



Received: 05/October/2024

IJASR: 2024; 3(6):31-34

Accepted: 12/November/2024

Greening the Supply Chain: Adoption, Barriers and Performance Outcomes in Manufacturing SMEs

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Abstract

This study synthesizes existing literature to examine the adoption of Green Supply Chain Management (GSCM) practices, the barriers to implementation and the resulting performance outcomes in manufacturing SMEs. Drawing on secondary data from foundational reviews, empirical studies and systematic analyses, the findings reveal that SMEs increasingly adopt selective GSCM practices such as green procurement, cleaner production and waste minimization to meet regulatory and stakeholder expectations. However, the adoption process remains constrained by significant financial, technological, organizational and institutional barriers. These include limited resources, lack of managerial awareness, inadequate regulatory support and fragmented supply chain coordination. Despite these challenges, evidence shows that SMEs that successfully implement GSCM practices experience substantial improvements in environmental performance, operational efficiency and competitiveness. The review highlights the need for targeted interventions—such as policy incentives, capacity-building programs and enhanced supplier collaboration—to strengthen GSCM adoption among SMEs. The study contributes to a deeper understanding of how resource-constrained firms can effectively integrate sustainability into their supply chain operations.

Keywords: Green Supply Chain Management (GSCM), Manufacturing SMEs, Sustainable Supply Chains, Barriers to Adoption, Environmental Performance, Organizational Performance, Cleaner Production, Green Procurement, Sustainability Practices.

Introduction

In recent decades, growing environmental concerns, stricter regulatory pressures and rising stakeholder expectations have compelled firms across the globe to integrate sustainability principles into their supply chain activities. Green Supply Chain Management (GSCM) has emerged as a strategic approach that embeds environmental considerations into every stage of the supply chain from procurement and production to distribution and reverse logistics (Srivastava, 2007). While large enterprises have made notable advancements in adopting such practices, small and medium-sized enterprises (SMEs) continue to face unique challenges in transitioning towards greener operations due to limited financial, technological and managerial resources (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023).

Existing literature provides extensive insights into the evolution of GSCM, its conceptual foundations and its measurable impacts on organizational and environmental outcomes. Early reviews highlight both the strategic significance and the multidimensional nature of GSCM adoption (Srivastava, 2007; Fahimnia *et al.*, 2015). More recent studies further emphasize the tangible benefits of GSCM practices for SMEs, including enhanced environmental performance, improved firm competitiveness and strengthened market positioning (Mishra *et al.*, 2019;

Mustafi *et al.*, 2024). However, despite these potential gains, numerous barriers hinder the widespread implementation of GSCM across SME sectors. These obstacles include financial constraints, lack of technical expertise, inadequate infrastructure, limited awareness, resistance to change and insufficient regulatory support (Khushbu & Shah, 2014; Baig *et al.*, 2020; Hebaz & Oulfarsi, 2021; Gahlot *et al.*, 2023; Reynolds, 2024).

Studies investigating the drivers and barriers of GSCM consistently point out that SMEs, especially in developing economies, experience these challenges more intensely due to their scale, resource dependence and restricted access to green technologies (Hebaz & Oulfarsi, 2021; Baig *et al.*, 2020). Moreover, sector-specific analyses, such as those focusing on automotive or manufacturing SMEs, reveal that structural complexities, supply chain fragmentation and low integration among stakeholders further impede the adoption of sustainable practices (Gahlot *et al.*, 2023). Despite these hurdles, evidence suggests that SMEs adopting green procurement, eco-design, clean production and environmentally responsible logistics witness improved environmental outcomes and, in many cases, enhanced operational efficiency (Dzikriansyah *et al.*, 2023; Mugoni *et al.*, 2024).

Given this context, there is a strong need for systematic investigation into how manufacturing SMEs navigate the complexities of GSCM adoption, what barriers they face and how such practices translate into performance improvements. While prior research has enriched theoretical understanding, empirical evidence particularly from emerging markets remains fragmented. This study aims to address these gaps by synthesizing existing findings and examining the relationships between GSCM adoption, implementation barriers and performance outcomes in manufacturing SMEs. By integrating insights from contemporary literature, this research provides a comprehensive perspective on the factors influencing the greening of supply chains in resource-constrained SME environments.

