International Journal of Innovations & Research Analysis (IJIRA)
e-ISSN :2583-0295, Impact Factor: (Cosmos 7.662 & I2OR 5.105), Volume 06, No. 01(II), January- March, 2026, pp 55-65

Sustainable Supply Chain Management

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Citation: Gangwal, N. (2026). Sustainable Supply Chain Management. International Journal of Innovations & Research Analysis, 06(01(II)), 55–65.

ABSTRACT

Sustainable Supply Chain Management (SSCM) has become an essential approach toward responsible and effective business management for the creation of shareholder value and sustainable operations. SSCM integrates the supervision of materials, information and capital, as well as collaborative actions with companies in the supply chain while considering goals for triple bottom line dimensions: economic, environmental, and social aspects. SSCM shows gradual transitions from cost-cutting approaches to value-based solutions that capture supply chain management's future vision. These range from green logistics to circular supply models, carbon footprint projects, and the use of technologies such as blockchain and AI to improve sustainability visibility. These actions not only reduce the environmental effects but also promote high ethical standards in employment and optimum utilisation of resources. However, several challenges are associated with the implementation of SSCM, predominantly in developing countries. Among them are facility limitations, weak regulations, lack of awareness, and resistance to change within stakeholders. To address these issues, it is possible to review peer-reviewed journals and industrial reports and engage stakeholders and conduct capacity-building activities. Real-life examples from different industries indicate that servicing SSCM standards has benefits that may include minimised emissions, cost advantages, and enhanced brand image. An analysis on how SSCM practices can benefit local development goals: Initiatives aboutSSCM can bolster these usually national objectives as the delivery of the triple bottom line, innovation, carbon-neutrality, and rural development. Supply chain management decisions integrated with sustainability practices not only add value to business operations and, as a result, help to increase competitiveness, but also contribute to the sustainable development of global society.This study establishes that analysis, integration, and the pursuit of an ethical approach are all integrated yet fundamental principles of the SCM discipline. Thus, it supports SSCM as away for improving the company's long-term performance by providing value to customers and contributing to the betterment of society and the environment.

***Keywords**: Sustainability, Supply Chain, Green Logistics, Ethical Sourcing, Circular Economy.*

Introduction

The accelerating rate at which the environment is degrading, climate change and social inequality are taking place has made a deep change necessary in how businesses should handle their concerns. Supply chains are reinvented while they were conventionally observed based on the perspective of efficiency and economy, now for larger concerns about sustainability (Karmaker et al., 2023). In this regard, Sustainable Supply Chain Management (SSCM) has developed into a strategic and moral mechanism used to marry a corporate goal with a green economy, but with an emphasis on social well-being. It is wider in that it ranges beyond the pinched perspective into the far vision of the triple bottom line supported by spirit: economic, environmental, and social sustainability (Khan et al., 2022).

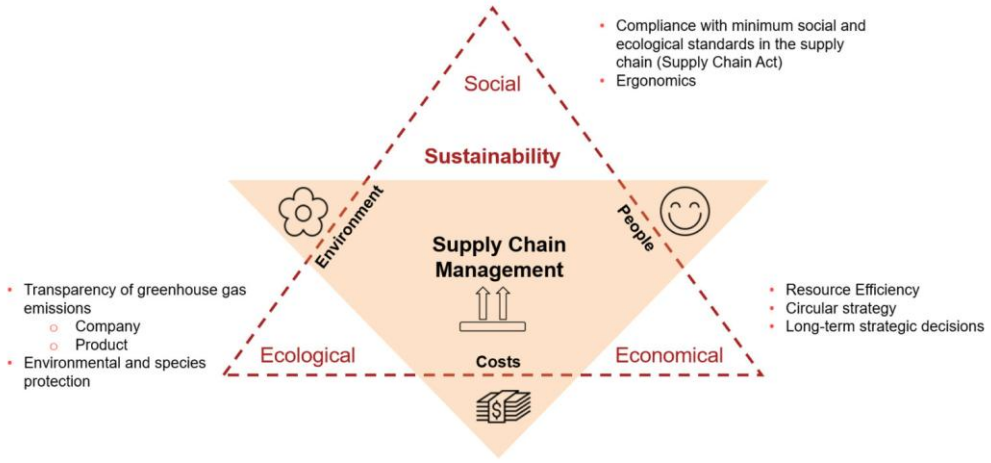

Figure 1: Sustainable Supply Chain Management

Source: (Khan et al., 2022)

SSCM is for systematic correlation of business functions in and across supply chains in order to raise long term economic performance, reduce pollution, and improve social justice. It includes green procurement, ethical sourcing of labour mark, lifecycle product design, reverse logistics and waste minimisation. In addition, sustainability within the supply chains goes beyond corporate responsibility; it is becoming a regulatory and market-driven necessity because of the pressures from governments, investors, and even the environmentally conscious consumers(Karmaker et al., 2023).

