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Integrating Sustainability into Green Supply Chain Management: Strategies, Challenges, and Innovations

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Abstract

Bangladesh's supply chains, especially the textiles and RMG sector, face a practical challenge, such as growing while staying green. This study reviews 23 peer-reviewed sources through an MIT-SCM lens of systems thinking, digital innovation, and resilience, translating global lessons for local use. We focus on four levers managers can act on now: greener purchasing with supplier scorecards; cleaner, more efficient production; circular product design that plans for reuse; and reverse-logistics loops that bring materials back. These levers work when a few conditions line up: leadership that is accountable, policies that are coherent, HR practices that reward sustainable behaviour, and fit-for-purpose digital tools from the basic blockchain traceability to machine learning and big-data analytics. The upside is clear: greater transparency, lower waste, and progress towards circularity. The obstacles are equally clear: finance and data gaps, infrastructure bottlenecks, and uneven enforcement that hit SMEs hardest. We map where government, industry, and buyers can partner and show how ESG/SDG expectations can become daily routines. Examples include pilot programmes that help track products at the cluster level for export rules and simple tools for small and medium-sized enterprises. To track progress, we propose operational KPIs managers can own emissions intensity, waste-recovery rates, and supplier-compliance scores. Overall, the evidence points to systems-level change that ties technology to policy and everyday practice, so Bangladesh can build supply chains that are competitive, resilient, and genuinely responsible.

Keywords
Sustainability, Green Supply Chain Management (GSCM), Systems Thinking, Digital Transformation

1. Introduction
Sustainability is now a major focus in global supply chains due to climate change, limited resources, and strict environmental rules (Bari et al., 2022). The MIT Supply Chain Management (SCM) framework sees sustainability as a system supported by innovation, digital tools, and cooperation (Butt et al., 2021). For Bangladesh, this shift is urgent for both economic growth and environmental safety (Hashmi, 2023).

Green supply chain management (GSCM) includes eco-friendly practices in buying, making, shipping, and reusing goods (Khan et al., 2022). Companies that use green practices often save costs, follow regulations better, and become

more competitive (Akbar et al., 2023). This is especially important in sectors like textiles, where buyers now demand sustainable methods (Zardini et al., 2021).

To support GSCM, firms need good policies, strong leadership, and a culture of innovation (Liu et al., 2023; Alam et al., 2023). Technologies like blockchain, machine learning, and big data help with tracking, forecasting, and decision-making (Munir et al., 2022; Lin et al., 2022; Zhu et al., 2022), but their use in Bangladesh is still low due to high costs and weak infrastructure (Caldarelli et al., 2021).

Other important areas include product design, reverse logistics (like recycling), and decision tools like MCDM, which help reduce waste and improve reuse (Bressanelli et al., 2018; Richnák & Gubová, 2021; Sahoo & Goswami, 2023). Despite the benefits, Bangladesh faces challenges. Many firms lack money, skilled workers, and proper tools (Dzikriansyah et al., 2023). Weak enforcement and unclear policies also slow progress (Caldarelli et al., 2021). New technologies are rarely used beyond pilot tests (Lin et al., 2022), and many leaders are not fully committed (Masudin et al., 2022).

Bangladesh's supply chains mostly follow a linear model, with little focus on recycling or reuse (Richnák & Gubová, 2021). In industries like fashion, price pressure and lack of supply chain visibility limit sustainability (Zardini et al., 2021). Many still see sustainability as a cost, not a benefit (Akbar et al., 2023).

This study reviews past research to understand how sustainability can be applied in Bangladesh's supply chains, using the MIT SCM approach (Butt et al., 2021). Identify the key enablers like digital tools, policies, and leadership (Hashmi, 2023; Liu et al., 2023), Explore the challenges faced by companies (Dzikriansyah et al., 2023; Caldarelli et al., 2021), and Assess how technologies like blockchain and big data can support green transitions (Lin et al., 2022; Zhu et al., 2022; Tariq et al., 2022).

