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GREEN SUPPLY CHAIN MANAGEMENT AND BUSINESS SUSTAINABILITY OF PHARMACEUTICAL INDUSTRY IN ANAMBRA STATE, NIGERIA

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Abstract

This study explored the relationship between Green Supply Chain Management (GSCM) and Business Sustainability within the pharmaceutical industry in Anambra State, Nigeria. The objective was to determine how specific GSCM practices, such as green procurement, transportation, reverse logistics, and manufacturing processes, influenced sustainability outcomes. The research was anchored on the Green Supply Chain Management Theory, which emphasizes the integration of environmental considerations across supply chain operations. A descriptive survey research design was adopted, collecting data through structured questionnaires distributed to employees in selected pharmaceutical firms. Analysis was conducted using descriptive statistics and the Pearson Product Moment Correlation Coefficient method. The findings revealed a significant positive relationship between green procurement practices and operational efficiency, with a correlation coefficient of 0.65; a strong connection between transportation practices and customer satisfaction (correlation coefficient of 0.72); a notable relationship between reverse logistics implementation and environmental compliance, showing a coefficient of 0.68; and a strong link between green manufacturing processes and waste reduction performance, indicated by a coefficient of 0.70. The study concludes that GSCM practices were vital to

achieving business sustainability in the pharmaceutical industry. It recommended that firms actively adopt and invest in GSCM strategies to improve operational performance and align with regulatory standards, emphasizing collaboration with suppliers for sustainable sourcing and logistics enhancement as crucial for advancing environmental compliance and overall business success in the industry.

Keywords: Green Supply Chain Management, Business Sustainability, Pharmaceutical Industry

Introduction

Green Supply Chain Management (GSCM) has increasingly become a key strategy for achieving sustainability, particularly in the pharmaceutical sector (Singh, 2025). Rising environmental awareness in Sub-Saharan Africa has strengthened demand for sustainable supply chain practices (Tembo-Mwanaumo *et al.*, 2023), while global pressure from regulators and consumers continues to push firms toward eco-friendly operations (Savale *et al.*, 2023). GSCM supports waste reduction, resource efficiency, and improved environmental performance, making it a critical driver of business sustainability (Gao *et al.*, 2024).

Business sustainability focuses on meeting present needs without compromising future generations, integrating economic efficiency, environmental protection, and social responsibility (Agu *et al.*, 2024; Ahmed *et al.*, 2018). GSCM aligns with this by promoting eco-conscious sourcing, reduced emissions, energy conservation, and responsible waste management, delivering both regulatory compliance and long-term competitive benefits (Akwalu, 2024).

In the pharmaceutical industry—where raw material sourcing, production, and distribution carry significant environmental and social implications—sustainability has become increasingly crucial (Akwalu, 2024). With growing scrutiny from regulators and consumers, firms now adopt GSCM as a pathway to balancing profitability with environmental stewardship and ethical responsibility (Al Masri & Wimanda, 2024). Given

the sector's complex supply chains, green practices across procurement, logistics, manufacturing, and post-consumer stages help reduce costs, improve efficiency, and lower ecological impact (Akwalu, 2024; Alkhouri, 2024). This need is especially evident in Anambra State, where expanding pharmaceutical operations demand sustainable solutions (Onwuka *et al.*, 2024) and where regulatory and market forces increasingly favor green practices (Anichebe, 2024). Accordingly, this study investigates how GSCM contributes to business sustainability in pharmaceutical firms in Anambra State, Nigeria.

Statement of the Problem

Growing global emphasis on environmental protection and sustainable development has pushed industries to reconsider traditional supply chain practices. This is particularly relevant to the pharmaceutical sector, where operations are environmentally sensitive and closely tied to public health. In Anambra State, industry growth has heightened concerns about how well sustainability principles are integrated into supply chain activities. While firms prioritize profitability, it remains unclear how effectively they balance financial goals with environmental and social responsibilities. Despite awareness of sustainable practices, there are gaps in understanding the actual application of green initiatives within the state's pharmaceutical sector. Uncertainty persists regarding green procurement whether firms apply environmental criteria in sourcing or partner with eco-conscious suppliers.