SCSM transition has been facilitated by technological developments. Tools such as the use of artificial intelligence (AI) are used to make logistics more efficient and accurately forecast demand, reducing waste(Khan et al., 2022). The adoption of blockchain technology increases transparency and traceability and consequently helps companies ensure their compliance with ethical sourcing standards. The benefits of the Internet of Things (Iot) include real-time monitoring of environmental conditions and asset tracking, which enhances resource utilisation and minimisesthe release of emissions(Khan et al., 2022).

Need/ Importance of the Study

Growing attention to global sustainability requires the realignment of supply chains operations of industries in their broader developmental and environmental goals as marked by initiatives like United Nations Sustainable Development Goals (SDGS). Sustainable Supply Chain Management (SSCM) is key within this change in that it is an acknowledgement of the reality that economic growth cannot occur with loss of ecological plundering and social injustices (Khan et al., 2022). In particular, with the help of SSCM, the companies can reduce operational risks, build a robust supply chain, and ensure stakeholder confidence, all of these add to long-term profitability and branding success (Jraisat et al., 2021).

The relevance of SSCM becomes that much more critical for developing countries. There, massive industrialisation invariably results in pollution of the environment, reduction of resources and exploitation of labour. Through SSCM, firms can be competitive in the world market but also address local socio-economic issues (Sahoo et al., 2022). This study thence becomes a necessity in determining how SSCM may serve as a strategic instrument in delivering inclusive growth, ethical governance and sustainable development.

Statement of Problem

Despite its enormous potential, however, the scarcity of application of Sustainable Supply Chain Management (SSCM), particularly in developing nations, is still tricky. Key barriers are weak enforcement of regulations, lack of awareness of supply chain stakeholders, poor infrastructure, and lack of access to enablers of technologies. It is also the case that many organisations are hampered by internal resistance

to change in terms of behaviour and structures to move to a more sustainable approach (Sahoo et al., 2022). Lacking a coherent approach and a good stakeholder engagement, the full benefits of SSCM (costs, risks and social impact) are highly unlikely to be realised. Therefore, there is an urgent necessity to address the challenges and opportunities of SSCM about the development goals.

Research Objectives

The main objectives are listed below:

- To scrutinise the current performs and principles of SSCM across industries.
- To assess the influence of SSCM on business presentation and stakeholder value.
- To explore the role of technology in enhancing SSCM practices.
- To evaluate the barriers and opportunities of SSCM implementation, especially in emerging countries.

Review of Literature

Sustainable Supply Chain Management (SSCM) has become a major concept in managing the nexus of business efficiency and sustainability (Karmaker et al., 2023). It signifies a move away from legacy supply chain models that have heavily favoured cost and speed, to those models that have incorporated an environmentally friendly approach, social responsibility, resilience in the face of economic adversity, and a commitment to the local communities. SSCM puts some emphasis on the management of material, information and financial flows in a manner that supportsthe triple bottom line: people, planet, and profit. It is becoming more and more apparent to businesses that sustainable practices are ethically necessary as well as strategically advantageous in the longterm.

Green Logistics and Models of Circular Economy

According to Chromjaková, Luu and Nguyen (2023), one of the major literature areas is green logistics and circular economy principles application in SSCM. Green logistics is the minimisation of environmental effects fromwhen an order is placed to when an order is delivered by optimising the transportation of goods, packaging, and the energy used. This is further achieved through circular economy models, which redesign supply chains to account for recycling, remanufacturing, and the return of products into the production cycle. Chen (2022) conversely said that these practices lead to waste and the use of resource reduction, thus increasing the long-term environmental and cost efficiency. Reverse logistics, as a mechanism responsible for product return and resource recovery, plays a central role in forming a loop in modern supply chains.