This review is based on 23 research papers and does not include new surveys or interviews (Sahoo & Goswami, 2023). It focuses on global and South Asian contexts, especially Bangladesh (Hashmi, 2023). The study is limited to literature only, so its findings are descriptive, not predictive (Khan et al., 2022), and it doesn't cover industry-specific differences or use simulation tools like digital twins (Masudin et al., 2022).

Still, the research offers helpful ideas for improving supply chain sustainability in developing countries (Butt et al., 2021; Bari et al., 2022).

2. Literature Review

The evolution of supply chain management (SCM) into green supply chain management (GSCM) reflects a paradigm shift in operational priorities—from efficiency-focused logistics to sustainability-led value creation (Bari et al., 2022). Traditional SCM systems emphasized speed and cost, often neglecting environmental and social implications (Butt et al., 2021). However, environmental degradation and global regulatory pressure have compelled firms to integrate ecological and ethical considerations into supply chain practices (Hashmi, 2023). In Bangladesh, where industries such as textiles are deeply integrated into global markets, this transformation is both a strategic necessity and a competitive obligation (Zardini et al., 2021).

GSCM incorporates processes such as green procurement, eco-design, reverse logistics, and end-of-life product recovery, shifting supply chains toward circular and low-emission models (Onukwulu et al., 2021). These practices are gaining traction in Bangladesh, especially among export-oriented manufacturers seeking to meet international sustainability standards (Akbar et al., 2023). Digital innovations such as blockchain and big data analytics have further expanded the scope of GSCM by enabling transparency, real-time monitoring, and improved resource optimization (Munir et al., 2022). However, challenges remain in terms of institutional readiness, technological infrastructure, and workforce capability in the Bangladeshi context (Caldarelli et al., 2021) (Table 1).

Table 1. Framework

Framework / Theory	Key Concept	Relevance to Bangladesh
Triple Bottom Line (TBL)	Balance among environmental, economic, and social performance	Helps export firms align with global ESG compliance
Circular Economy (CE)	Closed-loop systems to reduce waste and reuse materials	Applies to textiles, energy, and electronics through recycling and reuse initiatives
Resource-Based View (RBV)	Internal capabilities as a source of sustainable competitive advantage	Emphasizes leadership, HRM, and green innovation in resource-constrained environments
MIT SCM Systems Thinking	Holistic integration of sustainability, resilience, and digital transformation	Urges full-system transformation integrating tech, policy, and human capital

Green SCM has thus evolved from a niche strategy into a central component of organizational sustainability, with far-reaching implications for competitiveness and risk mitigation in emerging economies like Bangladesh (Khan et al., 2022).

The theoretical backbone of GSCM integrates several core frameworks, including the Triple Bottom Line (TBL), Circular Economy (CE), and the Resource-Based View (RBV) of the firm (Sahoo & Goswami, 2023). The TBL framework—emphasizing environmental, social, and economic performance—guides firms in balancing profitability with sustainable practices (Dzikriansyah et al., 2023). In Bangladesh, the growing influence of ESG-driven procurement by international buyers has accelerated the adoption of TBL-aligned policies in export sectors (Hashmi, 2023).

The Circular Economy framework encourages closed-loop systems where materials are reused, recycled, and reintegrated into production, thereby reducing dependency on virgin resources and lowering waste (Onukwulu et al., 2021). Reverse logistics and eco-design practices play a critical role in operationalizing CE principles in supply chains (Richnák & Gubová, 2021). In Bangladeshi energy and manufacturing sectors, CE-based strategies are emerging to reduce environmental impact and enhance resource efficiency (Tariq et al., 2022).

The RBV emphasizes the role of firm-specific capabilities—such as green innovation, digital infrastructure, and leadership—in building competitive advantage through sustainability (Liu et al., 2023). For example, the integration of green HRM and leadership values into strategic planning has been shown to significantly influence sustainable outcomes (Alam et al., 2023). These internal competencies are critical in the Bangladeshi context, where external institutional support remains weak (Masudin et al., 2022).

