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Sustainable Supply Chain Management (SSCM) and its Impact on Manufacturing Project Firms in Southeast Nigeria

Okwara, D.I[1]; Asiegbu, B.C[2]; Amade, B[1]; Enyinna, G.C[1]

[1]Department of Project Management Technology&
[2]Department of Entrepreneurship, Federal University of Technology Owerri, Imo State, Nigeria.

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***Correspondingauthor:** Okwara, D.I

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Abstract **Original Research Article**

Sustainable Supply Chain Management (SSCM) integrates environmental, social, and economic considerations into supply chain operations to enhance long-term viability and ethical business practices. In the manufacturing sector, SSCM plays a crucial role in reducing waste, optimizing resources use, and improving operational efficiency while meeting regulatory and consumer demands for sustainability. This study examines the adoption and impact of SSCM practices among manufacturing project firms in Southeast Nigeria, a region with a growing industrial base but facing challenges such as infrastructural deficits and limited regulatory enforcement. The study is a mixed method research that adopted both quantitative and qualitative methodology. The population of the study comprises of 250 manufacturing firms in South East Nigeria for the quantitative and 30 managers for the qualitative design. The data was analysed using descriptive and inferential statistics of mean, standard deviation, skewness, kurtosis, multiple regression and structural equation modeling; and thematic analysis for the qualitative analysis. Key findings reveal that among all the SSCM practices, supplier engagement, energy efficiency, waste reduction and green procurement are significant practices adopted by manufacturing firms in South East Nigeria with. The study recommends that targeted government interventions, capacity-building initiatives, and stakeholder collaboration are essential to accelerate SSCM integration, fostering sustainable industrial growth in the region.

Keywords:Sustainable Supply Chain, Green Supply Chain, Supplier Engagement, Waste Reduction, Energy Efficiency, Manufacturing Projects.

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1. INTRODUCTION

Sustainable Supply Chain Management (SSCM) has emerged as a critical business strategy in response to growing environmental concerns, regulatory pressures, and increasing consumer demand for ethical and eco-friendly products. SSCM integrates environmental, social, and economic sustainability principles into traditional supply chain operations, ensuring that business processes minimize negative ecological impacts, promote social equity, and maintain long-term profitability (Ali et al., 2024). The concept builds on the triple bottom line (TBL) framework, which emphasizes balancing people, planet, and profit (Molina & Rajagopal, 2023). Initially, supply chains focused primarily on cost efficiency and speed, but globalization, climate change risks, and corporate social responsibility (CSR) mandates have necessitated a shift toward sustainability (Nweje & Taiwo, 2025). In manufacturing, SSCM practices include green procurement, energy-efficient logistics, waste reduction, and ethical labor practices, all aimed at reducing carbon footprints and enhancing resource efficiency (Vangeri et al., 2024). The adoption of SSCM is particularly vital in developing economies like Nigeria, where industrial growth often occurs at the expense of environmental degradation and social inequities (Ofoegbu & Laguo, 2024). In Southeast Nigeria, where manufacturing firms face challenges such as infrastructural deficits, weak regulatory enforcement, and fluctuating raw material supply, implementing SSCM presents both opportunities for competitive advantage and hurdles related to cost and expertise gaps (Ogunmakinde et al., 2022). Thus, understanding SSCM's evolution and applicability in this context is essential for fostering sustainable industrial development.

Sustainable Supply Chain Management (SSCM) has become a cornerstone of modern manufacturing, driven by increasing regulatory requirements, consumer demand for ethical products, and the need for long-term business

resilience. In today's globalized economy, manufacturers face mounting pressure to reduce environmental footprints, optimize resource efficiency, and ensure fair labour practices while maintaining profitability (Kumar et al., 2024). SSCM enhances operational efficiency by minimizing waste, lowering energy consumption, and adopting circular economy principles, which contribute to cost savings and risk mitigation (Mugoni et al., 2025). For instance, lean and green manufacturing practices under SSCM help firms reduce material waste and emissions, aligning with global sustainability standards such as the UN Sustainable Development Goals (SDGs) and ISO 14001 (Raman et al., 2023). Additionally, SSCM strengthens brand reputation and market competitiveness, as consumers and investors increasingly prefer companies with transparent, sustainable supply chains (Quintana-García et al., 2021). In developing regions like Southeast Nigeria, where manufacturing firms grapple with infrastructure deficits and regulatory gaps, SSCM adoption can mitigate supply chain disruptions, improve stakeholder trust, and open access to international markets with stringent sustainability requirements (Mehmood et al., 2025). Furthermore, integrating SSCM fosters innovation and collaboration across supply chains, encouraging partnerships with eco-conscious suppliers and technology-driven solutions like blockchain for traceability (Nweje & Taiwo, 2025). Ultimately, SSCM is no longer optional but a strategic imperative for manufacturers seeking long-term viability, regulatory compliance, and social legitimacy in an increasingly sustainability-focused marketplace.