Ethical Labour and Responsible Sourcing

Ethics, in procurement and labour practices, is another important theme in SSCM literature. There is an emerging expectation that companies should ensure that their suppliers follow fair wages, safety at work and anti-discriminationpractices. Ethical sourcing helps build brand reputation, stronger stakeholder relations and reduction of risks(Chen, 2022). Studies also emphasise the fact that responsible procurement allows companies to comply with international regulations as well as to meet the rapidly growing consumer and investor expectations regarding sustainability and corporate accountability.

Technological Enablers of SSCM

Technological advancements have turned into transformative pivots for the adoption of the SSCM practices. Blockchain technology, for instance, offers end-to-end transparency and traceability in the supply chain. It enables companies to confirm the source and movement of products, according to environmental and ethical standards. This is especially applicable to industries at the mercy of sourcing-related risks, including but not limited to agriculture, apparel, and electronics industries(Chromjaková, Luu and Nguyen, 2023).

According to Mubarik et al. (2022), Artificial intelligence (AI) improves SSCM through predictive analytics for forecasting demand and supply planning. Through AI tools, waste can be minimised, inventory can be optimised, and production plans can be refined. Karmaker et al. (2023) argued that the addition of Internet of Things (Iot) brings additional efficiency by allowing real-time parameters of environmental conditions, movement of assets, and operational performance. These digital tools, as a set, enhance resilience, responsiveness, and sustainability in supply networks.

SSCM Challenges in Developing Economies

Although the literature accepts the high level of development of the SSCM practices at the global level, in the literature, it also admits the critical issue faced by the developing countries. Such as deficiencies in clean energy (shallow electric grids) and unreliable transportation systems, and a lack of adequate waste management infrastructure, infrastructure deficiencies limit effective implementation. In addition, the lack of regulatory standards in environmental and labour standards makes sustainable practices unsustainable(Alzubi and Akkerman, 2022).

Financial limits also check the ability of small and medium-scale businesses (SMEs) to invest in sustainable technologies or re-train the workforce. In many developing countries, many companies are either ignorant of the long-term benefits of SSCM or unwilling to change current supply arrangements. The compound challenges of integrating sustainability into business models are cultural resistance, absence of managerial commitment, and diffuse stakeholder coordination(Sahoo et al., 2022).

Need for Collaborative and Context-Specific Approaches

Alzubi and Akkerman (2022) stated that this engagement of multi-stakeholders including the government bodies, NGOs, multinational corporations, and the local communities is in regard to leveraging incentives and building capacity. Public policies are very critical on facilitating SSCM through incentives of green innovation, penalties for failure to comply with regulations and support to infrastructure development.

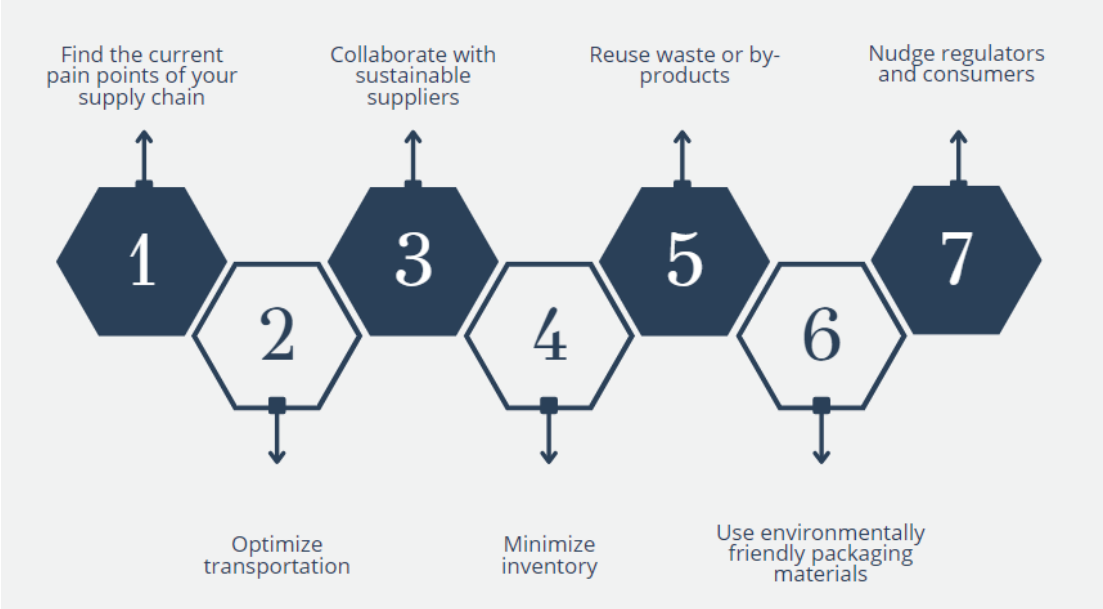

Figure 2: Approach for sustainable supply chain management

Source: (Jraisat et al., 2021)