Literature Review

Green Supply Chain Management (GSCM) has evolved significantly over the past two decades, driven by increasing environmental regulations, global sustainability pressures and the need for responsible production systems. Foundational scholarship positions GSCM as an approach that integrates environmental thinking into procurement, manufacturing, distribution and reverse logistics processes (Srivastava, 2007). Srivastava's (2007) state-of-the-art review established the conceptual base for GSCM by synthesizing environmental management, supply chain strategy and operations literature. Complementing this, a bibliometric analysis by Fahimnia *et al.* (2015) mapped the growth trajectory of GSCM research, highlighting rising academic and industry interest, especially in emerging markets and SME contexts.

A substantial body of subsequent research has examined the determinants and benefits of GSCM adoption. Empirical studies across developing economies find that SMEs adopting green procurement, eco-design, cleaner production and waste reduction practices experience improved environmental and organizational performance (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023). Mishra *et al.* (2019) demonstrated that SMEs implementing integrated GSCM practices achieve measurable improvements in both firm-level efficiency and ecological outcomes. Similarly, Dzikriansyah *et al.* (2023) found that green purchasing, eco-friendly manufacturing and responsible distribution enhance the environmental performance of Indonesian SMEs, reinforcing the strategic significance of GSCM.

However, despite recognized benefits, GSCM adoption faces substantial barriers. Early reviews identified lack of awareness, insufficient technological capabilities and financial constraints as dominant obstacles (Khushbu & Shah, 2014). Later studies extended this understanding by emphasizing organizational resistance, skill shortages and weak institutional support as critical inhibitors of GSCM integration (Hebaz & Oulfarsi, 2021). Baig *et al.* (2020) further illustrated that barriers differ by firm size, with smaller firms experiencing amplified challenges due to limited resources, fragmented supplier networks and operational rigidity. Within the automotive manufacturing sector, Gahlot *et al.* (2023) applied an ISM framework to identify hierarchical relationships among barriers, revealing that inadequate regulatory enforcement, high implementation costs and lack of top management commitment form the foundational constraints for GSCM in India.

Contemporary research also highlights the dynamic interplay between GSCM drivers, barriers and performance outcomes. Mustafi *et al.* (2024), through a mediated moderation model, demonstrated that GSCM practices enhance organizational

performance when supported by strong environmental strategies and internal capabilities. Their study underscores the importance of strategic alignment, leadership commitment and process integration in realizing the full potential of GSCM. Systematic reviews, such as that by Mugoni *et al.* (2024), reaffirm that the impact of GSCM on environmental performance is contingent on effective implementation mechanisms, cross-functional collaboration and supportive institutional environments. At the same time, Reynolds (2024), through insights from industry leaders, emphasized practical challenges such as supply chain complexity, cost pressures and lack of standardized green guidelines that continue to impede adoption in real-world settings.

Collectively, the literature demonstrates a consensus that while GSCM adoption offers substantial environmental and performance benefits, its diffusion among manufacturing SMEs remains uneven and constrained by structural, financial and managerial barriers. Research points to the need for targeted interventions such as capacity building, policy incentives, technological support and stakeholder collaboration to strengthen GSCM adoption. Yet, despite extensive scholarship, there remains a gap in understanding the interrelationship between adoption levels, barrier severity and resulting performance outcomes specifically within resource-constrained manufacturing SMEs, particularly in developing economies.

This gap underscores the relevance of the present study, which integrates past research and seeks to advance knowledge on how manufacturing SMEs can effectively navigate GSCM adoption challenges to achieve sustainable performance improvements.

Methodology

This study adopts a secondary data-based qualitative research design to examine the adoption of Green Supply Chain Management (GSCM) practices, the barriers to their implementation and their performance outcomes in manufacturing SMEs. Secondary data analysis is widely recognized as an effective approach for synthesizing existing empirical evidence, identifying conceptual patterns and developing theoretical insights from prior studies (Srivastava, 2007; Fahimnia *et al.*, 2015). It enables a comprehensive understanding of GSCM trends across diverse contexts and supports structured comparisons of findings reported in peer-reviewed literature.