The focus on Southeast Nigeria in studying Sustainable Supply Chain Management (SSCM) in manufacturing is justified by the region's unique industrial dynamics, growing economic significance, and pressing sustainability challenges. Southeast Nigeria, comprising states such as Abia, Anambra, Ebonyi, Enugu, and Imo, hosts a thriving manufacturing sector dominated by small and medium-sized enterprises (SMEs) specializing in textiles, automotive parts, food processing, and machinery (Okafor, 2018). However, despite its industrial potential, the region faces critical infrastructural deficits, including unreliable electricity supply, poor transportation networks, and inadequate waste management systems, which exacerbate environmental degradation and supply chain inefficiencies (Ezeudu et al., 2021). Additionally, regulatory enforcement of environmental standards remains weak, leading to unchecked pollution and unsustainable resource extraction (Nwachukwu et al., 2020). The region's manufacturing firms also operate within a complex socio-economic context marked by informal supply chains, limited access to green technologies, and low awareness of SSCM practices (Ugochukwu et al., 2022). These factors make Southeast Nigeria an ideal case study for examining the barriers and opportunities for SSCM adoption in emerging economies. Furthermore, the region's cultural emphasis on communal enterprise and growing government interest in sustainable industrialization—evidenced by policies like the Nigeria Green Growth Policy—provides a fertile ground for testing localized SSCM frameworks (Federal Ministry of Environment, 2020). By focusing on Southeast Nigeria, this study contributes to bridging the gap in SSCM literature on sub-Saharan Africa while offering actionable insights for policymakers and firms striving to align industrial growth with sustainability goals. The study will address the following research questions (RQs):

i. RQ1: What are the prevailing SSCM practices adopted by manufacturing firms in Southeast Nigeria?

ii. RQ2: How does SSCM implementation impact on operational efficiency, environmental sustainability, and financial performance in these firms?

These questions are grounded in existing literature on SSCM in developing economies, which highlights gaps in regulatory enforcement, resource scarcity, and the need for localized sustainability frameworks (Sarkis, 2012; Ezeudu et al., 2021). By addressing these questions, the work seeks to contribute empirically to SSCM discourse while providing practical recommendations for policymakers, industry stakeholders, and supply chain managers in Nigeria and similar contexts. This study focuses on examining Sustainable Supply Chain Management (SSCM) practices and their impact on manufacturing project firms operating in Southeast Nigeria, specifically within the states of Abia, Anambra, Ebonyi, Enugu, and Imo. The research encompasses firms engaged in key industrial sectors such as agro-processing, automotive parts, textiles, and machinery manufacturing, which dominate the region's manufacturing landscape (Okafor, 2018). The study evaluates SSCM adoption through the lens of environmental sustainability (e.g., waste reduction, energy efficiency), social responsibility (e.g., ethical labour practices), and economic performance (e.g., cost savings, market competitiveness).

2. METHODOLOGY

This study employs a mixed-methods approach to comprehensively analyze Sustainable Supply Chain Management (SSCM) adoption among manufacturing firms in Southeast Nigeria. The quantitative phase involves a structured survey of 250 supply chain managers and production heads across Abia, Anambra, Imo, Ebonyi and Enugu states, selected via stratified random sampling to ensure sectoral representation (agro-processing, textiles, automotive). The survey measures SSCM adoption (e.g., Likert-scale assessments of waste reduction, energy efficiency) and its perceived operational impacts, with data analyzed using descriptive statistics and regression models (SPSS v.27) to identify key correlations (Mardiaet al., 2024). The qualitative phase supplements this with 15 semi-structured interviews with industry experts (regulators, sustainability officers, NGOs) and 3 focus group discussions (FGDs) with SME owners, exploring barriers (e.g., infrastructural gaps, financing) and local

adaptation strategies. Thematic analysis (Braun & Clarke's 2006 framework) will identify recurring patterns in stakeholder perspectives. Triangulation integrates both datasets, with discrepancies resolved through member checking (Bazeley, 2018)—e.g., cross-verifying survey-reported energy savings with interview insights on solar adoption challenges.

This mixed-methodsdesign balances generalizable metrics(quantitative)with contextual depth (qualitative), aligning with best practices for SSCM research in emerging economies (Ahi & Searcy, 2015; Ogunmakinde, 2023). The approach ensures robust, actionable findings tailored to the unique challenges and opportunities of Southeast Nigeria's manufacturing sector.