Moreover, collaborative supply chain governance and knowledge sharing platforms can even encourage transparency and shared growth. It is possible to use the provision of education and availability of finance, to local suppliers to scale up SSCM practices across numerous supply chains with heterogeneous economic environment (Jraisat et al., 2021).

The current literature about SSCM highlights its strategic significance in the evolution of corporate responsibility, environmental vulnerability and operational efficiency respectively. While most international companies have been making great strides on getting SSCM into their enterprise, developing countries are faced with other structural and behavioural bottlenecks (Sahoo et al., 2022). Such efforts as coordination, adoption of new technology and adaptive governance mechanisms are needed to overcome such challenges. In the final analysis, SSCM is not only a pathway towards sustainable growth, but it also provides a framework for pursuing greater socio-economic development goals in a more interconnected and ecologically enlightened world(Jraisat et al., 2021).

Methodology

This research utilized the qualitative, as well as descriptive tradition of research, changing to only secondary data sources to research the practices, challenges and strategic implications of Sustainable Supply Chain Management (SSCM) in developing countries. The use of secondary data was classified as appropriate by several scholarly and industry-based related literature on the given topic, availability of Corporate sustainability reports from the rest of the world and sector-based research. This strategy promoted a large and comparative perspective of the SSCM tendencies in different sectors and regions.

Hypothesis

H_1: Employment of SSCM significantly advances a company's environmental and social performance without cooperating profitability.

H_2: Technological addition (e.g., AI and blockchain) in supply chains enhances the efficiency of SSCM performs.

H_3: Organisational and stakeholder confrontation is a major barrier to SSCM adoption in emerging economies.

Research Approach

The research was grounded by a qualitative framework for studying conceptual themes and strategic pieces of evidence as well as contextual problems in SSCM implementation. A descriptive design was used to organize and explain the existing knowledge analysis rather than hypothesis testing with an experimental or numerical analysis. In identifying patterns and themes from previously published studies, this study tried to construct a summary picture of the impact SSCM had on economic, environmental and social outcomes of supply chain operations(Mey, 2022).

The qualitative approach also supported examination of context-specific problems, e.g., regulatory shortcomings and resistance on the part of stakeholders in developing economies, which are not adequately captured with the use of the quantitative approach(Mey, 2022). This enabled exploration of how companies integrate sustainability into their supply chain, as well as what external/internal factors contribute to their success or failure.

Data Collection

The data used in this study emerged from a range of credible and authoritative secondary sources:

- **Academic Journals:** Peer-reviewed journals indexed in Scopus and Web of Science, were examined, in order to learn more about the theoretical and empirical studies of SSCM. These had articles that talked about sustainable procurement, green logistics, circular supply chains and technology integration(Taherdoost, 2021).
- **Reports from Global Organisations:** Verified institutions including United Nations Global Compact (UNGC), World Economic Forum (WEF), World Bank, and International Labour Organization (ILO) gave institutional publications with macro-level insights on sustainable development trends, policy frameworks and sectoral performance metrics.
- **Industry White Papers:** Consultancy firms such as McKinsey & Company, Pwc, Deloitte and Accenture's strategic reports were analysed. Such documents tend to include industry-specific case studies, benchmarking data and expert forecasts that present interesting real-world views on the adoption of SSCM and barriers associated with it(Taherdoost, 2021).
- **Corporate Sustainability Reports:** The research considered annual sustainability disclosures and integrated reports of multinational companies with the SSCM practice. IKEA, Nestlé, Infosys, Apple and Unilever were chosen because of their respective leadership in sustainability. Based on the data presented in these reports, there were specific strategic operation practices, indicators of performance, environmental initiatives, and stakeholder engagement.

The acquisition of this assorted set of documents guaranteed a balanced academic, institutional and corporate standpoint, hence playing a very valuable role in increasing the credibility and comprehensiveness of the study.

