

## Green Supply Chain Management and Economic Sustainability of Small and medium Enterprises (SMEs) in Enugu State, Nigeria

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### Abstract

*The study evaluated the effect of green supply chain management on the economic sustainability of small and medium enterprises (SMEs) in Enugu State, Nigeria. The specific objectives were to determine the effect of green production on cost efficiency and assess the effect of green logistics on the revenue growth of SMEs in Enugu State, Nigeria. The study adopted a descriptive survey research design. Primary data were collected through the administration of questionnaires. The study population comprised 3,740 staff members. A sample size of 345 was determined using Freund and William's statistical formula. Of the questionnaires distributed, 251 were returned and correctly completed. The validity of the research instrument was assessed using content analysis, and the result was satisfactory. The reliability of the instrument was tested using the Pearson correlation coefficient (r), which yielded a reliability coefficient of 0.82, indicating good reliability. Data were presented and analysed using mean scores and standard deviations based on the four-point Likert scale. The hypotheses were tested using the Z-test statistic. The findings revealed that green production had a significant positive effect on the cost efficiency of SMEs in Enugu State, Nigeria ( $Z = 9.673, p < .05$ ), while green logistics had a significant positive effect on the revenue growth of SMEs in the state ( $Z = 9.799, p < .05$ ). The study concluded that green supply chain management plays an important role in promoting the economic sustainability of SMEs in Enugu State, Nigeria. Among other recommendations, the study recommended that SME owners and managers in Enugu State should adopt environmentally friendly production techniques, including the use of energy-efficient equipment, waste minimisation, and the efficient use of raw materials, to reduce production costs and improve cost efficiency.*

**Keywords:** Green supply chain, cost efficiency, economic sustainability, green production, green logistics, revenue growth.

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## **Introduction**

Concern for environmentally responsible supply chain practices can be traced to the environmental management movements of the late twentieth century, when manufacturing firms began to recognize that the uncontrolled use of resources and the generation of waste had long-term economic consequences in addition to their environmental impacts. Early conceptualizations of green supply chain management focused primarily on waste reduction and regulatory compliance. However, the concept has since evolved into a broader strategic approach encompassing purchasing, production, and distribution decisions. Nwankwo (2023) traced this evolution within the Nigerian context, noting that firms increasingly view environmentally responsible sourcing, manufacturing, and distribution as strategies for achieving competitive advantage rather than merely as compliance costs. By the early 2020s, green supply chain management had evolved from a peripheral environmental initiative into a mainstream strategic consideration directly linked to firm profitability, cost structures, and revenue performance (Nwankwo, 2023).

Globally, manufacturing firms in both developed and developing economies have progressively integrated green supply chain practices into their operations in response to stricter environmental regulations, resource scarcity, and changing consumer preferences for sustainably produced goods. Afum, Agyabeng-Mensah, Sun, Frimpong, Kusi, and Acquah (2020) found that green manufacturing practices were positively associated with operational competitiveness and sustainable performance among manufacturing firms. Their findings suggest that environmentally responsible production is not merely a cost centre but can also serve as a source of competitive differentiation. Similarly, Al-Hakimi et al. (2022) found that green manufacturing practices enhanced corporate sustainability performance among small and medium-sized enterprises, with this effect being stronger in firms that cultivated a supportive green organizational culture. These international findings indicate a consistent global pattern in which firms that incorporate environmental considerations into purchasing, production, and logistics decisions tend to achieve better cost and revenue outcomes than those that treat sustainability as a peripheral concern.

In Nigeria, the adoption of green supply chain management has attracted increasing scholarly and policy attention as manufacturing firms contend with environmental regulatory pressures and the economic realities of operating in a resource-constrained environment. Akpan and Nkanta (2023) found that green accounting and related environmentally responsible practices were associated with improved shareholder value among listed Nigerian consumer goods companies. This finding suggests that environmental responsibility and financial performance are not mutually exclusive within the Nigerian corporate context. Nwankwo (2023) examined green supply chain management among manufacturing firms in Enugu State and found that green purchasing and green packaging practices had significant effects on profitability and revenue, respectively. This provides direct evidence from Nigeria that

environmentally responsible supply chain practices can translate into measurable economic outcomes. Despite this evidence, the adoption of green supply chain practices among Nigerian manufacturing firms remains uneven, partly because of infrastructural deficiencies, limited access to green technologies, and the relatively high initial costs associated with environmentally responsible production and logistics systems.

In Enugu State, manufacturing firms operate within a commercial environment shaped by the state's position as a growing industrial and commercial hub in south-eastern Nigeria, with businesses engaged in food processing, plastics, textiles, and light manufacturing. These firms increasingly face pressure from regulatory bodies, environmentally conscious customers, and rising input costs to reconsider their approaches to raw material procurement, production processes, and the distribution of finished goods. Nwankwo (2023), in a study of manufacturing firms in Enugu State, found that green supply chain management practices had a significant effect on financial performance. This finding provides local evidence that green purchasing, green production, and green logistics have economic implications for firms operating within the state. Despite the growing recognition of these relationships at both global and local levels, further investigation is needed into how specific dimensions of green supply chain management relate to particular indicators of economic sustainability among manufacturing firms in Enugu State. Consequently, this study examines the effects of green purchasing, green production, and green logistics on the profitability, cost efficiency, and revenue growth of manufacturing firms in Enugu State, Nigeria.