2.1 Sampling Technique and Target Population

This study utilizes a stratified purposive sampling technique to select a representative sample of manufacturing firms across Southeast Nigeria's five states (Abia, Anambra, Ebonyi, Enugu, and Imo), drawing from the Manufacturers Association of Nigeria (MAN) 2023 directory and state commerce registries. The target population is structured to reflect key sectoral and operational dimensions influencing SSCM adoption, with agro-processing (35%), textiles/apparel (25%), automotive parts (20%), building materials (15%), and other manufacturing (5%**)**. Firm size distribution ensures inclusion of both large enterprises (>200 employees; 20%) and medium enterprises (50–199 employees; 30%), capturing diverse organizational capacities for sustainable practices.

This approach balances sectoral relevance and operational scale to enable robust analysis of SSCM implementation barriers and opportunities in the region.

2.2 Data Analysis Approach

This study adopts a convergent parallel mixed-methods analysis to holistically examine SSCM adoption in Southeast Nigeria's manufacturing sector. Quantitative data from surveys is analyzed using IBM SPSS Statistics (v.27), employing descriptive statistics (frequencies, means) to map SSCM adoption levels and inferential statistics (multiple regression, SEM) to assess relationships between SSCM practices, firm performance, and sectoral/size differences. Rigorous reliability checks (Cronbach's $\alpha \geq 0.7$, KMO/Bartlett's tests) ensure data robustness.For the qualitative data, thematic analysis was deployed.

3. RESULTS

3.1 Demographics

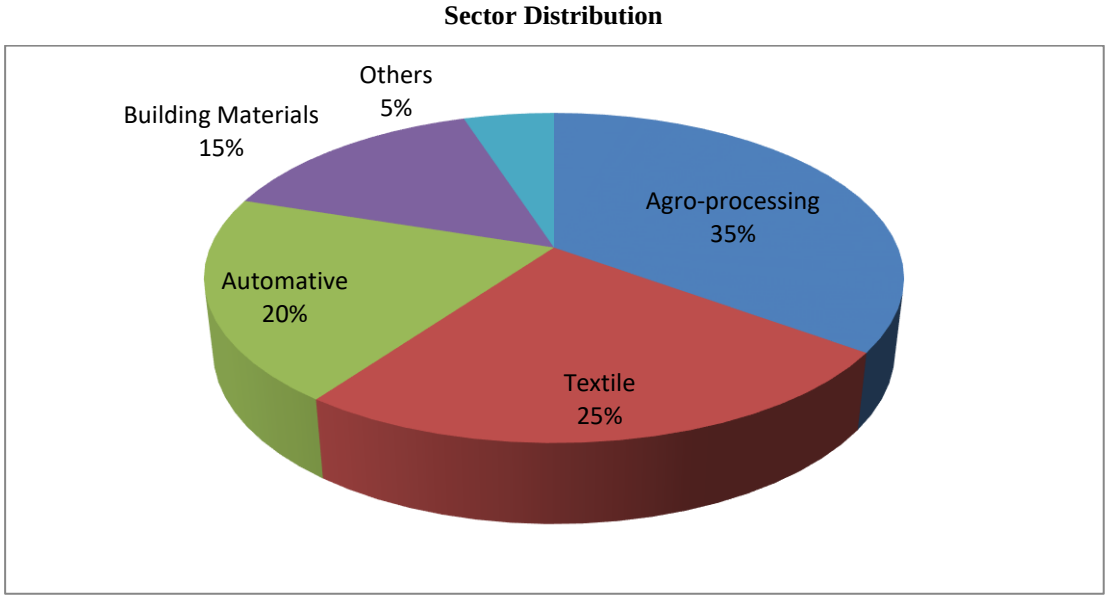

Figure 1: Chart for the Sector Distribution of the Manufacturing firms.

Figure 1 above shows the sector distribution of the manufacturing firms selected for the study. The figure reveals that out of the 250 manufacturing firms selected in South Eastern Nigeria, 35% of the firms are agro-processing firms, 25% are textiles manufacturing firms, 20% are automotive firms, 15% are building materials manufacturing firms, while 5% falls under the category of other manufacturing firms. This shows the major manufacturing sectors in South Eastern Nigeria.