Product design decisions, taken at early stages of the supply chain, strongly influence recyclability and environmental impact across the lifecycle, reinforcing the integration of CE and RBV theories (Bressanelli et al., 2018). Thus, a hybrid theoretical approach enables a more comprehensive understanding of GSCM practices in developing economies like Bangladesh (Sahoo & Goswami, 2023).

The MIT SCM perspective emphasizes systems thinking, digital transformation, and resilience as core drivers of sustainability in modern supply chains (Butt et al., 2021). Systems thinking recognizes that sustainability cannot be achieved in silos; instead, it requires the holistic integration of environmental goals into procurement, logistics, production, and reverse flows (Bari et al., 2022). In Bangladesh, where supply chains often operate in fragmented and informal ways, adopting systems thinking is essential for strategic sustainability alignment (Hashmi, 2023) (Table 2).

Table 2. Theme

Theme	Description	Key References
Digital Innovation in GSCM	Blockchain, machine learning, and big data for traceability, forecasting, and decision-making	Munir et al. (2022); Lin et al. (2022); Zhu et al. (2022)
Reverse Logistics & Circularity	Recycling loops, product take-back systems, and eco-design	Onukwulu et al. (2021); Bressanelli et al. (2018); Richnák & Gubová (2021)
Green Leadership and HRM	Cultural and organizational change through green leadership and training	Liu et al. (2023); Alam et al. (2023); Masudin et al. (2022)
Sustainability Performance Metrics	Emissions intensity, waste recovery rates, and supplier compliance KPIs	Khan et al. (2022); Sahoo & Goswami (2023); Hashmi (2023)
Industry 4.0 and Smart Operations	Digital twins, IoT, predictive analytics for energy and logistics optimization	Tariq et al. (2022); Masudin et al. (2022); Butt et al. (2021)

Resilience—another key MIT principle—refers to the adaptive capacity of supply chains to respond to disruptions such as pandemics, natural disasters, or regulatory shifts (Akbar et al., 2023). During COVID-19, firms that had embedded green and digital capabilities were better able to maintain continuity and compliance with shifting ESG expectations (Zhu et al., 2022). Resilience is particularly relevant for Bangladesh, which is prone to both environmental and geopolitical shocks (Dzikriansyah et al., 2023).

MIT SCM also promotes the strategic deployment of digital technologies such as blockchain, IoT, and machine learning to enable real-time decision-making and predictive analytics (Lin et al., 2022). These technologies enhance transparency and reduce inefficiencies in inventory and logistics operations (Munir et al., 2022). However, their adoption in Bangladesh remains limited due to infrastructural constraints, policy gaps, and digital skill shortages (Caldarelli et al., 2021).

Furthermore, organizational transformation is necessary to fully realize the MIT vision. Pro-environmental behavior, green leadership, and knowledge-sharing mechanisms are essential enablers of successful GSCM (Liu et al., 2023). Without cultural and structural shifts inside firms, even the most advanced technologies will fail to produce long-term sustainability (Alam et al., 2023). As such, the MIT framework offers a useful lens for guiding GSCM in the Bangladeshi industrial landscape (Masudin et al., 2022).

Global supply chains are rapidly aligning with frameworks such as the Sustainable Development Goals (SDGs), Environmental-Social-Governance (ESG) benchmarks, and Industry 4.0 (Zardini et al., 2021). These forces are redefining supply chain expectations, particularly in global industries such as fashion, energy, and electronics (Tariq et al., 2022). For Bangladesh—whose economy is deeply embedded in global supply networks—adapting to these trends is essential for trade continuity and reputational risk mitigation (Hashmi, 2023).

Industry 4.0 integrates cyber-physical systems, big data, and AI to enable real-time visibility and smart decision-making across supply chains (Lin et al., 2022). Big data analytics is increasingly used for supplier evaluation, emissions monitoring, and lifecycle cost optimization (Zhu et al., 2022). Blockchain improves transparency and stakeholder trust in industries with complex supplier hierarchies, such as apparel (Caldarelli et al., 2021).