Data Analysis

The approach used was a thematic analysis to synthesise the vast amount of data into a coherent pattern and themes. Categories of themes were aligned with the triple bottom line: economic, environmental, and social dimensions. The economic theme incorporated such other aspects as cost effectiveness, management of risks, and profitability associated with sustainable supply chain initiatives. The environmental theme for this objective was carbon reduction, resource conservation and green technologies. The social dimension included labour rights, community engagement, ethical sourcing and supply chain transparency(Braun and Clarke, 2023).

It should be also mentioned that a comparative case analysis was also done in order to point out differences and similarities between practices in SSCM in various organisations and fields. This was achieved by comparing sustainability initiatives and reported outcomes and strategic approaches of various firms and sectors in an attempt to establish key success factors and common bottlenecks.

It is not surprising that the use of only secondary data is not completely without limitations, among which the most critical is the impossibility of verifying the results of primary research (Braun and Clarke, 2023). However, the credibility of sources and meticulous thematic and comparative analysis of the sources makes the study deliver a legitimate and illuminating view of practices of SSCM.

- **Economic Impact**

Among the most striking effects that the implementation of SSCM can produce are certain impressive economic benefits. Sustainable practice companies realize considerable reduced cost, enhanced efficiency in operation, and long-term profitability (Gawusu et al., 2021). For example, sustainable sourcing, waste minimisation and energy efficiency under SSCM were implemented by Unilever in its global supply chains. These initiatives' outcomes meant more than €700 m worth of cost savings; hence, demonstrating the financial value of the sustainability-focused approaches (Shekarian et al., 2022).

In the same vein, IKEA has also rejuvenated its supply chain by optimising its transport logistics, which translates to reducing (even nothing) the use of the packaging materials and congregating its shipments. Such activities, in turn, did not only minimize the size of its footprint but also reduced the level of transport cost by its 14%. These examples demonstrate that SSCM is not a mere corporate responsibility matter but a strategic move that can help improve economic productivity and provide competitive edge in firms in markets of cost importances(Gawusu et al., 2021).

- **Environmental Outcomes**

Eco-friendly sustainability is the chief focus of SSCM. Proliferation of green logistics, circular economy and renewable energy throughout supply chains has proven to greatly reduce environmental impact. Apple Inc. has, for example, taken remarkable steps towards supplying its entire supply chain in the US and parts of Asia with 100% sources of renewable energy. This initiative was not only effective as far as the reduction of the nation's emissions is concerned, but also strengthened the brand anchor of Apple as a corporate stalwart of environmental responsibility (Siddiqi et al., 2024).

Large numbers of companies are also integrating closed-loop systems, which prioritise recycling, reuse, and remanufacturing. These practices drastically reduce virgin materials dependencies and help to advance the decarbonisation movement globally (Siddiqi et al., 2024). The decrease in carbon footprint and conservation of resources finally affect a firm's ESG performance positively, as it is becoming more and more important to investors and regulators.

- **Social Benefits**

While the benefits of SSCM are not limited to economic and environmental dimensions, but have social implications. Organisations that have/prioritised ethical sourcing, fair labour practices and supplier diversity tend to demonstrate stronger workforce engagement and customer loyalty. Infosys, for instance, launched initiatives to support sustainable development by its suppliers. Programmes for women's entrepreneurship, child-labour preventive audits and local skills development were part of the scheme (Stroumpoulis and Kopanaki, 2022).

Such initiatives are not only beyond compliance but also an expression of a social equity and empowerment stance. They strengthen community relations, raise the morale of the employees and bring about a better image of the company among socially sensitive customers (Stroumpoulis and Kopanaki,

2022). Such social investments in the immediate term are not necessarily financial in nature, but they pay off in the long term, through building up brand equity and stakeholder trust.

- **Technological Enablers**

Technology functions as a catalyst in promoting SSCM. The use of blockchain technology in industries such as electronics and food knows no bounds, greatly increasing the transparency of supply chain operations. Through creating irreversible digital ledgers, blockchain allows companies to trace the origin, transit and as well as, and handling of the goods during the journey in the supply chain (Bai, Quayson and Sarkis, 2022). This goes a long way in preventing fraud and unethical sourcing, and also ensures that we comply with regulations and have consumer confidence.

Artificial Intelligence (AI) is another important enabler that provides prediction analytics, demand forecasting capability, and optimisation of processes. For example, AI-rigged tools can analyse old sales data and market trends to predict demand for products, thus decreasing incidences of overproduction and inventory wastage. AI also helps in the real-time tracking of EPI's thereby enabling quicker and better informed decision making (Bai, Quayson and Sarkis, 2022).