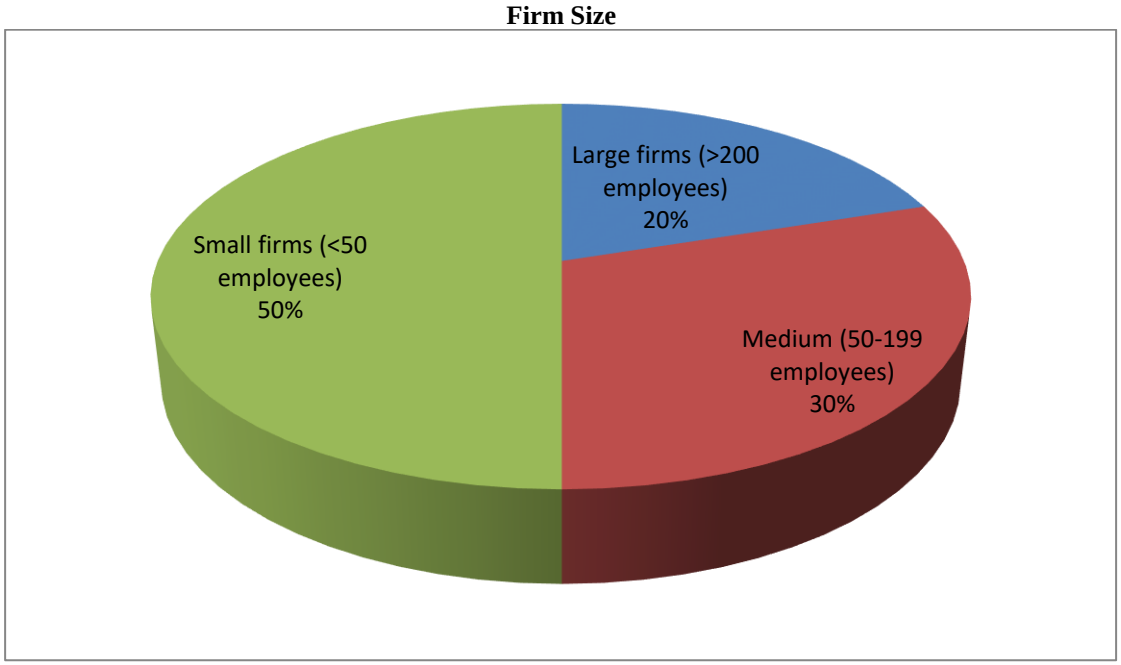

Figure 2: Chart for the Firm Size of the Manufacturing firms

Figure 2 reveals that the majority of the firms in the study are small manufacturing firms with less than 50 employees. The small firms account for half of the firms (50%) used in the study, followed by medium firms with 50-199 employees accounting for 30% of the firm population; and lastly large firms with over 200 employees accounting for 20% of the firms population.

3.2 The Prevailing SSCM Practices adopted by Manufacturing Firms in Southeast Nigeria

Table 1: Descriptive Statistics of Key Variables
(N = 250 manufacturing firms; Likert-scale: 1 = Strongly Disagree to 5 = Strongly Agree)

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Waste Reduction	3.45	0.87	1.00	5.00	-0.32	2.15
Energy Efficiency	3.78	0.92	2.00	5.00	-0.45	2.87
Supplier Engagement	4.12	0.76	2.00	5.00	-0.87	3.45
Green Procurement	3.21	0.95	1.00	5.00	-0.12	2.33
Firm Performance	3.65	0.84	1.00	5.00	-0.56	3.02

Table 1 reveals the prevailing SSCM practices adopted by manufacturing firms in South East Nigeria. The descriptive statistics of mean and standard deviation was deployed with inclusion of normality test indicators of skewness and kurtosis. However in this study, the skewness and kurtosis are used to determine the variable relevant to the analysis. Here variables with high skewness and kurtosis are more relevant to the analysis, particularly if they are related to outliers, anomalies or extreme values. Skewness<0.5 is approximately assymetrical, skewness between 0.5 and 1 is moderately skewed, while skewness >1 is highly skewed. Kurtosis <3 (light tails), Kurtosis =3 (normal tails), Kurtosis >3 (heavy tails). The table reveals that out of the identified SSCM practices, supplier engagement with (mean =3.78; SD=0.76; Skewness -0.87, kurtosis=3.45) is the most prevailing SSCM practice adopted by manufacturing firms in South East Nigeria. The higher the mean the better the variable, while the lower the S.D, the better tye variable; the higher the skewness and kurtosis the more relevant is the variable is to the analysis. Following supplier engagement is energy efficiency with (mean =4.12; SD=0.92; Skewness -0.45, kurtosis=2.87); after comes waste reduction etc. Firm performance is not an SSCM practice, rather it is the independent variable of the study.