Globally, ESG compliance has become a prerequisite for supplier selection and investment. Firms that fail to disclose environmental impacts or meet human rights standards face exclusion from global value chains (Akbar et al., 2023). In Bangladesh, where labor and environmental concerns are prevalent, compliance with ESG metrics is becoming a strategic imperative for retaining global buyers (Zardini et al., 2021).

Additionally, the SDGs are reshaping policy frameworks and funding priorities toward sustainable infrastructure, clean energy, and inclusive industrial growth (Onukwulu et al., 2021). Bangladeshi policymakers are increasingly aligning national strategy with SDG goals, influencing the broader SCM ecosystem (Bari et al., 2022). However,

capacity limitations in measurement, enforcement, and cross-sector collaboration remain challenges to implementation (Masudin et al., 2022).

Although literature on GSCM is growing, several gaps remain, particularly concerning developing countries like Bangladesh (Hashmi, 2023). First, most studies focus on large firms, neglecting the unique challenges and needs of SMEs (Caldarelli et al., 2021). Second, while digital technologies are widely discussed, few studies provide insight into how they are being implemented—or resisted—within the Bangladeshi industrial context (Munir et al., 2022). There is also limited research on how supply chain design influences environmental outcomes, especially in low-tech sectors like garments and food (Butt et al., 2021). Similarly, while circular economy models are emphasized, empirical studies on closed-loop implementation in Bangladesh remain sparse (Onukwulu et al., 2021). Reverse logistics, though recognized as crucial, is underdeveloped both in practice and literature (Richnák & Gubová, 2021).

Furthermore, the role of soft capabilities—such as leadership, green HRM, and organizational culture—remains underexplored, despite evidence showing their significance in driving sustainability transitions (Liu et al., 2023; Alam et al., 2023). Theoretical frameworks such as the RBV and TBL are frequently referenced but rarely operationalized in empirical models tailored to Bangladesh (Sahoo & Goswami, 2023).

Finally, few studies offer an integrated MIT SCM view that combines systems thinking, digital innovation, and stakeholder alignment in the Bangladeshi setting (Masudin et al., 2022). These gaps provide a strong rationale for further research that synthesizes global best practices with local realities to advance GSCM implementation in Bangladesh (Bari et al., 2022).

3. Research Methodology

This study is based on a secondary literature review to explore how sustainability is being integrated into green supply chain management (GSCM), using both global and Bangladeshi perspectives (Bari et al., 2022). The method follows the MIT SCM approach, which focuses on systems thinking, learning across fields, and insights from evidence (Butt et al., 2021). Since real-time data in Bangladesh is limited, reviewing existing studies helps identify important strategies (Hashmi, 2023). Literature was collected using keywords like “green supply chain,” “sustainability,” “MIT SCM,” “Industry 4.0,” and “circular economy” from trusted databases such as Scopus, Web of Science, and ScienceDirect (Sahoo & Goswami, 2023; Dzikriansyah et al., 2023). Studies were selected if they were published between 2018–2024, focused on at least one sustainability area—environmental, social, or economic—and were relevant to Bangladesh or similar countries (Zardini et al., 2021). Preference was given to papers covering topics like digital tools, reverse logistics, circular economy, and frameworks like resource-based view (Caldarelli et al., 2021; Onukwulu et al., 2021). Articles were excluded if they lacked methods, focused only on profits, or didn’t address sustainability goals such as SDGs or ESG (Akbar et al., 2023; Richnák & Gubová, 2021). A deductive thematic analysis helped group the papers into key themes like GSCM development, digital innovation, organizational capacity, MIT SCM principles, and Bangladesh-specific gaps (Tariq et al., 2022; Lin et al., 2022). The review looked at how these studies connect strategy, structure, and technology for sustainable supply chains, especially in garments and manufacturing sectors (Sahoo & Goswami, 2023; Hashmi, 2023). However, since the study uses only existing literature, it does not include field data like interviews or case studies (Caldarelli et al., 2021). Also, some findings may not fully apply to Bangladesh due to local differences like infrastructure or labor market issues (Masudin et al., 2022), and not all papers directly followed the MIT SCM model, so relevance was interpreted by the author (Bari et al., 2022). Lastly, few studies focus on soft factors like leadership or collaboration in Bangladesh’s supply chain, which remains a limitation (Alam et al., 2023).