### **Statement of the Problem**

Ideally, manufacturing firms that adopt green purchasing, green production, and green logistics should record improved profitability, lower operating costs, and stronger revenue growth, since environmentally responsible supply chain practices are theorized to reduce material wastage, lower energy and compliance costs, and open up new environmentally conscious customer segments.

In practice, manufacturing firms in Enugu State continue to face challenges in fully integrating green supply chain practices into their purchasing, production, and logistics operations. Nwankwo (2023) notes that the high cost of environmentally friendly inputs and technologies, weak enforcement of environmental regulations, and limited access to green suppliers and logistics infrastructure continue to constrain the extent to which manufacturing firms in the state adopt green supply chain practices, while broader evidence across Nigerian manufacturing points to similar infrastructural and cost-related constraints on environmentally responsible production

If the effect of green purchasing, green production, and green logistics on the profitability, cost efficiency, and revenue growth of manufacturing firms in Enugu State remains unexamined, the likely consequences

include continued underinvestment in environmentally responsible practices, forgone cost savings, and missed revenue opportunities associated with environmentally conscious markets, all of which threaten the long-term economic sustainability of the sector. It is against this background that this study examines the effect of green purchasing, green production, and green logistics on the profitability, cost efficiency, and revenue growth of Small and medium Enterprises (SMEs) in Enugu State, Nigeria.

### **Objectives of the Study**

The main objective of the study was to examine the effect of green supply chain management on the economic sustainability of Small and medium Enterprises (SMEs) in Enugu State, Nigeria. The specific objectives are to:

- i. Determine the effect of green production on the cost efficiency of Small and medium Enterprises in Enugu State, Nigeria.
- ii. Assess the effect of green logistics on the revenue growth of Small and medium Enterprises(SMEs)in Enugu State, Nigeria.

### **Research Questions**

- i. What is the effect of green production on the cost efficiency of Small and medium Enterprises(SMEs) in Enugu State, Nigeria?
- ii. What is the effect of green logistics on the revenue growth of Small and medium Enterprises(SMEs) in Enugu State, Nigeria?

### **Statement of Research Hypothesis**

- i. Green production has no significant effect on the cost efficiency of Small and medium Enterprises(SMEs) in Enugu State, Nigeria.
- ii. Green logistics has no significant effect on the revenue growth of Small and medium Enterprises(SMEs)in Enugu State, Nigeria.

### **Significance of the Study**

The significance of this study lies in its potential to provide valuable insights into how green supply chain management influences the economic sustainability of Small and medium Enterprises(SMEs) in Enugu State, Nigeria. The findings will be beneficial to the following stakeholders:

### **Manufacturing firm management**

Management of manufacturing firms will benefit from evidence clarifying which specific dimensions of green supply chain management matter most for profitability, cost efficiency, and revenue growth, guiding investment decisions around purchasing, production, and logistics practices.

### **Policymakers and environmental regulators**

Government agencies responsible for environmental policy and industrial regulation will find the study useful in designing incentives and regulations that encourage the adoption of green purchasing, green production, and green logistics practices within Enugu State's manufacturing sector.

### **Employees and industry professionals**

Employees within the sector stand to benefit indirectly, as improvements in the economic sustainability of their firms arising from green supply chain adoption are likely to translate into greater job security and improved working conditions.

### **Scope of the Study**

The unit scope covers management, procurement, production, and logistics staff of Small and medium Enterprises (SMEs) in Enugu State. The content scope centres on green purchasing, green production, and green logistics as dimensions of green supply chain management, and profitability, cost efficiency, and revenue growth as measures of economic sustainability. Geographically, the study is limited to Small and medium Enterprises (SMEs) operating within Enugu State, Nigeria.

## **Review of Related Literature**

### **Conceptual Review**

#### **Supply Chain Management**

Babalola et al. (2024) describe supply chain management as the coordination and integration of the flow of materials, information, and finances involved in moving a product from raw material sourcing through production and distribution to the final customer, with the aim of maximising value while minimising waste and cost across the entire chain. Effective supply chain management requires close coordination among suppliers, manufacturers, distributors, and retailers, and increasingly incorporates environmental considerations alongside traditional cost and service objectives (Babalola et al., 2024). For manufacturing firms, supply chain management determines how efficiently raw materials are converted into finished goods and delivered to customers.