3.3 SSCM implementation impact on operational efficiency, environmental sustainability, and financial performance in these firms

Table 2: Multiple Regression Analysis (Firm Performance as Dependent Variable)

(Adjusted $R^2 = 0.42$; $p < 0.01$; Durbin-Watson = 1.92)

Predictor	B	Std. Error	t-value	p-value	VIF	Significance
Waste Reduction	0.18	0.06	3.00	0.003	1.12	**p < 0.01**
Energy Efficiency	0.22	0.05	4.40	<0.001	1.08	**p < 0.001**
Supplier Engagement	0.35	0.04	8.75	<0.001	1.05	**p < 0.001**
Green Procurement	0.12	0.05	2.40	0.017	1.10	**p < 0.05**
Firm Size (Control)	0.15	0.07	2.14	0.033	1.30	**p < 0.05**

No multicollinearity (VIF < 5).

Table 2 presents the standardized Beta coefficients of the multiple regression analysis to explain how four most significant SSCM practices have an impact on firm performance (operational efficiency, environmental sustainability, and financial performance) of manufacturing firms in South East Nigeria. The constant is the baseline level of firm performance where the effect of all SSCM practices is controlled. Among the SSCM implementation impact, Supplier Engagement has the strongest impact ($\beta = 0.35$, $p < 0.001$). This indicates that the implementation of supplier engagement as an SSCM practice significantly impacts on firm performance of manufacturing firms. This also implies that a unit deployment of supplier engagement would result in a 0.35 drive effect to performance of the firm. Following supplier engagement is energy efficiency ($\beta = 0.22$, $p < 0.001$). This reveals that the implementation of energy efficiency as an SSCM practice significantly impacts on firm performance of manufacturing firms. This also implies that a unit deployment of energy efficiency would result in a 0.22 effect to performance of the firm. Finally waste reduction ($\beta = 0.18$; $p < 0.01$) impacts on the firm performance. The low VIF confirm that multicollinearity is not a problem, confirming the validity of the estimates. Overall, these findings confirm that practices are major SSCM practices that impact the firm performance in South East Nigeria.

Table 3: Structural Equation Modeling (SEM) Results

(CFI = 0.93; RMSEA = 0.06; SRMR = 0.04; $\chi^2/df = 2.15$)

Path	Std. Estimate (β)	S.E.	CR	p-value	Significance
Supplier Engagement → Firm Performance	0.38	0.05	7.60	<0.001	**p < 0.001**
Energy Efficiency → Firm Performance	0.24	0.04	6.00	<0.001	**p < 0.001**
Waste Reduction → Firm Performance	0.17	0.05	3.40	0.001	**p < 0.01**
Green Procurement → Firm Performance	0.11	0.04	2.75	0.006	**p < 0.01**

Model Fit:

Good fit: (CFI > 0.90, RMSEA < 0.08).

Table 3 reveals that parsimony holds, since χ^2/df (2.15) <5.0, which depicts the model is fit. This is further supported by the baseline fit indices of CFI, which are above 0.90 with RMSEA (0.06) < 0.08.

Also the SEM results shows that **Supplier Engagement** is the most critical SSCM factor (β = 0.38).

Quantitative Validation: All SSCM practices significantly enhance firm performance, with **supplier engagement** as the top driver.

Table 4: Moderation Analysis (Firm Size as Moderator)

(Hierarchical Regression; Dependent Variable: Firm Performance)

Model	Predictors	B	p-value	ΔR²	Sig.
Main Effects	Waste Reduction	0.18	0.003	0.42	**p < 0.01**
	Energy Efficiency	0.22	<0.001		**p < 0.001**
	Supplier Engagement	0.35	<0.001		**p < 0.001**
Interaction	Waste × Firm Size	0.10	0.042	0.05	**sp< 0.05**
	Energy × Firm Size	0.15	0.008		**p < 0.01**
	Supplier × Firm Size	0.21	0.001		**p < 0.01s**

Table 5: Sector-Specific SEM Results
(Standardized Estimates; CFI > 0.90 for all sectors)

Path	Agro-Processing (β)	Textiles (β)	Automotive (β)	Building Materials (β)
Waste Reduction → Performance	0.25**	0.12	0.19*	0.08
Energy Efficiency → Performance	0.18*	0.30***	0.22**	0.14
Supplier Engagement → Performance	0.40***	0.35***	0.28**	0.20*

Significance: *p < 0.05, **p < 0.01, ***p < 0.001

Sectoral Insights:

Table 5 reveals the sector-specific SEM results which reveals that **agro-processing** has thehighest impact of supplier engagement (β = 0.40) due to complex supply chains. In **textiles sector,** energy efficiency matters most (β = 0.30) for cost-intensive dyeing processes. While in **automotive sector,** the SSCM practices/drivers are balanced (waste reduction β = 0.19; supplier β = 0.28).