4. Strategies for Integrating Sustainability into GSCM

Sustainable procurement involves sourcing materials and services that meet environmental, ethical, and social criteria across the supplier network (Hashmi, 2023). In Bangladesh, supplier engagement is a major strategy to improve sustainability practices within the garment and energy sectors (Zardini et al., 2021). Green supplier collaboration enables firms to influence upstream emissions, improve traceability, and meet global ESG demands (Caldarelli et al., 2021). These engagements are increasingly supported by digital platforms and shared sustainability audits (Akbar et al., 2023). MIT SCM emphasizes alignment between supplier capabilities and buyer sustainability goals as a system-wide requirement (Butt et al., 2021).

Green manufacturing focuses on reducing environmental impacts during production through cleaner technologies, resource efficiency, and emissions control (Dzikriansyah et al., 2023). In Bangladesh, industries have begun adopting cleaner energy sources and reducing water-intensive processes in response to global buyer pressure (Hashmi, 2023). Integration of eco-efficient production lines enhances both cost and environmental performance (Richnák & Gubová, 2021). MIT SCM stresses continuous improvement in operational efficiency alongside sustainability integration (Bari et al., 2022) (Table 3).

Table 3. Strategy type

Strategy Type	Strategic Actions	Benefits to GSCM
Eco-Design & Sustainable Product Dev.	Design for disassembly, recyclable materials, lifecycle analysis	Reduces environmental footprint at product level
Green Procurement & Sourcing	Supplier audits, green criteria, ethical sourcing	Promotes sustainable sourcing, reduces supply risk
Low-Carbon Transportation	Route optimization, fuel-efficient fleets, carbon offset programs	Lowers emissions, improves transport efficiency
Closed-Loop & Reverse Logistics	Take-back schemes, recycling partnerships, remanufacturing	Supports circular economy, minimizes waste
Digitalization & Smart Technologies	IoT, AI, blockchain for traceability and monitoring	Enables real-time insights, improves compliance
Stakeholder Engagement & Transparency	ESG disclosure, certification, stakeholder collaboration	Builds trust, ensures compliance with market & policy trends

Greening logistics involves optimizing transport networks, adopting electric vehicles, and reducing packaging waste (Munir et al., 2022). In Bangladesh, logistics emissions remain high due to outdated infrastructure and inefficient routing (Tariq et al., 2022) (Table 4). Digital tracking systems, such as RFID and IoT sensors, support visibility and sustainability reporting in logistics (Lin et al., 2022). MIT SCM's logistics strategy integrates route optimization, modal shifts, and collaboration with third-party providers to reduce carbon intensity (Zhu et al., 2022).

Reverse logistics refers to the return and reuse of products or materials, essential for operationalizing the circular economy in supply chains (Onukwulu et al., 2021). Bangladeshi SMEs have limited infrastructure for product take-back and remanufacturing (Richnák & Gubová, 2021). Closed-loop systems require firms to integrate recycling into supply chain design and post-consumer collection efforts (Bressanelli et al., 2018). MIT SCM highlights reverse flows as a critical component of lifecycle supply chain strategy (Butt et al., 2021).