- **Barriers in Developing Nations**

Even though the results of SSCM are positive, its adoption in developing countries is quite low, and there are several structural and behavioural barriers to this adoption. Limited ability of the local suppliers' is one of the leading challenges, most of whom are financially weak, lack the necessary technology infrastructure, and skills to adopt practices and operations that are sustainable (Gonçalves et al., 2024).

Inconsistent or weak frameworks for regulation only serve to hinder any development, as enforcement of the environmental and labour standards is not always upheld. In such environments, if there are no robust legal mechanisms or incentives, companies may be reluctant or will not be forced in any way will be forced to incorporate sustainability in their supply chains.

The rigorous levels of capital required to use technologies like AI, blockchain and renewable energy solutions is yet another significant barrier towards firms operating in low-income regions. Moreover, lack of cultural acceptance to organisational change in particular in traditional industries is also a challenge in changing over to sustainable practices (Gonçalves et al., 2024).

These are the calls for action regarding the urgent need to prioritize capacity building programs, government and public-private partnership. Such strategic initiatives that include regulators, multinational corporations, NGOs, and academic institutions should be used to open portals for knowledge transfer, technology access and infrastructural development in these regions (Mubarik et al., 2022).

Results and Discussion

The results of this study that is based on a detailed review of secondary data of corporate sustainability reports, industrial white papers & academic literature, offer a list concerning diverse significant implications of Sustainable Supply Chain Management (SSCM) in terms of Economic, Environmental & Social issues. It is also found that technological progress can help sustainability when dealing with persistent matters that impact developing economies.

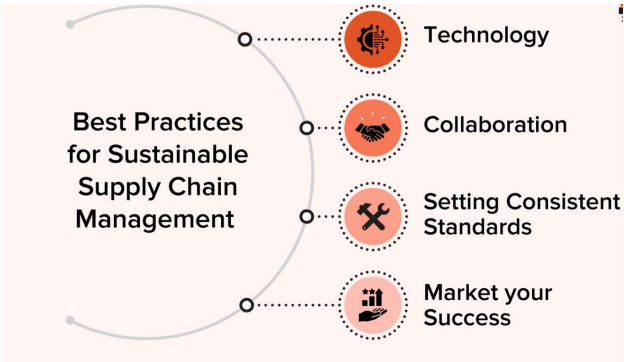

Figure 3: Best Practices for SSCM

Source: (Shekarian et al., 2022)

Result

The research findings illustrate how SSCM brings positive changes to an organization and outlines the most crucial elements that help it succeed. The SSCM has ensured improvement across the three areas of sustainability: economic, environmental and social. From economic aspect, SSCM promotes long-term profitability with enhanced resource efficiency, reduced costs, and risk reduction. Businesses that incorporate sustainability into their supply-side strategies have obtained tangible financial benefits such as energy and transportation reductions and inventory flow optimisation, as well as a more valuable brand image (Gonçalves et al., 2024). This economic hardiness is especially useful at times of global uncertainty and supply chain breakdowns, as was the case during the COVID-19 pandemic and current geopolitical tensions. Those companies having sustainable supply chains are more likely to adjust, recover and sustain continuity in such volatile conditions.

Environmentally speaking, the combination of green logistics, renewable, and circular economy has resulted in a considerable reduction of emissions, waste and prudent usage of the resources (Gawusu et al., 2021). SSCM practices are a new trend-setting activity to which leading firms have taken their benchmarks in implementing them with sustainable design, ethical sourcing, and responsible production. Such activities have not only been in line with global climate targets but also answered to greater demands from the consumer and regulatory worlds for implementation of requirements for environmental accountability (Mubarik et al., 2022).

In social terms, SSCM increases corporate progress by encouraging ethical practices in the use of labour, community relations, and an inclusive supplier system. Fair wages, safe working environment, gender inclusion and local development initiatives have enhanced the corporate social responsibility profiles and built stakeholder trust.

The study also shows that technological integration, although a potent enabler of SSCM, is highly Vendor (or user) dependent in this technology area. Digital gap between countries limits the level to which new technologies including AI, blockchain and Internet of things can be implemented in the developing economies (Gawusu et al., 2021).