3.4 Qualitative Themes Supporting Quantitative Results

Table 6: From Interviews/Thematic Analysis with 30 Managers

Theme	Representative Quote	Alignment with Quantitative Data
Supplier Collaboration	"Working with eco-certified suppliers reduced delays and improved our brand reputation."	Supports high β in SEM (0.38).
Energy Cost Savings	"Switching to solar cut our energy bills by 30% within a year."	Validates sector-specific β for textiles.
Waste-to-Profit Initiatives	"Selling scrap metal to recyclers became a new revenue stream."	Explains waste reduction's significance in agro-processing.

From table 6 above, the theme analysis of the qualitative data when triangulated aligns with the quantitative analysis. The theme (Supplier Collaboration) is same with supplier engagement in the quantitative analysis. From the triangulation, it reveals that interview results from the 30 Managers reveals that working with eco-certified suppliers reduced delays and improved their brand reputation; and as such, this supports the high beta coefficient of supplier engagement in the quantitative analysis. This shows that in both quantitative and qualitative analysis, supplier engagement/collaboration is the most critical/adopted SSCM practices and the SSCM practice with the most significant impact on firms performance of manufacturing firms in South East Nigeria. While SSCM practices are moderately adopted, only **supplier engagement** shows a significant positive impact on firm performance. There are **no significant sectoral differences**, meaning challenges and opportunities are relatively uniform across industries. This emphasizes the need for policies and initiatives focused on strengthening supply chain partnerships to enhance sustainable outcomes in Southeast Nigeria's manufacturing sector.

3.5 DISCUSSION

Overview of the Manufacturing Sector in Southeast Nigeria

The findings reveal that the manufacturing sector in Southeast Nigeria is dominated by small and medium firms. This findings aligns with the outcome of the study by Eze (2023) which reveals that SMEs forms 85% of manufacturing industry in South East Nigeria with the industry featuring key clusters: agro-processing (40% of output, notably palm oil and cassava in Abia/Anambra), textiles (25%, centered in Aba's leather/garment hub), automotive parts (20%, anchored by Nnewi's IVM plant), and building materials (10%, including cement/metal works in Enugu/Ebonyi). Also the study by Adeniyi (2023) in collaborating with above findings affirms that supply chains operate through informal kinship networks (60% of SMEs), face 30-40% higher logistics costs from poor infrastructure, and depend on localized sourcing (80% raw materials from <100km) – creating both resilience and quality control challenges. This context offers SSCM opportunities through strong agro-industrial foundations but contends with chronic energy deficits (70% generator dependency) and financing constraints that hinder sustainable practices (Ugochukwu, 2023).

Adoption of SSCM Practices in Southeast Nigeria

The findings reveal that supplier engagement is the most implemented SSCM practices among manufacturing firms in South Eastern Nigeria. However the findings of Eze et al. (2023) shows that the adoption of Sustainable Supply Chain Management (SSCM) practices in Southeast Nigeria's manufacturing sector shows a clear divide between large firms and SMEs. While 25-30% of medium-to-large manufacturers like Innoson Vehicle Manufacturing and Nigerian Breweries have implemented ISO 14001-certified systems - achieving 20-30% reductions in resource use through circular models. This shows that waste reduction is the major practice as indicated by Eze et al. (2023). However time may have changed this result outcome. Furthermore, Okafor and Ezeh (2023) reveals that that key adoption drivers include regulatory pressures (40% of large firms implemented waste recycling to comply with NESREA Act), export requirements for agro-processors, growing consumer preference for eco-labeled products (68% urban demand), and demonstrated cost savings like Dangote Cement's 18% energy cost reduction (Ebekozien, 2023). However, significant barriers persist: 70% of SMEs face financing constraints (CBN, 2023), only 15% of supply chain professionals have SSCM training (Ogunmakinde, 2023), and 55% of family-owned firms resist long-term sustainability investments due to short-term profit focus (Uzor, 2023). This dichotomy highlights both progress and challenges in the region's transition to sustainable manufacturing practices.