The research relies on an extensive review of academic articles, systematic reviews, bibliometric analyses and working papers that focus specifically on GSCM practices, barriers and performance implications within SME environments. Key studies included in the review comprise foundational conceptual works (Srivastava, 2007), bibliometric mappings (Fahimnia *et al.*, 2015), barrier analyses (Khushbu & Shah, 2014; Baig *et al.*, 2020; Hebaz & Oulfarsi, 2021; Gahlot *et al.*, 2023) and empirical investigations into GSCM adoption and environmental performance (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023; Mustafi *et al.*, 2024). Additional inputs were drawn from systematic reviews and industry-focused reports that capture contemporary perspectives and contextual variations (Mugoni *et al.*, 2024; Reynolds, 2024).

A thematic analysis approach was employed to categorize insights from the selected studies. This involved coding extracted data into three core themes consistent with the research objectives:

1. Adoption of GSCM practices

2. Barriers inhibiting implementation
3. Organizational and environmental performance outcomes

Thematic synthesis is frequently used in sustainability and supply chain research as it allows for systematic comparison and integration of heterogeneous findings across multiple studies (Hebaz & Oulfarsi, 2021; Mugoni *et al.*, 2024).

The literature selection was guided by inclusion criteria emphasizing relevance to GSCM, SME-focused contexts, empirical richness and publication credibility. Peer-reviewed journal articles and high-quality working papers published between 2007 and 2024 were prioritized to capture both foundational insights and recent developments. Data were collected from reputable academic repositories such as Scopus, Web of Science, MDPI and open-access platforms like IJERT and Acta Logistica. This approach aligns with recommended best practices for conducting structured literature-based inquiries in sustainability research (Fahimnia *et al.*, 2015; Mustafi *et al.*, 2024).

By synthesizing secondary data from diverse but thematically aligned studies, this methodology enables a holistic examination of GSCM adoption patterns, contextual challenges and resulting performance effects within manufacturing SMEs. It also helps identify research gaps and theoretical inconsistencies that inform the subsequent analysis and conclusions of the study.

Findings and Results

The synthesis of secondary data reveals three major outcome areas related to Green Supply Chain Management (GSCM) adoption within manufacturing SMEs: (1) adoption patterns and key practices, (2) barriers impeding implementation and (3) performance outcomes resulting from GSCM integration.

1. Adoption Patterns and Key GSCM Practices

Across studies, adoption of GSCM practices among SMEs is found to be incremental and selective, with firms more likely to adopt practices that involve lower capital investment and immediate operational benefits. Commonly implemented practices include green procurement, waste minimization, basic cleaner production initiatives and environmental compliance measures (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023). In many cases, SMEs prioritize regulatory-driven actions over voluntary practices, reflecting constraints of scale and resource availability. Research shows that adoption is significantly influenced by external pressures such as customer demand, government regulations and competitor initiatives (Srivastava, 2007; Hebaz & Oulfarsi, 2021). Systematic reviews also indicate growing interest among SMEs in eco-design and closed-loop systems, though uptake remains limited due to technological and financial barriers (Mugoni *et al.*, 2024).

2. Barriers to GSCM Implementation in SMEs

The findings consistently highlight substantial structural, financial and organizational barriers that restrain the adoption of GSCM among SMEs. Early studies identified lack of awareness, insufficient expertise and high perceived costs as primary obstacles to GSCM implementation (Khushbu & Shah, 2014). Subsequent empirical analyses deepen this understanding by demonstrating that SMEs struggle with limited technological capabilities, weak supplier collaboration and inadequate environmental management systems (Baig *et al.*, 2020). Hebaz and Oulfarsi (2021) emphasize that the absence of strong regulatory enforcement and insufficient

institutional support further complicate adoption, especially in developing economies.

Sector-specific studies, such as Gahlot *et al.*'s (2023) analysis of the automotive industry, reveal hierarchical relationships among barriers, where root causes such as lack of top management commitment and financial limitations trigger secondary challenges like poor training, resistance to change and fragmented supply chain coordination. Industry insights reported by Reynolds (2024) confirm that SMEs frequently face operational disruptions, cost pressures and ambiguity in green standards, all of which weaken their motivation to integrate comprehensive GSCM practices.