Table 4. Category

Category	Details	Suggested Mitigation
Enabler: Leadership & Culture	Commitment from top management and a green-oriented organizational culture	Leadership training, KPIs, internal alignment
Enabler: Digital Infrastructure	ERP, IoT, and data platforms support GSCM integration	Invest in tools, upskill staff
Barrier: Cost & Investment	High upfront cost of technologies with unclear short-term ROI	Use green financing, long-term ROI planning
Barrier: Supplier Readiness	Tier-2/3 suppliers often lack green capability	Supplier development and training programs
Barrier: Regulatory Complexity	Confusing or conflicting environmental standards across sectors	Harmonize policies, cooperate with regulators
Barrier: Data Transparency	Lack of reliable data across supplier networks	Use blockchain, promote standardized reporting frameworks

Sustainability transitions are best achieved through collaboration between firms, regulators, civil society, and global buyers (Alam et al., 2023). Public-private partnerships and regional coalitions are emerging in Bangladesh to

implement environmental standards and shared logistics hubs (Munir et al., 2022). Effective sustainability strategies require shared goals, data transparency, and risk-sharing agreements among stakeholders (Masudin et al., 2022). MIT SCM promotes network-wide alignment and joint innovation as pillars of collaborative GSCM (Liu et al., 2023).

Measuring sustainability performance is key to monitoring impact and driving continuous improvement (Sahoo & Goswami, 2023). In Bangladesh, firms are increasingly required to report on carbon footprint, water use, and labor standards in line with global buyer expectations (Hashmi, 2023). Key performance indicators (KPIs) include emissions intensity, waste recovery rates, and supplier compliance scores (Khan et al., 2022). MIT SCM recommends embedding measurement systems into supply chain dashboards and planning tools (Zhu et al., 2022).

5. Innovations Driving Sustainable Supply Chains

Industry 4.0 technologies—including IoT, machine learning, and big data—support predictive, transparent, and adaptive supply chains (Lin et al., 2022). In Bangladesh, pilot projects in textiles and electronics show promise in energy monitoring and inventory optimization (Zhu et al., 2022). These tools enable sustainability by reducing forecasting errors and energy waste (Tariq et al., 2022). MIT SCM considers digitalization fundamental to building smart and sustainable supply networks (Munir et al., 2022).

Table 5. Innovation

Innovation	Description	Sustainability Impact	Examples in Practice
Blockchain Technology	Distributed ledger ensuring traceability, transparency, and authenticity	Reduces fraud, ensures supplier compliance, enhances ethical sourcing	Walmart's food traceability; Everledger
Artificial Intelligence (AI)	Machine learning and analytics for forecasting, optimization, and automation	Reduces waste, optimizes inventory, enhances responsiveness	Predictive maintenance in logistics
Digital Twins	Virtual replicas of supply chain systems used for simulation and testing	Minimizes errors, supports low-carbon decision-making	Siemens smart factory models
Internet of Things (IoT)	Sensors and devices for real-time tracking and environment monitoring	Enables emissions tracking, energy management, and asset optimization	Smart containers in Maersk
Big Data Analytics (BDA)	Analysis of structured and unstructured data to support decision-making	Identifies inefficiencies, drives continuous improvement	Amazon's dynamic demand forecasting
Circular Product Design	Products designed for reuse, disassembly, and recycling	Supports closed-loop systems and zero-waste manufacturing	Adidas "Made to Be Remade" shoes
Green Packaging Tech	Biodegradable, compostable, and reusable packaging innovations	Reduces plastic waste, improves brand sustainability perception	Coca-Cola's PlantBottle, Loop™ system

Adoption of solar, biogas, and energy-efficient machinery helps decarbonize supply operations (Akbar et al., 2023). Bangladesh's reliance on fossil fuels is shifting slowly (Table 5), but policy-driven incentives for renewable adoption are emerging (Onukwulu et al., 2021). MIT SCM supports decarbonization through energy sourcing strategies integrated into logistics and production systems (Hashmi, 2023).

Digital twins simulate physical systems, enabling real-time monitoring and scenario testing in supply chain networks (Masudin et al., 2022). Though underutilized in Bangladesh, they hold potential for impact analysis in apparel and food sectors (Bari et al., 2022). Predictive analytics based on historical and sensor data can identify risks, such as emissions peaks or delivery delays (Zhu et al., 2022). MIT SCM applies these tools in resilience modeling and sustainability scorecarding (Lin et al., 2022).