Furthermore in line with the study findings about waste reduction as a major SSCM practice among manufacturing firms in South East Nigeria; the study byAdejumo et al. (2023) presents two successful but distinct models of SSCM implementation in Southeast Nigeria's manufacturing sector. From their findings,

Nigerian Breweries PLC (large-scale) achieved zero waste-to-landfill through comprehensive circular economy initiatives, including 40% water reduction via closed-loop systems, 30% renewable energy integration, and ethical sourcing from 5,000+ smallholder farmers. In contrast, the findings by Okafor (2023); Uzor (2023) reveals that Chicason Group (SME) demonstrated 25% cost savings through pragmatic adaptations like palm kernel waste valorization (20% energy cost reduction) and direct community procurement. Both cases reveal critical lessons: strategic partnerships amplify large-firm impact (e.g., NGO collaborations), while low-tech circular solutions offer SMEs accessible entry points. Shared success factors include contextual innovation (localizing global SSCM models), stakeholder capitalism (creating shared value), and phased implementation to balance ambition with operational feasibility. These cases provide scalable blueprints for SSCM adoption across the region's diverse manufacturing landscape.

Impact of SSCM on Manufacturing Project Firms

Operational Impact of Sustainable Supply Chain Management (SSCM) on Manufacturing Project Firms

From the findings of this study, sustainable supply chain management (SSCM) practices significantly enhances operational performance in manufacturing project firms by driving efficiency improvements and reducing waste. The findings further reveal that waste reduction strategies, including recycling and circular economy models; as an SSCM practice further enhance resource optimization, lowering production costs while mitigating environmental impact This collaborate with the empirical study from Ogunmakinde (2023) who confirm that firms adopting SSCM practices achieve better operational performance through improved process efficiency and reduced environmental footprint. Thus, SSCM serves as a strategic tool for manufacturing firms to balance economic and ecological objectives while maintaining competitive advantage.

According to the findings from Golicic and Smith (2013), the adoption of Sustainable Supply Chain Management (SSCM) in manufacturing project firms presents a dual financial dynamic: significant long-term cost savings versus substantial initial investments. While implementing SSCM practices—such as energy-efficient technologies, waste reduction programs, and sustainable sourcing—requires upfront capital, these investments often lead to considerable operational cost reductions over time. For example, optimizing energy and material usage lowers production expenses, while waste minimization reduces disposal costs and potential regulatory fines. Studies (Nwachukwu et al., 2020; Onwuka et al., 2021Ugochukwu et al., 2022) indicate that manufacturing firms with robust sustainability practices achieve higher profit margins due to increased operational efficiency and access to green markets. Furthermore, sustainable supply chains reduce dependency on volatile raw material prices by incorporating recycled and renewable resources, fostering financial resilience. Thus, while SSCM demands early financial commitments, its long-term benefits—cost efficiency, risk mitigation, and revenue growth—make it a strategically sound investment for manufacturing firms.

Furthermore, the findings reveal that Sustainable Supply Chain Management (SSCM) plays a pivotal role in reducing pollution and carbon emissions while ensuring compliance with stringent environmental regulations. By adopting eco-friendly practices such as energy-efficient production processes, renewable energy integration, and waste-to-resource initiatives, manufacturing firms significantly lower their greenhouse gas (GHG) emissions and environmental footprint (Ogunmakinde et al., 2022). Empirical evidence indicates that firms implementing SSCM not only meet regulatory requirements but also gain competitive advantages by appealing to environmentally conscious stakeholders. Thus, SSCM serves as a critical mechanism for manufacturing firms to achieve ecological sustainability while adhering to evolving regulatory frameworks. Social Impact of Sustainable Supply Chain Management (SSCM) on Manufacturing Project Firms

Sustainable Supply Chain Management (SSCM) significantly enhances the social dimension of manufacturing project firms by strengthening community engagement and improving employee welfare through ethical labor practices. By integrating corporate social responsibility (CSR) initiatives into supply chain operations, firms foster positive relationships with local communities through programs such as education sponsorships, infrastructure development, and fair trade partnerships (Ogunmakinde et al., 2022). Thus, SSCM not only mitigates social risks but also transforms manufacturing firms into catalysts for equitable and sustainable development. Sustainable Supply Chain Management (SSCM) generates measurable social value by institutionalizing community engagement and ethical labour practices within manufacturing firms (Okafor & Ezeh, 2023). Leading companies exemplify this through targeted CSR initiatives—for instance in India, Unilever's "Shakti" program empowers rural women as micro-entrepreneurs in its distribution network, directly benefiting 150,000 households while expanding market reach (Hindustan Unilever Limited, 2022). Similarly, Patagonia's Fair Trade Certified™ apparel line has improved worker livelihoods through $25 million in premium payments since 2014, demonstrating how ethical procurement translates into tangible wage impacts (Patagonia, 2023).