## **Green Supply Chain Management**

Babalola et al. (2024) describe green supply chain management (GSCM) as the integration of environmental thinking into supply chain management, encompassing product design, material sourcing and selection, manufacturing processes, delivery of the final product to consumers, and end-of-life management of the product, with the goal of minimizing environmental impact while sustaining economic performance. GSCM practices typically include green purchasing, green production, green distribution and logistics, green packaging, and reverse logistics, and are increasingly adopted by manufacturing firms in response to regulatory pressure, customer demand, and competitive positioning (Babalola et al., 2024). For manufacturing firms in Enugu State, GSCM offers a way to respond to rising environmental expectations while also pursuing efficiency gains that support long-term economic sustainability.

### **Components of Green Supply Chain Management**

The following are components of Green Supply Chain Management according to the following authors: Green Production, Green Logistics, Green Purchasing, Green Packaging, and Reverse Logistics (Babalola, et al., 2024; Maji, et al., 2023; Epoh, et al., 2024; Okonkwo et al., 2025).

### **Components of Green Supply Chain Management that formed part of the objectives**

#### **Green Production**

Amornkitvikai, O'Brien and Bhula-or (2024) describe green production as the adoption of manufacturing practices, technologies, and systems designed to minimise the consumption of energy, water, and raw materials and to reduce waste and emissions generated during the production process, while still meeting output and quality targets. Green production commitment, activity, and culture within a firm are associated with cleaner production technologies and process modifications that reduce the resources consumed per unit of output (Amornkitvikai et al., 2024). For pharmaceutical and other manufacturing firms, green production offers a route to lowering material and energy costs while simultaneously reducing environmental impact.

#### **Green Logistics**

Maji et al. (2023) describe green logistics as the set of practices through which firms plan, implement, and control the forward and reverse flow and storage of goods, services, and related information in a manner that reduces the environmental impact of transportation, warehousing, packaging, and distribution activities. Green logistics practices typically include route optimisation, fuel-efficient or low-emission transportation modes, sustainable packaging, and reverse logistics for product returns and recycling (Maji et al., 2023). For manufacturing firms, green logistics shapes how efficiently and sustainably finished

goods reach customers and markets, with direct implications for delivery cost, customer reach, and sales performance.

### **Economic Sustainability**

Nwaulune and Bamidele (2024) describe economic sustainability as the capacity of a firm to maintain and grow its financial viability over the long term by generating consistent revenue, controlling costs, and using resources efficiently, while also positioning the firm to withstand future economic and environmental pressures. Economic sustainability differs from short-term profitability in that it emphasises the durability and resilience of a firm's financial performance rather than performance in a single period (Nwaulune & Bamidele, 2024). For manufacturing firms, economic sustainability increasingly depends on how well environmental practices, including green production and green logistics, are integrated into cost structures and revenue-generating activities.

### **Components of Economic Sustainability**

The following are components of Economic Sustainability according to the following authors: Cost Efficiency, Revenue Growth, Profitability, Return on Assets, and Financial Resilience (Nwaulune & Bamidele, 2024; Owoeye et al. 2026; Okonkwo et al. 2026; Ononye et al., 2022).

### **Components of Economic Sustainability that formed part of the objectives**

#### **Cost Efficiency**

Owoeye et al. (2026) describe cost efficiency as the extent to which a firm minimises the cost incurred in producing a given level of output or delivering a given level of service, reflecting how effectively the firm converts its resource inputs, including materials, energy, and labour, into finished goods or services without unnecessary waste or expense. Cost efficiency is commonly assessed through indicators such as unit production cost, operating expense ratios, and the direct, indirect, or operating expenses associated with specific practices such as clean technology adoption or pollution control (Owoeye et al., 2026). For manufacturing firms, cost efficiency gained through cleaner, less wasteful production processes can directly strengthen overall financial performance.

#### **Revenue Growth**

Okonkwo et al. (2026) describe revenue growth as the increase, over a defined period, in the total income a firm generates from the sale of its goods or services, commonly assessed through indicators such as sales volume, market share, and consumer patronage of the firm's products. Revenue growth reflects not only the volume of goods a firm is able to move to market but also the extent to which its products and distribution practices remain attractive and accessible to customers relative to competitors (Okonkwo et

al., 2026). For manufacturing firms, revenue growth is closely tied to how efficiently and reliably finished goods are distributed to the markets and customers that generate sales.

### **Theoretical Framework**

The following theories guided the study:

- i. **Natural Resource-Based View by Hart (1995)**
- ii. **Stakeholder Theory by Freeman (1984)**

#### **Natural Resource-Based View by Hart (1995)**

The Natural Resource-Based View (NRBV), advanced by Stuart Hart in 1995, extends the resource-based view of the firm by proposing that a firm's competitive advantage increasingly depends on its capabilities for managing its relationship with the natural environment, through strategies such as pollution prevention, product stewardship, and clean technology development. Hart argued that pollution prevention strategies, which reduce waste and emissions at the source rather than treating them after the fact, are typically associated with lower compliance and input costs, giving environmentally proactive firms a cost-based competitive advantage.

