

Green Supply Chain Management Practices and Economic Performance of Food and Beverage Manufacturing SMEs in North-Western Nigeria

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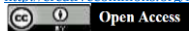
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ABSTRACT

Green supply chain management (GSCM) has become increasingly important to manufacturing firms seeking to balance environmental responsibility with economic performance. However, empirical evidence on whether individual GSCM practices translate into economic benefits remains mixed, particularly among small and medium-sized enterprises (SMEs) in developing economies. This study examines the direct influence of four GSCM practices green design, green purchasing, green manufacturing, and green transportation on the economic performance of food and beverage manufacturing SMEs in North-Western Nigeria. The study adopted a quantitative, descriptive-survey design. Data were collected through a self-administered questionnaire from respondents drawn from food and beverage manufacturing SMEs registered within the study area. Of 305 questionnaires distributed, 243 usable responses were obtained. Data were analysed using SPSS and Partial Least Squares Structural Equation Modelling (PLS-SEM) through SmartPLS 4.0. The findings show that green design has a significant positive relationship with economic performance ($\beta = .302$, $t = 4.283$, $p < .001$), while green manufacturing also has a significant positive relationship with economic performance ($\beta = .302$, $t = 3.603$, $p < .001$). In contrast, green purchasing ($\beta = .039$, $t = .567$, $p = .285$) and green transportation ($\beta = .126$, $t = 1.003$, $p = .158$) do not have statistically significant direct relationships with economic performance. The findings indicate that GSCM practices do not generate uniform economic returns in the context studied. The study contributes context-specific evidence from Nigerian food and beverage manufacturing SMEs and suggests that managers should prioritize environmentally oriented design and production improvements while developing the supporting capabilities and supplier relationships needed to convert other green practices into economic value.

Introduction

Environmental sustainability has increasingly moved from the margins of corporate decision-making to the centre of supply chain and operations strategy. Manufacturing firms are under growing pressure from regulators, customers, communities and supply-chain partners to reduce environmental impacts while maintaining competitiveness. Green supply chain management (GSCM) responds to this pressure by integrating environmental considerations into activities such as product design, sourcing, manufacturing, transportation and related supply-chain decisions. Recent evidence indicates that GSCM can improve several dimensions of corporate performance, although the magnitude and direction of effects vary across industries, firm sizes, geographical settings and other contextual conditions (Li & Zhang, 2024).

The economic dimension is particularly important for small and medium-sized enterprises (SMEs). SMEs frequently face financial, technological and infrastructural constraints that make environmental investments more difficult to undertake. Consequently, the economic value of GSCM cannot simply be assumed from the environmental value of a practice. A practice may require substantial initial expenditure before its expected benefits are realized, or its benefits may be conditional on other organizational capabilities. Recent evidence from manufacturing SMEs supports the view that green

supply-chain practices can improve organizational outcomes, but that the relationships may differ by practice and context (Hassan, 2025; Junejo et al., 2025).

The food and beverage manufacturing sector provides an important setting for examining these relationships. The sector relies heavily on raw materials, energy, water, packaging, production facilities and transportation. It also deals with perishable products and generates substantial food and packaging waste. These characteristics create opportunities for environmental practices to affect material efficiency, production costs, waste management, logistics and ultimately economic performance. At the same time, the resource requirements of green technologies and environmentally preferable inputs can impose costs on smaller firms.

Within Nigeria, evidence on the direct economic consequences of specific GSCM practices among food and beverage manufacturing SMEs remains limited. The present study therefore disaggregates GSCM into four practices green design, green purchasing, green manufacturing and green transportation and examines their direct relationships with economic performance. This approach responds to the need to move beyond treating GSCM as a single aggregate construct and to identify which specific practices are associated with economic outcomes in the Nigerian SME context.