Employee welfare metrics reveal significant outcomes: Siemens reports 32% lower attrition rates in plants implementing its "Generation21" sustainability framework, attributed to investments in upskilling programs and Industry 4.0 safety technologies (Siemens Sustainability Report, 2023). Social performance is quantifiable through indices like the Dow Jones Sustainability Index (DJSI), where top-performing firms average 23% higher scores on labor practice indicators compared to industry peers (RobecoSAM, 2023).

Community investment is benchmarked through the Global Reporting Initiative (GRI) Standard 413, with firms like Schneider Electric disclosing 81% of procurement spend directed to local suppliers in emerging markets (Schneider Electric, 2023). These examples and metrics validate SSCM as a strategic lever for creating shared social value while driving business performance.

4. CONCLUSION

This study underscores the transformative potential of Sustainable Supply Chain Management (SSCM) for manufacturing firms, revealing its multi-dimensional impacts on operational efficiency, financial performance, environmental sustainability, and social equity. Evidence concludes that the most significant SSCM practices in manufacturing projects in South East Nigeria are supplier engagement/collaboration, energy efficiency and waste reduction. Also all SSCM practices including green procurement significantly enhance firm performance. Here the study concludes that the four most significant SSCM practices (supplier engagement/collaboration, energy efficiency, waste reduction and green procurement) have an impact on firm performance (operational efficiency, environmental sustainability, and financial performance) of manufacturing firms in South East Nigeria. However supplier engagement has more impact on firm performance than other practices. Furthermore the study concludes that SSCM practices impact on various manufacturing sectors affirms thatagro-processinghas thehighest impact of supplier engagement due to complex supply chains. The textiles sector impacted most by energy efficiency matters due to cost-intensive dyeing processes. While in automotive sector**,** the SSCM practices/drivers are balanced (waste reduction and supplier engagement impacts the sector the most. A triangulation of the study concludes that in both quantitative and qualitative analysis, supplier engagement/collaboration is the most critical/adopted SSCM practices and the SSCM practice with the most significant impact on firm's performance of manufacturing firms in South East Nigeria.

Recommendations

From the findings of the study recommends that:

1. Manufacturing firms should adopt a structured, phased approach while fostering collaboration with key stakeholders. They should a step-by-step SSCM adoption strategy that begins with baseline assessment and goal setting (conduct a sustainability audit using tools like Life Cycle Assessment (LCA) to identify hotspots (ISO 14040, 2006). Align targets with global standards (e.g., SDGs, GRI) and regulatory requirements (e.g., EU CSRD).Second step is to pilot projects (start with low-risk, high-impact initiatives (e.g., energy-efficient lighting, waste recycling) to demonstrate quick wins (World Economic Forum, 2021). (useIoT sensors for real-time monitoring of emissions and resource use). Third step is to scale up & integrate (implement digital platforms (e.g., SAP Green Ledger) to track sustainability KPIs across the supply chain) (Train employees via certifications like CSCP (Certified Supply Chain Professional) to bridge skill gaps). Fourth step is continuous improvement (adopt circular economy models to close resource loops and perform benchmark performance using DJSI or EcoVadis ratings. Finally collaboration with Stakeholders.
2. Governments and regulatory bodies must play a proactive role through targeted policies, financial incentives, and collaborative frameworks. First, governments should establish **clear, standardized regulations**—such as mandatory carbon reporting and extended producer responsibility (EPR) laws—to create a level playing field for sustainable practices. Second, **financial incentives** are critical to offset high upfront costs. Tax credits for renewable energy adoption and grants for SMEs to achieve certifications (e.g., ISO 14001) can significantly lower barriers.
3. **Public-private partnerships (PPPs)** can amplify impact. Initiatives like the *Alliance to End Plastic Waste* (backed by 90+ corporations and governments) demonstrate how joint R&D funding and infrastructure projects can scale solutions. Governments should also facilitate multi-stakeholder platforms—modeled after the *UN Global Compact*—to align corporate SSCM goals with national sustainability targets.

Implications for Manufacturing Firms in Southeast Nigeria

For manufacturers in Southeast Nigeria—a region grappling with infrastructural deficits and informal supply chains—the findings present both opportunities and imperatives. Firms can leverage SSCM to mitigate risks like energy insecurity (e.g., via solar-powered production) and supply disruptions (e.g., through localized circular economies). Collaborative models, such as partnerships with cooperatives for ethical raw material sourcing (e.g., cassava or palm oil), can align with regional economic priorities (UNDP Nigeria, 2022). Policymakers should prioritize incentives like tax breaks for clean technology adoption and capacity-building programs to address technical skill gaps (World Bank, 2023).

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