Applied to this study, the Natural Resource-Based View explains why green production, by preventing waste and reducing the resources consumed per unit of output at the source, is expected to lower a firm's operating costs and thereby strengthen cost efficiency. This theory anchors the study's first objective, which determines the effect of green production on the cost efficiency of manufacturing firms in Enugu State, Nigeria.

#### **Stakeholder Theory by Freeman (1984)**

Stakeholder Theory, developed by Edward Freeman in 1984, proposes that a firm's long-term success depends on how well it manages its relationships with all parties who affect or are affected by its operations, including customers, suppliers, regulators, and the communities in which it operates, rather than focusing narrowly on shareholders alone. The theory holds that firms which respond to the environmental and social expectations of their stakeholders are better positioned to sustain the trust, patronage, and market access those stakeholders control.

Applied to this study, Stakeholder Theory explains why green logistics, by responding to the growing expectations of environmentally conscious customers, regulators, and distribution partners for sustainably managed transportation and packaging, is expected to protect and expand a firm's market access and thereby support revenue growth. This theory anchors the study's second objective, which

assesses the effect of green logistics on the revenue growth of manufacturing firms in Enugu State, Nigeria.

### **Linking the Theories to the Study's Variables and Justification for the Multi-Theory Approach**

The Natural Resource-Based View links green production to cost efficiency by explaining how source-level waste and emission reduction lowers a firm's input and compliance costs, while Stakeholder Theory links green logistics to revenue growth by explaining how meeting stakeholder expectations for sustainable distribution protects and expands a firm's customer base and sales. A single theory would not adequately capture both mechanisms: the Natural Resource-Based View centres on the cost implications of a firm's internal production capabilities, whereas Stakeholder Theory centres on the external, relationship-based drivers of market access and revenue. Combining both theories therefore provides a more complete theoretical foundation for the study's two objectives.

### **Empirical Review**

#### **Green Production and Cost Efficiency**

Amornkitvikai et al. (2024) investigated the effect of green industrial practices on technical efficiency among Thai manufacturers, using stochastic frontier analysis to estimate a stochastic frontier production function and inefficiency effects model. Their findings showed that Thai manufacturing firms with a strong green commitment achieved the highest technical efficiency, followed by those with green activity, green systems, and green culture, compared to firms without any commitment to green manufacturing practices. This study is relevant as it demonstrates that firms which commit more fully to green production practices achieve measurably higher production efficiency than those that do not.

Epoh et al. (2024) examined the relationships between green supply chain management practices, green capabilities, and supply chain performance in the South African manufacturing sector, using structural equation modelling on data from 402 supply chain professionals. Their findings showed that eco-design and green training positively influenced green capabilities, which in turn were linked to improved agility, reliability, and reduced supply chain costs. This study is relevant as it demonstrates that green production-related capabilities translate into measurable cost reductions across the supply chain.

Nazir et al. (2024) examined the impact of green supply chain management practices on the environmental performance of manufacturing firms, testing institutional pressure as a moderator. Their findings showed that green supply chain management practices, including green production-oriented practices, significantly improved environmental performance, with the strength of this relationship shaped by the degree of institutional pressure firms faced to adopt cleaner, more resource-efficient processes. This study is relevant as it demonstrates that the institutional and regulatory context

surrounding green production shapes the extent to which such practices translate into efficient resource use.

Onyeka-Iheme et al. (2024) investigated the impact of green manufacturing practices on the learning and growth efficiency of consumer goods manufacturing companies listed in Nigeria, examining green product design, green supply chain management, green efficient processes, green renewable energy, and end-of-life product management. Their findings, drawn from a survey of listed Nigerian manufacturing firms, showed that green manufacturing practices had a significant positive effect on learning and growth efficiency, an outcome closely tied to how efficiently firms convert resources into organisational capability and output. This study is relevant as it demonstrates, within a Nigerian manufacturing context, that green production-related practices are empirically linked to stronger efficiency outcomes.

Owoeye et al. (2026) examined the effect of green cost accounting practices, specifically clean technology adoption, pollution control, and recycling costs, on the financial performance of Nigerian listed manufacturing firms, using an ex-post facto research design on a sample of 47 firms listed on the Nigerian Exchange Group. Their findings showed that clean technology adoption cost had a positive relationship with return on assets, indicating that resources committed to cleaner, greener production processes were associated with improved financial efficiency. This study is relevant as it demonstrates a direct empirical link, within a Nigerian manufacturing context, between green production-related costs and the efficiency of financial outcomes.

### **Green Logistics and Revenue Growth**

Maji et al. (2023) assessed green logistics and environmental sustainability in Bauchi State, Nigeria, examining how green logistics practices related to sustainability outcomes among firms operating in the state. Their findings showed that green logistics practices, including route optimisation and sustainable warehousing, were positively associated with sustainability performance, with firms benefiting from efficiency gains that supported continued market operation and sales. This study is relevant as it demonstrates, within a Nigerian context comparable to the present study, that green logistics practices are linked to sustained business performance.