Circular models include leasing, product-service systems, and modular design, reducing material throughput and waste (Bressanelli et al., 2018). In Bangladesh, such models are emerging in electronics and fashion through recycling platforms and product repurposing (Onukwulu et al., 2021). Reverse logistics, design for disassembly, and lifecycle tracking are core enablers (Richnák & Gubová, 2021). MIT SCM promotes circularity as a systems-level redesign of value chains (Butt et al., 2021).

Caldarelli et al. (2021) show blockchain applications in tracking ethical sourcing in fast fashion supply chains (Caldarelli et al., 2021). Akbar et al. (2023) analyze green logistics strategies during the pandemic, showing how flexible operations enhanced resilience (Akbar et al., 2023). Liu et al. (2023) present leadership-led GSCM transformations in Southeast Asia that can be adapted to Bangladesh (Liu et al., 2023). MIT SCM incorporates these real-world cases into adaptive and replicable frameworks for scaling sustainability (Masudin et al., 2022).

6. Challenges and Barriers in Integrating Sustainability

Bangladeshi firms—especially SMEs—struggle with funding sustainability initiatives due to limited cash flow and weak access to green finance (Dzikriansyah et al., 2023). Sustainability projects often involve upfront costs with delayed ROI, discouraging investment (Akbar et al., 2023). MIT SCM recommends supply chain finance tools and carbon-linked incentives to overcome cost barriers (Hashmi, 2023).

Poor digital infrastructure, unreliable internet, and lack of sensor networks limit technology adoption in GSCM (Caldarelli et al., 2021). Firms face difficulties implementing IoT, BDA, and blockchain tools due to lack of expertise and integration issues (Munir et al., 2022). MIT SCM proposes phased implementation and capacity-building programs as pathways for tech adoption (Lin et al., 2022).

Regulatory inconsistencies and fragmented enforcement hinder long-term sustainability efforts (Tariq et al., 2022). Green procurement and environmental standards are often poorly monitored, and enforcement bodies remain under-resourced (Hashmi, 2023). MIT SCM emphasizes institutional coordination and stakeholder-driven policy alignment to bridge these gaps (Bari et al., 2022).

Lack of top management commitment, employee engagement, and change management tools create inertia in sustainability adoption (Liu et al., 2023). Firms often treat sustainability as a compliance task rather than a core value (Alam et al., 2023). MIT SCM highlights organizational learning, change champions, and values-led leadership to overcome internal resistance (Masudin et al., 2022).

Firms in Bangladesh face trade-offs between cost efficiency and long-term environmental goals, especially under pressure from global buyers (Zardini et al., 2021). Faster delivery cycles often lead to higher emissions, and many firms prioritize speed over sustainability (Butt et al., 2021). MIT SCM promotes lifecycle costing and triple-bottom-line accounting to manage such trade-offs (Sahoo & Goswami, 2023).

Context-specific challenges include energy shortages, informal labor structures, and limited innovation ecosystems (Hashmi, 2023). Resource scarcity, fragmented supply chain systems, and weak education linkages further delay sustainability transitions (Caldarelli et al., 2021). MIT SCM encourages South-South collaboration, public-private innovation labs, and inclusive policy development to address these issues (Bari et al., 2022).

7. Future Directions for Research and Practice

Although research on Green Supply Chain Management (GSCM) is increasing, key knowledge gaps still exist—especially in developing countries like Bangladesh (Hashmi, 2023). Most studies focus on large firms, leaving out small and medium-sized enterprises (SMEs), which are central to Bangladesh's economy (Dzikriansyah et al., 2023; Caldarelli et al., 2021). There's also little practical research on how technologies like blockchain, IoT, and big data are used in low-resource industries like textiles (Munir et al., 2022; Lin et al., 2022), making tech-sustainability integration underexplored (Tariq et al., 2022).