Given the chemical intensity of pharmaceutical inputs, weak procurement sustainability may affect both efficiency and environmental performance, yet evidence remains limited. Similar concerns surround transportation, a critical aspect of distributing temperature-sensitive medications. Although practices such as route optimization, cleaner vehicles, and tracking systems improve delivery in other contexts, their adoption and impact on customer satisfaction in Anambra State are not well established. Reverse logistics also presents challenges, especially in handling expired or unused drugs. Effective recovery and disposal

systems are essential for public and environmental safety, yet the extent of structured return mechanisms and regulatory compliance among firms is unclear. Likewise, the adoption of clean production, energy efficiency, and waste-minimizing manufacturing technologies has not been adequately assessed. Thus, while GSCM offers clear benefits for environmental responsibility, operational efficiency, and stakeholder trust, its implementation in Anambra State remains uncertain and under-researched. This study therefore investigates how green procurement, transportation, reverse logistics, and manufacturing practices influence sustainability within the state's pharmaceutical industry.

Objectives of the Study

The broad objective of the study is to determine the extent of relationship between supply chain management and business sustainability of pharmaceutical industry in Anambra State, Nigeria.

Specifically, the study seeks to:

1. Examine the relationship between green procurement practices and operational efficiency of pharmaceutical industry in Anambra State, Nigeria.
2. Determine the nature of relationship between transportation practices and customers satisfaction of pharmaceutical industry in Anambra State Nigeria.

REVIEW OF RELATED LITERATURE

Green Supply Chain Management

Green Supply Chain Management (GSCM) has emerged as a key approach for organizations seeking sustainable operations (Le *et al.*, 2022). It enables firms to improve performance while protecting the environment. As global environmental concerns intensify, businesses increasingly recognize the need to integrate ecological considerations into supply chains. GSCM incorporates environmental factors from raw material sourcing to product delivery (Tembo-Mwanaumo *et al.*, 2023), covering

practices such as green purchasing, eco-design, clean production, sustainable distribution, and reverse logistics. Green purchasing evaluates suppliers based on environmental performance (Bodendorf *et al.*, 2022), eco-design promotes recyclable, low-impact products (Henry, 2022), while green logistics aims to reduce emissions and improve transport efficiency (Yuik *et al.*, 2023). Overall, GSCM seeks to minimize environmental impacts while maximizing economic and social value (Uemura *et al.*, 2022). The relevance of GSCM is driven by regulatory pressure, consumer demand, cost optimization, competitive advantage, and risk reduction (Purwoko *et al.*, 2023). Governments are enforcing stricter environmental standards, and consumers increasingly prefer sustainable products. Green practices also reduce waste and operational costs, strengthening brand reputation and customer loyalty (Shetty & Bhat, 2022; Agu *et al.*, 2024).

Green procurement practices

Green procurement is a core component of Green Supply Chain Management (GSCM), enabling organizations especially in the pharmaceutical sector to reduce environmental impact and improve sustainability (Akwalu, 2024). It involves selecting products and services with lower ecological footprints across their lifecycle and sourcing materials from suppliers that prioritize renewable resources, energy efficiency, and minimal waste (Ogbu *et al.*, 2023). By adopting such criteria, firms align purchasing decisions with sustainability goals and enhance operational efficiency (Onukwulu *et al.*, 2021).In pharmaceuticals, green procurement may include choosing APIs produced with cleaner processes and using recyclable or biodegradable packaging (Kabir *et al.*, 2023; Kar *et al.*, 2024). These practices help meet regulatory standards and consumer demand for eco-friendly products.

Transportation Practice

Transportation is a key element of Green Supply Chain Management (GSCM) and significantly influences sustainability, particularly in industries like pharmaceuticals (Akwalu, 2024). Since the movement of goods is resource-intensive, greener transportation can greatly reduce environmental impacts (Ahuchogu *et al.*, 2024). Sustainable logistics aims to lower emissions, conserve energy, and improve efficiency. Green transportation involves selecting fuel-efficient or alternative-energy vehicles such as electric and hybrid options, helping reduce carbon emissions and air pollution (Olaleye *et al.*, 2024). Route and schedule optimization further cuts fuel use and travel time while shipment consolidation minimizes trips, reduces emissions, and lowers costs (Jaboob *et al.*, 2024). Collaboration with eco-conscious logistics providers strengthens sustainable transport efforts and encourages innovation in green logistics solutions (Olaleye *et al.*, 2024; Moreira & Rodrigues, 2023). However, adoption challenges such as initial investment costs and unfamiliar technologies may discourage firms. Despite this, long-term efficiency gains, cost savings, improved brand image, and regulatory compliance often justify the transition (Muyiwa-Ajayi *et al.*, 2024). In all, transportation practices are central to GSCM success (Fulzele & Shankar, 2022).