There is a large gap of adoption of SSCM in developed versus developing countries. This is primarily because of structural weaknesses; weak regulatory enforcement, lack of financial resources and lack of awareness. The issue needs to be addressed in order to close the global gap in sustainable supply chain practices and make it possible for SSCM to make a meaningful contribution to inclusive sustainable development throughout the world.

Recommendations

- **Strengthen Regulatory Frameworks**

It must be unprecedented for governments in developing countries to create and enforce sustainability regulations in every sector. This ought to include environmental regulations, ethical labour standards and guidelines for sustainable procurement. A strong legal infrastructure would bring in accountability and ensure that businesses adhere to the sustainability benchmarks of the nation and nations(Shekarian et al., 2022).

- **Promote Capacity Building and Education**

Small and medium-sized enterprises (SMEs) usually do not know how or the means to implement SSCM strategies. Training programmes of targeted focus, workshops, and awareness campaigns may increase the knowledge of their sustainable practices among the suppliers and the operational staff. Academic institutions and NGOs can be instrumental in executing such educational initiatives.

- **Enhance Access to Technology**

The ability for firms to monitor, optimise and manage their supply chains transparently is something that can be aided by subsidised, or low-cost access to enabling technologies such as blockchain, AI and IoT(Khan et al., 2022). Governments and industry bodies need to work hand in hand to establish innovation hubs and provide technical support to local businesses.

- **Facilitate Multi-Stakeholder Collaboration**

SSCM is successful in a cooperative ecosystem. Building platforms for dialogue and partnership among businesses, governments, NGOs, and consumers can hasten the integration of sustainable practices by shared resources and aligned goal fervour.

- **Offer Financial Incentives**

Incentives such as tax breaks, green loans or even sustainability-linked financing could encourage companies to invest in SSCM. Such incentives lower the barriers for entry on the part of money while rewarding firms for durable innovations(Karmaker et al., 2023).

Conclusion

Environmental threats to global supply chains have compelled businesses to make the transition from theoretical aspirations to operational practice. It plays an integral role in geared economic activity in ecological stewardship and social responsibility, and it strengthens the triple bottom line. With escalating pressure exerted from regulators and consumers and demands from investors, businesses that embrace SSCM practices stand to benefit more as far as risk management, responsibility in innovation and long term profitability factors are concerned. SSCM is a challenge regarding a structural and a behavioural aspect in the developing economies. Nevertheless, these barriers can be overcome with the help of appropriate policy support, capacity-building measures and technological interventions. SSCM also helps in attaining national development aims, including rural employment, conservation of resources, and social equity. Thus, the integration of sustainability into supply chain management should be regarded not just as a corporate duty but as a strategic tool for inclusive and resilient economic development.

Limitations

This study is mainly based on secondary data and therefore, it may have a reduced scope for the recent firm-specific information. Where the research is founded on publicly accessible sources, the lack of confidential operational data results in a deficiency of knowledge on SSCM performance metrics. In addition, such findings may not be generalizable across all sectors and all geographies owing to variable economic, regulatory and cultural contexts. The lack of primary empirical data also limits the possibility of statistically verifying hypotheses, and hence the study lacks robustness in terms of its generalisability and ability to predict.

Scope for Further Research

Potential future research could focus on industry-based SSCM frameworks, especially in high-impact industries like agriculture, fashion and electronics, where sustainability issues are highly pronounced. Quantitative research based on primary data among supply chain stakeholders would enrich the statistical and context-based depth. Also, the responsive nature of SSCM in crises, such as global pandemics or disruption of supply, is an interesting area for further study. Longitudinal research on the impact of regulation or policy on SSCM adoption in the long term may help understand the performance of governance frameworks and the adaptation to sustainable practices among different economic landscapes.