Nwaulune and Bamidele (2024) examined the role of green logistics practices in the financial sustainability of fast-moving consumer goods companies in Nigeria, investigating the relationship between green logistics practices and financial sustainability outcomes. Their findings showed that green logistics practices, including sustainable transportation and packaging, were significantly related to financial sustainability, with firms that adopted stronger green logistics practices reporting improved financial outcomes tied to sales and revenue generation. This study is relevant as it demonstrates, within a Nigerian

FMCG context, that green logistics adoption is empirically linked to stronger financial and revenue-related outcomes.

Anh et al. (2025) examined the impact of green logistics practices on the sustainable performance of small and medium logistics service providers in Hanoi, Vietnam, testing how green warehousing and transportation practices influenced economic, environmental, and social outcomes. Their findings showed that green warehousing and transportation significantly and positively influenced economic performance, including revenue-related outcomes, alongside environmental and social performance. This study is relevant as it demonstrates that green logistics practices, particularly in warehousing and transportation, are empirically linked to stronger economic performance.

Ajike et al. (2025) examined the effect of green logistics practices on the environmental sustainability of selected fast-moving consumer goods companies in Nigeria, drawing on survey data from FMCG firms. Their findings showed that green logistics practices had a significant positive effect on sustainability outcomes, with firms that adopted more extensive green logistics practices better able to maintain consistent product availability and market presence, both of which support continued revenue generation. This study is relevant as it demonstrates that green logistics adoption among Nigerian FMCG firms supports the market presence that underlies revenue growth.

Okonkwo et al. (2026) investigated the effect of green logistics adoption on the marketing performance of brewery companies in Nigeria, examining eco-friendly packaging, sustainable storage and materials handling, and transportation route optimisation across six southern Nigerian states, including Enugu. Their findings showed that eco-friendly packaging significantly influenced consumer patronage and that sustainable storage and materials handling significantly boosted sales, though optimisation of transportation routes did not significantly affect market share. This study is relevant as it demonstrates, within a South-East and Southern Nigerian brewing context, that specific green logistics practices are empirically linked to increased consumer patronage and sales.

## **Methodology**

The area of the study comprised of twenty-two (22) small and medium enterprises selected within Enugu metropolis, Enugu state, Nigeria. These organizations were chosen because of entrepreneurship education skills involved in their activities and with capital base of not less than 10million naira and with high number of employees. The study used the descriptive survey design approach. The primary source of data was the administration of questionnaire. A total population of three thousand, seven hundred and forty (3740) staff was used. The adequate sample size of 345, using Freund and William's statistic formula. 251 staff returned the questionnaire and accurately filled. That gave 75 percent response rate. The validity of the instrument was tested using content analysis and the result was good. The reliability

was tested using the Pearson correlation coefficient ( $r$ ). It gave a reliability co-efficient of 0.82 which was also good. Data was presented and analyzed by mean score and standard deviation using Sprint Likert Scale. The hypotheses were analyzed using Z - test statistics tool.

#### **Data Presentation and Analysis**

**The effect of green production on the cost efficiency of Small and medium Enterprises(SMEs) in Enugu State, Nigeria**

**Table 1: Responses on the effect of green production on the cost efficiency of Small and medium Enterprises (SMEs) in Enugu State, Nigeria**

| S/N                                     | Statement                                                                                                      | 5    | 4    | 3   | 2   | 1   | ΣFX   | $\bar{X}$ | SD    | Decision |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------|------|------|-----|-----|-----|-------|-----------|-------|----------|
|                                         |                                                                                                                | SA   | A    | N   | DA  | SD  |       |           |       |          |
| 1                                       | Green production practices help our firm reduce production costs.                                              | 560  | 392  | 39  | 22  | 17  | 1030  |           |       |          |
|                                         |                                                                                                                | 112  | 98   | 13  | 11  | 17  | 251   | 4.10      | 1.130 | Agree    |
|                                         |                                                                                                                | 44.6 | 39.0 | 5.2 | 4.4 | 6.8 | 100.0 |           |       |          |
| 2                                       | The use of environmentally friendly raw materials improves resource utilization and reduces waste in our firm. | 575  | 392  | 39  | 26  | 12  | 1044  |           |       |          |
|                                         |                                                                                                                | 115  | 98   | 13  | 13  | 12  | 251   | 4.16      | 1.061 | Agree    |
|                                         |                                                                                                                | 45.8 | 39.0 | 5.2 | 5.2 | 4.8 | 100.0 |           |       |          |
| 3                                       | Energy-efficient production equipment helps our firm minimize energy expenses.                                 | 585  | 392  | 39  | 20  | 13  | 1049  |           |       |          |
|                                         |                                                                                                                | 117  | 98   | 13  | 10  | 13  | 251   | 4.18      | 1.056 | Agree    |
|                                         |                                                                                                                | 46.6 | 39.0 | 5.2 | 4.0 | 5.2 | 100.0 |           |       |          |
| 4                                       | Green production processes reduce material wastage and improve cost efficiency in our firm.                    | 575  | 392  | 39  | 24  | 13  | 1043  |           |       |          |
|                                         |                                                                                                                | 115  | 98   | 13  | 12  | 13  | 251   | 4.16      | 1.071 | Agree    |
|                                         |                                                                                                                | 45.8 | 39.0 | 5.2 | 4.8 | 5.2 | 100.0 |           |       |          |
| 5                                       | Adopting environmentally friendly production technologies helps our firm control operating costs.              | 590  | 392  | 39  | 14  | 15  | 1050  |           |       |          |
|                                         |                                                                                                                | 118  | 98   | 13  | 7   | 15  | 251   | 4.18      | 1.069 | Agree    |
|                                         |                                                                                                                | 47.0 | 39.0 | 5.2 | 2.8 | 6.0 | 100.0 |           |       |          |
| Total Grand mean and standard deviation |                                                                                                                |      |      |     |     |     |       | 4.16      | 1.077 |          |