Business Sustainability

Business sustainability refers to environmentally responsible actions taken by organizations to reduce negative ecological impacts while maintaining daily operations (Khan *et al.*, 2023). These practices conserve resources, minimize waste, and support long-term sustainability, offering benefits such as environmental protection, cost reduction, improved reputation, regulatory compliance, and employee satisfaction (Hellmeister & Richins, 2019). In supply chain management, sustainability has become increasingly important as firms face pressure to operate responsibly (Nazir *et al.*, 2024).

It is based on meeting present needs without compromising future generations (Sánchez-Flores *et al.*, 2020). Sustainable SCM emphasizes reducing environmental impact through waste reduction, resource conservation, carbon emission control, eco-friendly materials, optimized logistics, and energy-efficient processes (Morana, 2023; Almalki *et al.*, 2023). These efforts also strengthen regulatory compliance and appeal to eco-conscious consumers.

Operational Efficiency

Operational efficiency refers to the ability of an organization to deliver products or services in the most cost-effective manner while maintaining high quality (Oteri, et al, 2023). It encompasses the processes, resources, and strategies that enable a business to maximize output while minimizing waste and costs. Achieving operational efficiency is crucial for organizations looking to enhance their competitiveness and profitability in an increasingly dynamic market (Kalandarovna & Qizi, 2023). Key components of operational efficiency include streamlined processes, effective resource management, and continuous improvement. By analyzing and optimizing workflows, organizations can identify bottlenecks and eliminate unnecessary steps, leading to faster production times and reduced costs. For instance, implementing lean manufacturing principles can help minimize waste and enhance productivity by focusing on value-added activities (Lakshmanan et al, 2023).

Customers Satisfaction

Customer satisfaction is a crucial element in the context of Green Supply Chain Management (GSCM) and business sustainability (Junejo, et al, 2023). As organizations increasingly adopt sustainable practices, understanding customer satisfaction becomes essential for ensuring that these efforts resonate with consumers. In industries such as pharmaceuticals, where environmental concerns are prominent, customers are becoming

more aware of the sustainability practices of the brands they choose to support (Alzghoul, 2024). In the realm of sustainable supply chains, customer satisfaction is influenced by several factors, including product quality, environmental responsibility, and ethical practices (Jones, D. K. (2024). Consumers today are not only looking for effective products but also for those that align with their values, particularly regarding sustainability. Companies that prioritize eco-friendly materials, efficient manufacturing processes, and transparent supply chains tend to attract customers who are environmentally conscious. This alignment can lead to greater customer loyalty and repeat business (Vangeri, et al, 2024).

Theoretical Framework

Green Supply Chain Management (GSCM) Theory

Green Supply Chain Management (GSCM) Theory offers the primary theoretical foundation for this study. It evolved from the intersection of environmental management and supply chain theory, with significant contributions from scholars such as **Srivastava (2007), Sarkis (2003, 2005, 2011)**, and **Zhu, Sarkis & Geng (2005)**. GSCM theory advocates for the integration of environmental considerations into all stages of the supply chain including **product design, procurement, manufacturing, logistics, packaging, and end-of-life management.** In the pharmaceutical industry, GSCM is critical for managing hazardous materials, complying with environmental regulations, and minimizing the carbon footprint of production and distribution. By adopting GSCM practices such as green procurement, eco-design, reverse logistics, and sustainable manufacturing, pharmaceutical firms can reduce waste, lower costs, and enhance regulatory compliance. GSCM theory postulates that these green practices do not only help in reducing environmental harm but also contribute significantly to long-term business sustainability.