2. Problem Statement and Research Gap

Although GSCM has attracted considerable scholarly attention, the empirical relationship between individual green practices and economic performance remains inconsistent. Some studies report that green practices improve efficiency, reduce waste and generate economic benefits, whereas others identify insignificant or even negative effects, particularly where implementation costs are high. The thesis underpinning this article identifies a specific gap in the Nigerian SME literature: the relationship between GSCM practices and economic performance has not been adequately examined, particularly in food and beverage manufacturing SMEs in North-Western Nigeria.

The gap is important because the four practices examined in this study require different organizational and financial commitments. Green design may influence the use of materials and energy from the earliest stage of product development. Green purchasing depends partly on the availability and reliability of environmentally responsible suppliers. Green manufacturing requires changes in production processes and technologies. Green transportation involves logistics choices that may increase or decrease operating costs depending on infrastructure, distance, vehicle utilization and transport arrangements. Treating these practices as interchangeable may therefore conceal important differences in their economic consequences.

3. Research Objective and Hypotheses

The objective of the study is to determine the significant relationships between green design, green purchasing, green manufacturing, green transportation and economic performance of Nigerian food and beverage manufacturing SMEs.

The study tests the following hypotheses:

H1a: Green design practices have a significant relationship with economic performance.

H1b: Green purchasing practices have a significant relationship with economic performance.

H1c: Green manufacturing practices have a significant relationship with economic performance.

H1d: Green transportation practices have a significant relationship with economic performance.

4. Literature Review

4.1 Green Supply Chain Management

Green supply chain management integrates environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery and product end-of-life considerations. The concept therefore extends traditional supply chain management by incorporating environmental objectives into decisions that influence the movement and

transformation of materials and products. In the present study, GSCM is treated as a multidimensional construct represented by green design, green purchasing, green manufacturing and green transportation.

4.2 Green Design and Economic Performance

Green design refers to the systematic consideration of environmental issues throughout the product and process life cycle. It can involve reducing material and energy requirements, designing products for reuse or recycling, eliminating harmful production processes and facilitating distribution and return. Economically, such practices can reduce material consumption, waste and energy requirements and may enhance the firm's ability to meet changing market expectations. The present thesis found a positive and significant relationship between green design and economic performance, consistent with evidence that eco-design can create competitive and economic value through resource efficiency and environmental innovation (Khan et al., 2024).

4.3 Green Purchasing and Economic Performance

Green purchasing incorporates environmental criteria into supplier selection and purchasing decisions. It may include purchasing environmentally preferable materials, evaluating suppliers against environmental criteria, requiring suppliers to maintain environmental management systems and collaborating with suppliers to achieve environmental objectives. The economic effect may nevertheless be difficult to realize immediately because green inputs may carry higher acquisition costs or because suitable suppliers may be limited. Recent research indicates that the performance consequences of green purchasing are context dependent, making empirical investigation important (Arifin et al., 2023).

4.4 Green Manufacturing and Economic Performance

Green manufacturing incorporates environmental considerations into production processes to reduce resource consumption, waste, emissions and pollution. Its economic rationale is closely related to resource efficiency: lower energy, water and material use can reduce production costs, while waste minimization can lower disposal and treatment costs. Evidence from manufacturing research indicates that green manufacturing activities and investments can contribute positively to economic performance (D'Angelo et al., 2023).

4.5 Green Transportation and Economic Performance

Green transportation involves the use of less-polluting transportation modes and logistics arrangements. It can include efficient vehicle utilization, route optimization, consolidation, alternative transport modes and reduced fuel consumption. The economic effect, however, may depend on infrastructure, distance, transport costs and the availability of suitable logistics providers. Thus, green transportation may produce environmental benefits without necessarily producing an immediate direct economic return for resource-constrained SMEs.

4.6 Theoretical Foundation

The study is principally informed by the Natural Resource-Based View (NRBV), which extends the resource-based view by recognizing environmental capabilities as potential sources of competitive advantage. From this perspective, capabilities such as pollution prevention, product stewardship and sustainable development can become strategic resources when they are effectively developed and deployed (Hart, 1995; Hart & Dowell, 2011). GSCM practices can therefore be interpreted as organizational capabilities that may improve resource efficiency and economic performance.