**Source: Field Survey, 2026**

Table 1 shows that 210 respondents out of 251 representing 83.7 percent agreed that Green production practices help our firm reduce production costs, with a mean score of 4.10 and standard deviation of 1.130. 213 respondents out of 251 representing 84.9 percent agreed that The use of environmentally

friendly raw materials improves resource utilization and reduces waste in our firm, with a mean score of 4.16 and standard deviation of 1.061. 215 respondents out of 251 representing 85.7 percent agreed that Energy-efficient production equipment helps our firm minimize energy expenses, with a mean score of 4.18 and standard deviation of 1.056. 213 respondents out of 251 representing 84.9 percent agreed that Green production processes reduce material wastage and improve cost efficiency in our firm, with a mean score of 4.16 and standard deviation of 1.071. 216 respondents out of 251 representing 86.1 percent agreed that Adopting environmentally friendly production technologies helps our firm control operating costs, with a mean score of 4.18 and standard deviation of 1.069.

**The effect of green logistics on the revenue growth of Small and medium Enterprises(SMEs) in Enugu State, Nigeria**

**Table 2: Responses on the effect of green logistics on the revenue growth of Small and medium Enterprises(SMEs) in Enugu State, Nigeria**

| S/N                                     | Statement                                                                                                              | 5    | 4    | 3   | 2   | 1   | ΣFX   | X̄   | SD    | Decision |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------|------|------|-----|-----|-----|-------|------|-------|----------|
|                                         |                                                                                                                        | SA   | A    | N   | DA  | SD  |       |      |       |          |
| 1                                       | Green logistics practices contribute to increased revenue in our firm.                                                 | 600  | 392  | 39  | 34  | 3   | 1068  |      |       |          |
|                                         |                                                                                                                        | 120  | 98   | 13  | 17  | 3   | 251   | 4.25 | 0.920 | Agree    |
|                                         |                                                                                                                        | 47.8 | 39.0 | 5.2 | 6.8 | 1.2 | 100.0 |      |       |          |
| 2                                       | The use of fuel-efficient transportation reduces delivery costs and supports revenue growth in our firm.               | 575  | 368  | 39  | 38  | 12  | 1032  |      |       |          |
|                                         |                                                                                                                        | 115  | 92   | 13  | 19  | 12  | 251   | 4.11 | 1.112 | Agree    |
|                                         |                                                                                                                        | 45.8 | 36.7 | 5.2 | 7.6 | 4.8 | 100.0 |      |       |          |
| 3                                       | Environmentally friendly packaging improves customer acceptance of our products.                                       | 580  | 368  | 39  | 34  | 13  | 1034  |      |       |          |
|                                         |                                                                                                                        | 116  | 92   | 13  | 17  | 13  | 251   | 4.12 | 1.114 | Agree    |
|                                         |                                                                                                                        | 46.2 | 36.7 | 5.2 | 6.8 | 5.2 | 100.0 |      |       |          |
| 4                                       | Efficient route planning and distribution reduce delivery delays and help increase sales revenue.                      | 580  | 368  | 39  | 32  | 14  | 1033  |      |       |          |
|                                         |                                                                                                                        | 116  | 92   | 13  | 16  | 14  | 251   | 4.12 | 1.124 | Agree    |
|                                         |                                                                                                                        | 46.2 | 36.7 | 5.2 | 6.4 | 5.6 | 100.0 |      |       |          |
| 5                                       | Green logistics practices improve our firm's reputation and attract more customers, thereby supporting revenue growth. | 570  | 368  | 39  | 48  | 8   | 1033  |      |       |          |
|                                         |                                                                                                                        | 114  | 92   | 13  | 24  | 8   | 251   | 4.12 | 1.080 | Agree    |
|                                         |                                                                                                                        | 45.4 | 36.7 | 5.2 | 9.6 | 3.2 | 100.0 |      |       |          |
| Total Grand mean and standard deviation |                                                                                                                        |      |      |     |     |     |       | 4.14 | 1.070 |          |