Models such as the Triple Bottom Line (TBL), Resource-Based View (RBV), and Circular Economy (CE) are often mentioned but rarely applied to real Bangladeshi supply chain settings (Sahoo & Goswami, 2023; Butt et al., 2021). Organizational factors like green HRM, leadership, and learning also receive limited attention (Liu et al., 2023; Alam

et al., 2023). Reverse logistics, vital for circular practices, is still under-researched (Onukwulu et al., 2021; Richnák & Gubová, 2021).

Technologies like AI and predictive analytics offer major potential, such as better inventory management, lower emissions, and traceability (Caldarelli et al., 2021; Lin et al., 2022). However, the MIT SCM model stresses that tools alone are not enough. System redesign is needed, especially given Bangladesh's weak digital infrastructure and tech capacity (Butt et al., 2021; Tariq et al., 2022). Tools like digital twins can help, but must be simplified and made affordable for SMEs (Masudin et al., 2022). Future research should align tech, policy, and human behavior (Zhu et al., 2022).
Governance is another weak point. Rules are often poorly enforced, and policies like green procurement or tax breaks are underused (Hashmi, 2023; Dzikriansyah et al., 2023; Zardini et al., 2021). Collaboration between government, business, and civil society is needed for better oversight and shared accountability (Alam et al., 2023). Ethical and labor issues are also overlooked, though they're critical in labor-heavy supply chains like Bangladesh's (Akbar et al., 2023; Sahoo & Goswami, 2023).

Using the MIT SCM framework, this study imagines a future where Bangladeshi supply chains are sustainable, data-driven, and inclusive (Butt et al., 2021; Hashmi, 2023). In this future, companies embrace renewable energy, closed-loop systems, and real-time logistics (Onukwulu et al., 2021). Industrial zones could share green infrastructure (Tariq et al., 2022), while product designs support reuse and recycling (Bressanelli et al., 2018). Local innovations may even inspire solutions for other countries (Caldarelli et al., 2021). This future depends on co-created policies, green metrics, and collective innovation across sectors (Alam et al., 2023; Liu et al., 2023).

8. Conclusion

This research has systematically reviewed the integration of sustainability into Green Supply Chain Management (GSCM) from a Bangladeshi perspective, guided by the MIT SCM framework. The findings reveal that GSCM in Bangladesh is evolving through a combination of policy support, leadership commitment, and adoption of Industry 4.0 tools such as blockchain, big data, and digital twins. Core strategies such as sustainable procurement, eco-efficient manufacturing, reverse logistics, and stakeholder collaboration are being implemented with varying levels of success across industries. At the same time, literature identifies several challenges including financial barriers, weak infrastructure, policy inconsistencies, and cultural resistance to change. A major contribution of this study is its alignment with the MIT SCM systems-thinking lens, highlighting that sustainability must be embedded across supply chain design, operations, and decision-making processes.

This thesis contributes to supply chain scholarship by synthesizing 23 high-impact academic sources into a cohesive framework for understanding sustainability integration in emerging economies. It bridges global theoretical foundations such as the Triple Bottom Line (TBL), Circular Economy (CE), and Resource-Based View (RBV) with the practical realities of the Bangladeshi industrial landscape. From a practical standpoint, the research offers actionable strategies for firms, policymakers, and development partners seeking to embed sustainability in supply chains, particularly in the textile, food, and manufacturing sectors. Furthermore, by applying the MIT SCM framework, the study reinforces the importance of resilience, digital transformation, and collaborative governance as essential enablers of sustainable operations.

Sustainability in GSCM is no longer a voluntary corporate gesture it is an economic, environmental, and reputational necessity, especially for nations like Bangladesh that are integrated into global value chains. While the journey toward sustainable supply chains is fraught with systemic and operational challenges, this review underscores that transformation is possible through technology, leadership, and systems thinking. Future supply chains must be designed not only for efficiency but also for circularity, transparency, and social equity. As Bangladesh stands at the crossroads of industrial development and ecological vulnerability, GSCM anchored in innovation and inclusivityoffers a roadmap toward long-term resilience and global competitiveness.

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