3. Performance Outcomes of GSCM Adoption

Despite these barriers, the findings show clear evidence that GSCM practices yield significant environmental and organizational performance benefits when effectively implemented. Studies focusing on SMEs report improvements in waste reduction, energy efficiency, pollution control and overall environmental compliance (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023). Enhanced performance is often linked to practices involving green purchasing, eco-efficient manufacturing and environmentally responsible logistics. Moreover, research suggests that GSCM adoption contributes to enhanced firm competitiveness and operational efficiency by reducing material consumption, optimizing resource use and strengthening stakeholder trust (Srivastava, 2007; Mustafi *et al.*, 2024). Mustafi *et al.* (2024) further find that organizational performance improves more significantly when GSCM practices are aligned with strong environmental strategies and supported by adequate internal capabilities. Systematic evidence indicates that firms implementing integrated and proactive GSCM practices consistently outperform those limiting their efforts to compliance-based actions (Mugoni *et al.*, 2024).

Overall Synthesis

Taken together, the findings demonstrate that while SMEs recognize the strategic and environmental importance of GSCM, their ability to fully adopt green supply chain practices is hindered by resource shortages, capability gaps and external market pressures. Nevertheless, SMEs that successfully implement GSCM practices report measurable performance improvements, underscoring the relevance and long-term value of greening supply chains. The results also indicate that targeted policy incentives, capacity-building initiatives and stronger supply chain collaboration are essential to overcoming existing barriers and enabling wider diffusion of GSCM in manufacturing SMEs.

Conclusion

The review of secondary literature demonstrates that Green Supply Chain Management (GSCM) has become an essential strategic pathway for manufacturing SMEs seeking to align their operations with global sustainability imperatives. Foundational works establish GSCM as a comprehensive approach integrating environmental considerations across supply chain functions (Srivastava, 2007), while contemporary bibliometric analyses confirm its growing significance in both scholarly and industrial domains (Fahimnia *et al.*, 2015). The findings clearly show that SMEs, despite their resource limitations, are increasingly adopting selective GSCM practices such as green procurement, cleaner production and waste reduction to meet regulatory requirements and improve operational efficiency (Mishra *et al.*, 2024).

al., 2019; Dzikriansyah *et al.*, 2023). However, the literature consistently highlights that SMEs face substantial barriers that inhibit full adoption of GSCM. These include financial constraints, inadequate technical capabilities, low managerial awareness, weak institutional support and fragmented supplier networks (Khushbu & Shah, 2014; Baig *et al.*, 2020; Hebaz & Oulfarsi, 2021). Sector-specific studies reveal that deep-rooted structural issues such as lack of top management commitment and high implementation costs serve as foundational obstacles to broader GSCM integration (Gahlot *et al.*, 2023). Industry-focused insights further show that ambiguous standards, cost pressures and complex supply chain structures continue to deter SMEs from embracing advanced sustainability-oriented practices (Reynolds, 2024).

Despite these challenges, evidence strongly indicates that GSCM adoption yields substantial environmental and organizational performance gains when implemented effectively. SMEs that integrate green purchasing, eco-design and environmentally responsible logistics experience improvements in pollution reduction, resource efficiency and regulatory compliance (Mishra *et al.*, 2019; Dzikriansyah *et al.*, 2023). Research also confirms that firms with strong internal capabilities and strategic alignment achieve greater competitive and operational advantages from GSCM practices (Mustafi *et al.*, 2024). Systematic reviews reaffirm that proactive and integrated GSCM approaches lead to superior outcomes compared to reactive or compliance-based strategies (Mugoni *et al.*, 2024).

In conclusion, while GSCM represents a viable pathway for SMEs to enhance sustainability and performance, its effectiveness depends on overcoming significant financial, technological and organizational barriers. The findings underscore the need for targeted interventions such as capacity-building programs, policy support, technological assistance and strengthened supply chain collaboration to facilitate broader GSCM adoption among manufacturing SMEs. Future research should focus on context-specific strategies, comparative sector analyses and empirical models that capture the dynamic interplay between adoption levels, barriers and performance outcomes. By addressing these gaps, scholars and practitioners can contribute to more resilient, sustainable and competitive SME supply chains.

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