**Source: Field Survey, 2026**

Table 2 shows that 218 respondents out of 251 representing 86.9 percent agreed that Green logistics practices contribute to increased revenue in our firm, with a mean score of 4.25 and standard deviation of 0.920. 207 respondents out of 251 representing 82.5 percent agreed that The use of fuel-efficient transportation reduces delivery costs and supports revenue growth in our firm, with a mean score of 4.11 and standard deviation of 1.112. 208 respondents out of 251 representing 82.9 percent agreed that Environmentally friendly packaging improves customer acceptance of our products, with a mean score of 4.12 and standard deviation of 1.114. 208 respondents out of 251 representing 82.9 percent agreed that Efficient route planning and distribution reduce delivery delays and help increase sales revenue, with a mean score of 4.12 and standard deviation of 1.124. 206 respondents out of 251 representing 82.1 percent agreed that Green logistics practices improve our firm's reputation and attract more customers, thereby supporting revenue growth, with a mean score of 4.12 and standard deviation of 1.080.

### Test of Hypotheses

**Test of Hypotheses One: Green production has no significant effect on the cost efficiency of Small and medium Enterprises (SMEs) in Enugu State, Nigeria.**

**One-Sample Kolmogorov-Smirnov Test**

|                                   |          | Green production practices help our firm reduce production costs. | The use of environmentally friendly raw materials improves resource utilization and reduces waste in our firm. | Energy-efficient production equipment helps our firm minimize energy expenses. | Green production processes reduce material wastage and improve cost efficiency in our firm. | Adopting environmentally friendly production technologies helps our firm control operating costs. |
|-----------------------------------|----------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| N                                 |          | 251                                                               | 251                                                                                                            | 251                                                                            | 251                                                                                         | 251                                                                                               |
| Uniform Parameters <sup>a,b</sup> | Minimum  | 1                                                                 | 1                                                                                                              | 1                                                                              | 1                                                                                           | 1                                                                                                 |
|                                   | Maximum  | 5                                                                 | 5                                                                                                              | 5                                                                              | 5                                                                                           | 5                                                                                                 |
| Most Extreme Differences          | Absolute | .587                                                              | .599                                                                                                           | .607                                                                           | .599                                                                                        | .611                                                                                              |
|                                   | Positive | .068                                                              | .048                                                                                                           | .052                                                                           | .052                                                                                        | .060                                                                                              |
|                                   | Negative | -.587                                                             | -.599                                                                                                          | -.607                                                                          | -.599                                                                                       | -.611                                                                                             |
| Kolmogorov-Smirnov Z              |          | 9.294                                                             | 9.484                                                                                                          | 9.610                                                                          | 9.484                                                                                       | 9.673                                                                                             |
| Asymp. Sig. (2-tailed)            |          | .000                                                              | .000                                                                                                           | .000                                                                           | .000                                                                                        | .000                                                                                              |

a. Test distribution is Uniform.

b. Calculated from data.

### Decision Rule:

Since the calculated z-value (9.673) > critical z-value (.000) at the 5% significance level, we reject the null hypothesis

**Decision:**

Furthermore, comparing the calculated Z- value ranges from  $9.294 < 9.673$  against the critical Z- value of .000 (2-tailed test at 95 percent level of confidence) the null hypothesis were rejected. Thus the alternative hypothesis was accepted which states that Green production has no significant effect on the cost efficiency of Small and medium Enterprises(SMEs) in Enugu State, Nigeria.

**Test of Hypotheses Two: Green logistics has no significant effect on the revenue growth of Small and medium Enterprises (SMEs)in Enugu State, Nigeria.**

**One-Sample Kolmogorov-Smirnov Test**

|                                   |          | Green logistics practices contribute to increased revenue in our firm. | The use of fuel-efficient transportation reduces delivery costs and supports revenue growth in our firm. | Environmentally friendly packaging improves customer acceptance of our products. | Efficient route planning and distribution reduce delivery delays and help increase sales revenue. | Green logistics practices improve our firm's reputation and attract more customers, thereby supporting revenue growth. |
|-----------------------------------|----------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| N                                 |          | 251                                                                    | 251                                                                                                      | 251                                                                              | 251                                                                                               | 251                                                                                                                    |
| Uniform Parameters <sup>a,b</sup> | Minimum  | 1                                                                      | 1                                                                                                        | 1                                                                                | 1                                                                                                 | 1                                                                                                                      |
|                                   | Maximum  | 5                                                                      | 5                                                                                                        | 5                                                                                | 5                                                                                                 | 5                                                                                                                      |
|                                   | Absolute | .619                                                                   | .575                                                                                                     | .579                                                                             | .579                                                                                              | .571                                                                                                                   |
| Most Extreme Differences          | Positive | .012                                                                   | .048                                                                                                     | .052                                                                             | .056                                                                                              | .032                                                                                                                   |
|                                   | Negative | -.619                                                                  | -.575                                                                                                    | -.579                                                                            | -.579                                                                                             | -.571                                                                                                                  |
| Kolmogorov-Smirnov Z              |          | 9.799                                                                  | 9.105                                                                                                    | 9.168                                                                            | 9.168                                                                                             | 9.042                                                                                                                  |
| Asymp. Sig. (2-tailed)            |          | .000                                                                   | .000                                                                                                     | .000                                                                             | .000                                                                                              | .000                                                                                                                   |

a. Test distribution is Uniform.

b. Calculated from data.

