.30	.000	Significant
RL → EP	0.4781	5.78	.000	Significant

Note. ** p < .05, GP = Green Purchasing, ECS = Environmental Collaboration with Suppliers, RL = Reverse Logistics, EP = Environmental Performance

The hypothesis shows that green purchasing influences environmental performance. From a theoretical perspective, Green Purchasing directly influences an organization's environmental footprint by ensuring that inputs, materials, and services are sourced to minimize negative environmental impacts. According to the principles of the Natural Resource-Based View (NRBV), firms that integrate environmental considerations into their procurement processes enhance their overall environmental sustainability by reducing waste, emissions, and resource depletion across the supply chain. In addition, from a practical standpoint, organizations that prioritize Green Purchasing typically choose suppliers who comply with environmental regulations, adopt eco-friendly technologies, and provide recyclable or biodegradable materials. This proactive sourcing approach promotes cleaner production processes, energy efficiency, and waste reduction, thereby improving environmental performance outcomes. Lastly, the strong beta coefficient (0.5506) indicates that improvements in Green Purchasing practices translate into significantly greater measurable environmental gains than other green supply chain dimensions. This implies that firms can achieve higher environmental performance primarily by focusing on sustainable procurement strategies, as purchasing decisions determine the overall environmental orientation of the production and distribution systems. This result aligns with Afzal and Hanif (2022), who affirm that green purchasing directly shapes the upstream environmental behaviour of firms and their suppliers, making it the most influential driver of improved environmental performance.

The hypothesis showcases that environmental collaboration with suppliers exhibits significant positive impacts. This finding aligns with the Resource-Based View (RBV) and Stakeholder Theory, which emphasize that collaboration with external partners, such as suppliers, enhances a firm's ability to access complementary resources, share knowledge, and jointly develop eco-friendly solutions. When firms work closely with their suppliers on environmental issues, they

co-create value through improved resource efficiency, pollution control, and sustainable innovation. On a practical level, environmental collaboration encourages joint problem-solving and the exchange of best practices related to cleaner production, waste minimization, and the use of renewable materials. Suppliers often have specialized knowledge about raw materials, logistics, or technologies that can help reduce the firm's environmental impact. This synergy enhances both operational efficiency and compliance with environmental standards, resulting in measurable improvements in environmental performance. Finally, the relatively high beta value (0.5260) indicates that collaboration with suppliers is a critical driver of sustainability success, almost as influential as green purchasing. It underscores the importance of integrating suppliers into the firm's environmental management system, as their actions directly affect the supply chain's overall ecological footprint. This finding supports the assertions of Cousins et al. (2019) and Gera et al. (2022) that sustainability is best achieved through cooperative supplier relationships, in which aligned environmental goals foster superior green performance. This suggests that effective collaboration with suppliers fosters shared environmental responsibility, innovation, and continuous improvement, thereby significantly enhancing environmental performance.

The hypothesis posits that reverse logistics are positively associated with environmental performance. This finding aligns with the Circular Economy and Natural Resource-Based View (NRBV) frameworks, which emphasize that recovering, reusing, remanufacturing, and recycling products or materials can significantly reduce environmental degradation. Reverse logistics helps minimize waste and resource consumption by extending product lifecycles and diverting materials from landfills. The effective reverse logistics systems enable organizations to collect used products, manage returns, and recover valuable materials for reuse or resale. These processes reduce the need for virgin raw materials, lower energy consumption, and decrease greenhouse gas emissions. As a result, firms that invest in efficient reverse logistics systems achieve improved environmental performance by reducing waste and conserving resources. Moreover, the positive beta coefficient (0.4781) indicates that, while reverse logistics may have a slightly lower impact than green purchasing or supplier collaboration, it remains a substantial contributor to environmental improvement. This suggests that integrating reverse logistics into overall supply chain management enhances sustainability outcomes and reinforces a firm's commitment to environmental stewardship. This suggests that reverse logistics promotes waste minimization, resource recovery, and pollution reduction, thereby directly enhancing environmental performance and supporting the transition toward a sustainable, circular supply chain.

CONCLUSION

The research presents strong support for the idea that Green Supply Chain Management (GSCM) strategies, specifically Green Purchasing, collaborating with suppliers on environmental matters, and Reverse Logistics, significantly enhance Environmental Performance in Nigeria's manufacturing industry. Green Purchasing stood out as the most impactful practice, emphasizing the crucial role of procuring resources sustainably and ethically. Environmental Collaboration with Suppliers and Reverse Logistics also made substantial contributions, underscoring the value of joint environmental efforts and effective waste management. The high average score (3.42) for awareness of GSCM practices, well above the midpoint, indicates that Nigerian manufacturing companies have a solid grasp of sustainability concepts. This awareness, statistically validated, suggests a strong capacity to adopt and implement GSCM. In essence, the results highlight the need for a unified GSCM approach across the manufacturing sector, supported by supportive policies, development programs, and strategic alliances. This coordinated effort can lead to better environmental outcomes, increased long-term competitiveness, and adherence to international sustainability benchmarks. Consequently, both company executives and government officials should leverage this existing awareness and drive to foster practical, effective, and sustainable supply chain methods.

This study offers significant practical insights for enhancing the environmental performance within Nigeria's manufacturing industry. Primarily, manufacturing businesses should prioritize green procurement by selecting suppliers and materials that comply with environmental

regulations. This involves obtaining environmentally sound raw materials and partnering with suppliers committed to sustainable methods. Secondly, corporations should collaborate with their suppliers to achieve common environmental objectives. Establishing enduring alliances and participating in collective innovation can lead to more sustainable supply chains. Thirdly, it is essential to bolster reverse logistics operations to facilitate the reuse, recycling, or appropriate disposal of products and materials, thereby minimizing waste and improving ecological results. Fourthly, although many companies are already informed about green supply chain strategies, they must now translate this knowledge into concrete actions by integrating sustainability into routine operations, educating their workforce, and aligning performance assessments with environmental targets. Fifthly, governmental bodies should champion these initiatives by encouraging measures such as tax exemptions or awards for firms adopting sustainable practices, and by updating environmental laws to promote adherence to contemporary sustainability benchmarks. Lastly, trade organizations should offer expanded training opportunities and establish forums for businesses to exchange successful strategies and learn from one another via comparative analysis. In conclusion, the research underscores that enhancing environmental performance necessitates a blend of strategic foresight, cooperative efforts, investment in sustainable infrastructure, and supportive governmental policies.

This study has some limitations that should be considered. It used a cross-sectional design, meaning data were collected at one point in time, so it cannot fully establish cause-and-effect relationships. The study also focused only on manufacturing firms in Oyo State, Nigeria, limiting the extent to which the findings can be applied to other sectors or states in the country. In addition, only three green supply chain practices, green purchasing, environmental collaboration with suppliers, and reverse logistics, were examined, leaving out other important areas like eco-design and green production. The use of self-reported survey data may also have introduced some bias. Finally, the study focused solely on environmental performance and did not include economic or social aspects of sustainability. Future research should therefore consider using a longitudinal approach, include more industries and countries, examine more GSCM dimensions, and explore broader sustainability outcomes to provide a more comprehensive understanding of green supply chain management.

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