Resource Dependency Theory (RDT) also provides a complementary perspective because several GSCM practices depend on external actors. Green purchasing requires suitable suppliers, while transportation depends on logistics providers and infrastructure. RDT highlights the importance of managing external resource dependencies and interorganizational relationships (Pfeffer & Salancik, 1978). Together, NRBV and RDT provide a useful basis for examining both internal green capabilities and external supply-chain relationships.

5. Methodology

5.1 Research Design

The study adopted a quantitative descriptive-survey design. Primary data were collected using a structured, self-administered questionnaire. The research focused on food and beverage manufacturing SMEs operating in North-Western Nigeria.

5.2 Population, Sampling and Respondents

The sampling frame comprised 1,477 food and beverage manufacturing SMEs across the seven states of North-Western Nigeria: Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara. A sample size of 305 was selected. Cluster and proportionate stratified random sampling were used, with the enterprises grouped geographically and then stratified by food products and beverages. Respondents comprised owners, founders, shareholders and senior management personnel who were considered knowledgeable about their organizations' operations.

5.3 Data Collection

A total of 305 questionnaires were distributed through face-to-face and/or email contact. The final analysis was based on 243 usable responses. Respondents were assured of confidentiality and anonymity.

5.4 Measurement of Variables

The questionnaire operationalized the study constructs using measures adapted from established literature. Green design was measured with five items; green purchasing with five items; green manufacturing with six items; green transportation with four items; and economic performance with seven items. The economic-performance measure focused on cost-related outcomes associated with green practices.

5.5 Reliability

The pilot reliability assessment produced Cronbach's alpha coefficients of .824 for green design, .878 for green purchasing, .851 for green manufacturing, .851 for green transportation and .916 for economic performance. All coefficients exceeded the conventional .70 threshold used in the study, indicating satisfactory internal consistency.

5.6 Data Analysis

SPSS version 25 was used for coding, data loading, cleaning and preliminary screening. SmartPLS 4.0 was then used to assess the measurement and structural models using Partial Least Squares Structural Equation Modelling (PLS-SEM). Hypothesis testing was based on path coefficients, t-statistics and p-values.

6. Results

6.1 Model Explanatory Power

The structural model explained 42.0% of the variance in economic performance ($R^2 = .420$; adjusted $R^2 = .403$). The predictive relevance value for economic performance was $Q^2 = .253$, indicating predictive relevance of the model.

6.2 Direct Effects

Hypothesis	Relationship	β	t	p	Decision
H1a	Green Design $\rightarrow$ Economic Performance	.302	4.283	< .001	Supported
H1b	Green Purchasing $\rightarrow$ Economic Performance	.039	.567	.285	Not supported
H1c	Green Manufacturing $\rightarrow$ Economic Performance	.302	3.603	< .001	Supported
H1d	Green Transportation $\rightarrow$ Economic Performance	.126	1.003	.158	Not supported

The direct-effects results show that green design and green manufacturing are positively and significantly associated with economic performance. Green purchasing and green transportation do not

show statistically significant direct relationships with economic performance at the 5% significance level.

7. Discussion

7.1 Green Design and Economic Performance

Green design had a positive and statistically significant relationship with economic performance ($\beta = .302$, $t = 4.283$, $p < .001$). This result suggests that incorporating environmental considerations into product and process design can generate economic value for food and beverage manufacturing SMEs. Possible mechanisms include lower material use, improved energy efficiency, reduced waste and improved product suitability for environmentally conscious markets. The finding is consistent with recent evidence that eco-design can contribute to organizational performance and competitive value (Khan et al., 2024).

7.2 Green Purchasing and Economic Performance

Green purchasing did not have a statistically significant direct relationship with economic performance ($\beta = .039$, $t = .567$, $p = .285$). The result indicates that environmentally responsible procurement alone may not be sufficient to produce measurable economic benefits for the SMEs studied. One possible contextual explanation is that green purchasing can initially involve higher acquisition costs, supplier-development costs or limited access to environmentally preferable inputs. The thesis also reports a significant relationship between green purchasing and operational performance, suggesting that economic benefits may arise through an indirect pathway rather than through a direct effect. That indirect mechanism is outside the narrower focus of this article.