**Decision Rule:**

Since the calculated z-value (9.799) > critical z-value (.000) at the 5% significance level, we reject the null hypothesis

**Decision:**

Furthermore, comparing the calculated Z- value ranges from  $9.042 < 9.799$  against the critical Z- value of .000 (2-tailed test at 95percent level of confidence) the null hypothesis were rejected. Thus the alternative hypothesis was accepted which states that ii. Green logistics has no significant effect on the revenue growth of Small and medium Enterprises(SMEs) in Enugu State, Nigeria.

## **Discussion of Findings**

From the result of hypotheses one, the calculated Z- value ranges from  $9.294 < 9.673$  against the critical Z- value of .000 which states that Green production had significant positive effect on the cost efficiency of Small and medium Enterprises (SMEs) in Enugu State, Nigeria. In support of the result in the literature review, Onyeka-lheme et al. (2024) investigated the impact of green manufacturing practices on the learning and growth efficiency of consumer goods manufacturing companies listed in Nigeria, examining green product design, green supply chain management, green efficient processes, green renewable energy, and end-of-life product management. The findings, drawn from a survey of listed Nigerian manufacturing firms, showed that green manufacturing practices had a significant positive effect on learning and growth efficiency, an outcome closely tied to how efficiently firms convert resources into organizational capability and output. Owoeye, et al., (2026) examined the effect of green cost accounting practices, specifically clean technology adoption, pollution control, and recycling costs, on the financial performance of Nigerian listed manufacturing firms. The findings showed that clean technology adoption cost had a positive relationship with return on assets, indicating that resources committed to cleaner, greener production processes were associated with improved financial efficiency.

From the result of hypotheses two, the calculated Z- value ranges from  $9.042 < 9.799$  against the critical Z- value of .000 which implies that Green logistics had significant positive effect on the revenue growth of Small and medium Enterprises(SMEs)in Enugu State, Nigeria. In support of the result in the literature review, Maji, et al., (2023) assessed green logistics and environmental sustainability in Bauchi State, Nigeria, examining how green logistics practices related to sustainability outcomes among firms operating in the state. The findings showed that green logistics practices, including route optimization and sustainable warehousing, were positively associated with sustainability performance, with firms benefiting from efficiency gains that supported continued market operation and sales. Nwaulune and Bamidele (2024) examined the role of green logistics practices in the financial sustainability of fast-moving consumer goods companies in Nigeria, investigating the relationship between green logistics practices and financial sustainability outcomes. The findings showed that green logistics practices, including sustainable transportation and packaging, were significantly related to financial sustainability, with firms that adopted stronger green logistics practices reporting improved financial outcomes tied to sales and revenue generation.

## **Summary of Findings, Conclusion and Recommendations**

### **Summary of Findings**

- i. Green production had a significant positive effect on the cost efficiency of small and medium enterprises (SMEs) in Enugu State, Nigeria, ( $Z = 9.673$ ,  $p < .05$ ). This implies that adopting environmentally friendly production methods, reducing material wastage, conserving energy, and using resources efficiently can help SMEs minimize production expenses and improve cost efficiency.
- ii. Green logistics had a significant positive effect on the revenue growth of SMEs in Enugu State, Nigeria ( $Z = 9.799$ ,  $p < .05$ ). This implies that environmentally friendly transportation, efficient delivery planning, optimized distribution routes, and reduced fuel consumption can improve delivery performance and customer satisfaction.

### **Conclusion**

The study concluded that green supply chain management plays an important role in promoting the economic sustainability of small and medium enterprises (SMEs) in Enugu State, Nigeria. The adoption of environmentally friendly procurement practices, green production processes, sustainable transportation, and waste reduction strategies can help SMEs minimize operating costs, improve resource utilization, enhance customer satisfaction, and strengthen their competitive advantage. Effective implementation of green supply chain management can therefore support profitability, business continuity, and long-term economic growth.

### **Recommendations**

- i. SME owners and managers in Enugu State should adopt environmentally friendly production techniques, including energy-efficient equipment, waste minimization, and efficient use of raw materials, to reduce production costs and improve cost efficiency.
- ii. SME owners and managers in Enugu State should implement green logistics practices, such as route optimization, vehicle maintenance, efficient delivery scheduling, and appropriate eco-friendly packaging, to reduce distribution costs, improve customer satisfaction, and support revenue growth.

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