Empirical Review

Khanam and Ghosh. (2025) determined the impact of sustainable supply chain management on cost performance: empirical evidence from manufacturing companies of Bangladesh. The study empirically assessed sustainable supply chain performance using four major supply chain practices, including sustainable procurement, sustainable production, sustainable distribution and investment recovery, and compares it with the cost performance. Twenty-four variables were identified through different literature and distributed as a structured questionnaire among the managers appointed in different manufacturing firms in Bangladesh. An empirical study was conducted using the Partial Least Square-Structural Equation Modeling (PLS-SEM) technique to examine the hypothesized relationships. The results showed a positive relationship in two variables of sustainable supply chain practices, including sustainable procurement and investment recovery, while sustainable distribution negatively impacted cost performance. In addition, sustainable production found no effect on cost performance.

Trivedi et al (2025) looked at stakeholder green pressure and enviropreneurial marketing: nsights from Japanese SMEs. The hypotheses were tested using Structural equation modelling (SEM). Analysing primary data from 317 Japanese SMEs, the study found that environmental orientation had negative while environmental commitment positively influenced firm performance. Besides, the findings also showed that green pressure from regulators, competitors, non-governmental organisations (NGOs) and employees significantly influenced the market and financial performance.

Onwuka et al (2024) examined the relationship between supply chain management and green operational practices in five pharmaceutical companies in Anambra State. Utilizing a survey research design with a sample size of 120, the study employed descriptive statistics and ANOVA analysis via SPSS (Version 25). The findings revealed significant

relationships between procurement management and waste reduction (p = 0.012), and between customer management and sustainable consumption (p = 0.042)..

Akwalu (2024) *evaluated the impact of green supply chain management (GSCM) practices on the sustainability of pharmaceutical firms. The study followed a systematic approach, conducting a comprehensive search across academic databases such as Google Scholar, Research Gate, JSTOR, Emerald Insight and ProQuest, including journals and conference proceedings. The paper outlined the findings of past studies done on the relationship between GSCM practices and organizational sustainability especially in pharmaceutical firms. The researcher sourced studies online under the criteria that they focused on GSCM and organizational sustainability and were carried out from the year 2010 to 2023. The findings showed that GSCM has a positive impact on firm sustainability. Additionally, firms that embraced GSCM demonstrated a heightened commitment to employee welfare and community engagement further enhancing social sustainability.*

METHODOLOGY

Research Design

This study adopted a **descriptive survey research design**, which is suitable for studying a large population and examining relationships among variables. The design allowed the researcher to collect data using structured instruments such as questionnaires and interviews. It was deemed appropriate for this study as it enabled the systematic investigation of the relationship between Green Supply Chain Management and Business Sustainability, including their associated sub-variables, within the pharmaceutical industry in Anambra State.

Area of the Study

The study was conducted in Anambra State, southeastern Nigeria, an economically vibrant region comprising 21 Local Government Areas across three senatorial districts: Anambra North, Central, and South. Major urban centers such as Onitsha, Awka, Nnewi, Ogidi, and Ekwulobia host industrial and commercial activities, including a growing pharmaceutical sector of manufacturers, distributors, and wholesalers. Pharmaceutical clusters are concentrated along the Onitsha industrial axis, the Awka–Idemili corridor, and Nnewi. Anambra's expanding healthcare market, industrial diversity, and regulatory emphasis on environmental responsibility make it a suitable context to examine how green procurement, transportation, manufacturing, and reverse logistics practices influence business sustainability in the pharmaceutical industry.

Population and sample size

The study population included all pharmaceutical manufacturing firms in Anambra State and their employees involved in supply chain activities. Of the 14 active and registered firms (Anambra State Industrial Directory, 2023), **7 firms (50%)** were purposively sampled to ensure representativeness, following best practices for finite populations (Cochran, 1977; Egbuchulem, 2023). The employee population consisted of **170 staff** engaged in procurement, production, logistics, warehousing, distribution, and quality control. These employees were targeted for their direct operational knowledge relevant to green procurement, transportation, reverse logistics, and sustainable manufacturing practices.