7.3 Green Manufacturing and Economic Performance

Green manufacturing had a positive and statistically significant relationship with economic performance ($\beta = .302$, $t = 3.603$, $p < .001$). This finding indicates that environmentally oriented production processes can generate economic value in the study context. Resource efficiency, waste reduction, lower energy and water consumption, and cleaner production can contribute to lower operating costs and improved profitability. The result is consistent with evidence that green manufacturing activities and investments can have positive economic consequences (D'Angelo et al., 2023).

7.4 Green Transportation and Economic Performance

Green transportation did not have a statistically significant direct relationship with economic performance ($\beta = .126$, $t = 1.003$, $p = .158$). The positive coefficient suggests a positive direction, but the effect was not statistically significant at the 5% level. For SMEs operating under infrastructure and resource constraints, the economic returns from green transportation may be difficult to realize directly. Transport investments can require substantial capital, while the availability of suitable vehicles, alternative fuels and efficient logistics infrastructure may be limited. The thesis also found a significant relationship between green transportation and operational performance, indicating that its economic contribution may be realized through operational mechanisms rather than a direct pathway.

7.5 Overall Interpretation

Taken together, the findings demonstrate that the four GSCM practices do not have uniform direct economic effects. Green design and green manufacturing appear to translate more directly into economic value, whereas green purchasing and green transportation do not show significant direct effects in this sample. This pattern supports the broader view that GSCM outcomes are context dependent and may vary by practice, industry, firm size, geography and organizational capability (Li & Zhang, 2024).

8. Theoretical Implications

The findings provide empirical support for the NRBV perspective by showing that specific environmental capabilities particularly green design and green manufacturing—can be associated with

economic performance. This reinforces the proposition that environmental practices can function as strategic capabilities rather than simply compliance activities. The findings also complement RDT by highlighting the importance of external conditions surrounding practices such as green purchasing and green transportation. Where suppliers, logistics providers or infrastructure do not adequately support green activities, the economic value of those practices may be difficult to capture.

9. Managerial Implications

First, managers of food and beverage manufacturing SMEs should integrate environmental criteria into product and process design because green design demonstrated a significant direct relationship with economic performance. Second, green manufacturing should be treated as an economic and operational investment, particularly where resource efficiency and waste reduction can generate measurable cost savings. Third, managers should avoid assuming that green purchasing automatically produces immediate financial returns; supplier development, quality control and long-term supplier collaboration may be required. Fourth, transportation initiatives should emphasize cost-effective logistics improvements such as route optimization, scheduling, vehicle utilization and load consolidation before committing to expensive transportation technologies.

10. Conclusion

This study examined the direct relationships between green design, green purchasing, green manufacturing, green transportation and economic performance among food and beverage manufacturing SMEs in North-Western Nigeria. The evidence indicates that green design and green manufacturing have significant positive direct relationships with economic performance, while green purchasing and green transportation do not have significant direct relationships. The results suggest that the economic value of GSCM depends on the specific practice being implemented and the context in which it is deployed. For Nigerian SMEs, the strategic priority should therefore be to identify and strengthen those green practices that can generate measurable resource and cost efficiencies while developing the organizational and supply-chain conditions required for other practices to yield economic benefits.

11. Limitations and Future Research

The study is cross-sectional, which limits strong causal interpretation. The analysis also relies primarily on perceptual survey measures of economic performance. Future research could employ longitudinal designs and combine perceptual measures with objective financial indicators. Future studies could also examine whether supplier capability, green innovation, operational performance, supply-chain resilience or organizational culture explain why some GSCM practices generate stronger economic outcomes than others. Finally, comparative research across Nigerian regions and manufacturing sectors could establish the generalizability of the findings.

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