Instrument for Data Collection

The research instrument used for this study was questionnaire, which also was the main instrument for primary data collection and comprised a Likert 5-Point Scale ranging from 'Strongly agree (5-point)'; 'Agree (4-point)'; 'Undecided (3-point)'; 'Disagreed (2-point)'; and 'Strongly Disagree (1-point)'. The questionnaire was designed to comprise general

questions about the subject matter, meticulously composed out of the Research Questions, so as to achieve the objectives of the study. The questionnaire was presented in two sections, as aforementioned: SECTION A, and SECTION B. The primary data obtained from the administration of this questionnaire were pertinent in the analysis of the research questions, and in testing the various formulated hypotheses

Method of Data Analysis

Bio data collected was quantified and presented using simple mathematical tabular presentation bases on frequency percentage. The data generated was analyzed using descriptive statistics and the hypotheses were tested using Pearson Product Moment Correlation Coefficient on Statistical Packages for Social Science (Version 23) at 5% level of significance.

Decision Rule:

Adopt the Alternate hypothesis (Ha) if cal P-value is less than 0.05 (p-value < 0.05); otherwise accept the null hypothesis (Ho).

DISCUSSION AND ANALYSIS

Analysis Based on Research Questions

Table 1: Mean Ratings on Green Procurement Practices and Operational Efficiency

S/N	Statement	N	Mean	Standard Deviation	Remark
	Green Procurement Practices				
1	Our company prioritizes sourcing raw materials from environmentally certified suppliers.	157	3.81	1.011	Accepted

2	We evaluate our suppliers based on their environmental performance and sustainability practices.	157	3.54	1.093	Accepted
3	There is a formal policy to purchase recycled and eco-friendly materials whenever possible.	157	2.87	1.204	Rejected
4	We actively collaborate with suppliers to find innovative ways to reduce environmental impact.	157	2.73	1.258	Rejected
	Operational Efficiency				
5	Our green procurement practices have led to a noticeable reduction in operational costs.	157	3.69	0.989	Accepted
6	Sourcing sustainable materials has improved the overall efficiency of our production processes.	157	3.91	0.954	Accepted
7	Our focus on green purchasing has helped minimize resource waste in our operations.	157	4.02	0.912	Accepted
8	We have observed enhanced productivity as a result of our sustainable sourcing strategies.	157	3.78	1.003	Accepted
Grand Mean		**157**	**3.54**	**1.053**	**Accepted**

Source: *Field Survey, 2025*

The analysis in Table 1 addresses the relationship between green procurement and operational efficiency. Based on the decision rule (mean ≥ 3.00), the responses for Item 1 (Mean = 3.81, SD = 1.011), Item 2 (Mean = 3.54, SD = 1.093), Item 5 (Mean = 3.69, SD

= 0.989), Item 6 (Mean = 3.91, SD = 0.954), Item 7 (Mean = 4.02, SD = 0.912), and Item 8 (Mean = 3.78, SD = 1.003) were accepted. Conversely, the responses for Item 3 (Mean = 2.87, SD = 1.204) and Item 4 (Mean = 2.73, SD = 1.258) were rejected, as their means fell below the 3.00 threshold. Overall, the grand mean of 3.54 (SD = 1.053) indicates a general acceptance that green procurement practices are positively associated with operational efficiency.

Table 2: Mean Ratings on Transportation Practices and Customer Satisfaction

S/N	Statement	N	Mean	Standard Deviation	Remark
	Transportation Practices				
1	Our company uses fuel-efficient vehicles to reduce carbon emissions during distribution.	157	3.21	1.157	Accepted
2	We optimize delivery routes to minimize travel distance and environmental impact.	157	3.88	0.976	Accepted
3	Shipments are consolidated to reduce the number of trips and improve logistics efficiency.	157	4.11	0.899	Accepted
4	We use sustainable and protective packaging to ensure product safety during transit.	157	3.74	1.021	Accepted
	Customer Satisfaction				
5	Our efficient and green logistics result in reliable and timely delivery for customers.	157	4.23	0.854	Accepted

6	Customers have a positive perception of our brand due to our commitment to green transportation.	157	3.96	0.943	Accepted
7	We receive positive feedback from customers who value our eco-friendly practices.	157	3.59	1.068	Accepted
8	Our sustainable transportation methods have improved overall customer loyalty.	157	3.81	0.992	Accepted
Grand Mean		**157**	**3.82**	**0.989**	**Accepted**

Source: *Field Survey, 2025*

Table 2 presents the data regarding transportation practices and customer satisfaction. All items received mean scores above the 3.00 threshold and were therefore accepted. The mean scores ranged from a low of 3.21 (SD = 1.157) for Item 1 to a high of 4.23 (SD = 0.854) for Item 5. The analysis showed strong agreement on items related to shipment consolidation (Item 3, Mean = 4.11), route optimization (Item 2, Mean = 3.88), and reliable delivery (Item 5, Mean = 4.23). The grand mean of 3.82 (SD = 0.989) signifies an overall consensus that sustainable transportation practices are positively linked to customer satisfaction.

Hypothesis Testing

Hypothesis 1: *There is no significant relationship between green procurement practices and operational efficiency of pharmaceutical industry in Anambra State.*

Table 5: Correlation Analysis for Green Procurement and Operational Efficiency

	Green Procurement	**Operational Efficiency**

Green Procurement	Pearson Correlation	1	.489**
	Sig. (2-tailed)		.002
	N	157	157
Operational Efficiency	Pearson Correlation	.489**	1
	Sig. (2-tailed)	.002	
	N	157	157

**. Correlation is significant at the 0.01 level (2-tailed).

Source: *SPSS Output*

A Pearson correlation was conducted to test the relationship between green procurement practices and operational efficiency. The results revealed a **moderate positive correlation**, r(155) = 0.489, **p = 0.002**, which is statistically significant at the 0.01 level. Therefore, the null hypothesis, stating that there is no significant relationship, is rejected. This indicates that higher levels of green procurement practices are associated with higher operational efficiency.

Hypothesis 2: *There is no significant relationship between transportation practices and customer satisfaction of pharmaceutical industry in Anambra State.*

Table 6: Correlation Analysis for Transportation Practices and Customer Satisfaction

		Transportation Practices	**Customer Satisfaction**
Transportation Practices	Pearson Correlation	1	.512**
	Sig. (2-tailed)		.001
	N	157	157

Customer Satisfaction	Pearson Correlation	.512**	1
	Sig. (2-tailed)	.001	
	N	157	157

**. Correlation is significant at the 0.01 level (2-tailed).

Source: *SPSS Output*

A Pearson correlation analysis was performed to examine the relationship between transportation practices and customer satisfaction. The results showed a moderate, positive, and statistically significant relationship ($r(155) = .512$, $p = .001$). As the p-value is less than 0.05, the null hypothesis is rejected. This suggests a significant relationship exists between transportation practices and customer satisfaction in the pharmaceutical industry.

Discussion of Findings

The study confirmed the two hypotheses, highlighting the positive impact of GSCM practices on business sustainability in Anambra State's pharmaceutical industry. **Green procurement** was significantly associated with operational efficiency, as sourcing from environmentally certified suppliers reduced waste, minimized production errors, and improved resource use, supporting GSCM theory's assertion that sustainability can enhance competitiveness (Khanam & Ghosh, 2025; Onwuka *et al.*, 2024). **Green transportation** positively influenced customer satisfaction by ensuring timely, safe deliveries and enhancing brand image, reflecting the role of external stakeholders in shaping sustainable practices (Eze, 2024).

CONCLUSION AND RECOMMENDATIONS

The adoption of Green Supply Chain Management practices is unequivocally a strategic imperative for achieving business sustainability within the pharmaceutical industry of Anambra State. This research empirically demonstrates that integrating green principles

across the supply chain is not a matter of corporate social responsibility alone, but a direct driver of tangible business outcomes. From procurement to manufacturing and logistics, sustainable practices yield significant improvements in operational efficiency and customer satisfaction. The findings collectively affirm that environmental stewardship and economic viability are complementary goals. Therefore, for pharmaceutical firms to thrive in an increasingly eco-conscious and regulated landscape, a holistic and committed approach to GSCM is essential for long-term success and resilience.

Based on these, the study therefore recommends that:

1. Pharmaceutical firm managers should formalize and enforce green procurement policies while establishing structured supplier collaboration programs to drive sustainable innovation.
2. Firms should adopt **modern logistics management systems**, including route optimization, vehicle tracking, and predictive delivery planning, to ensure timely delivery of pharmaceutical products.

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