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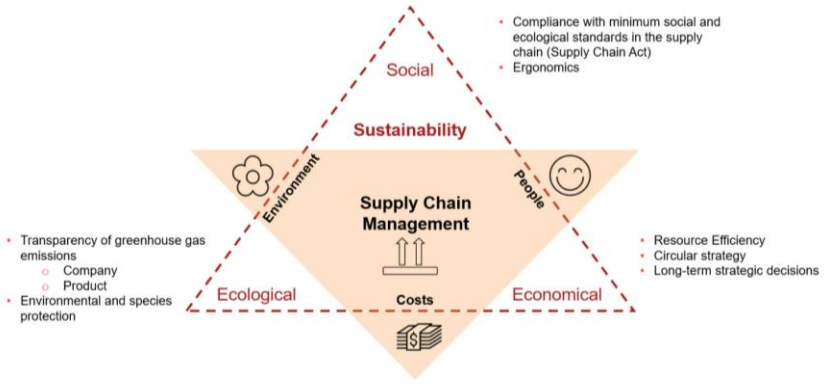
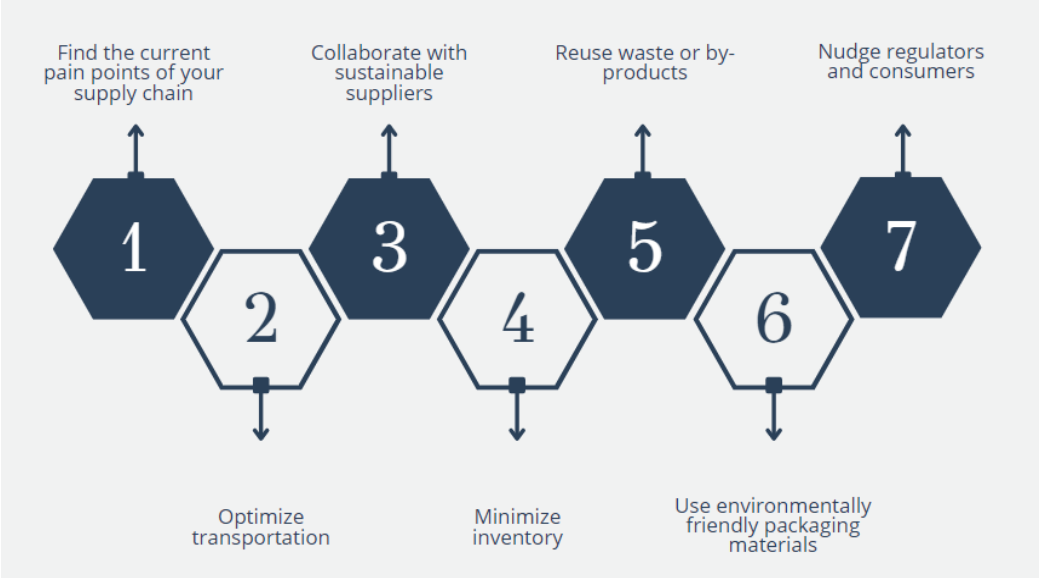
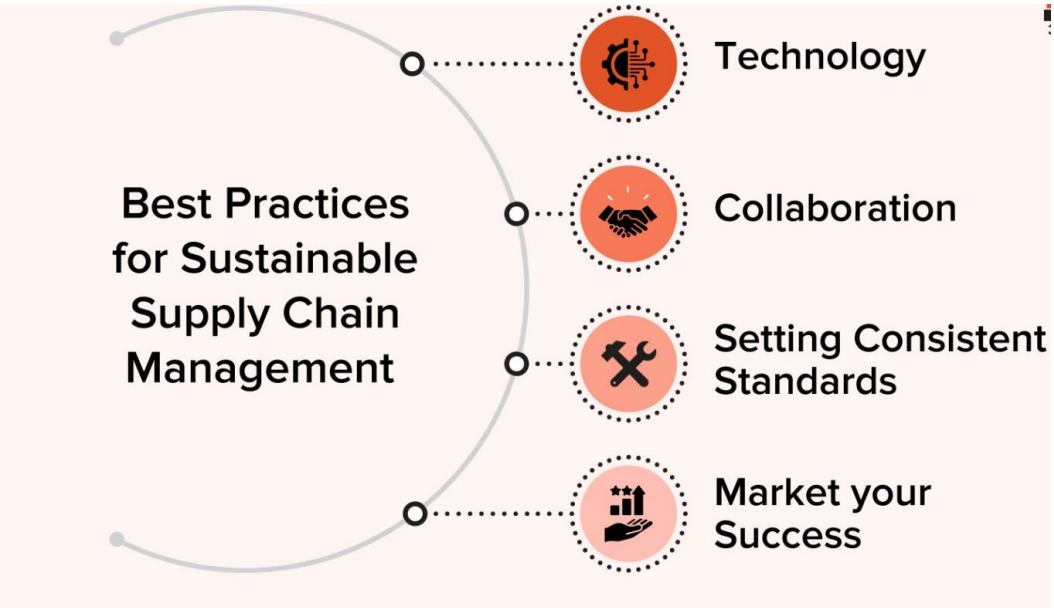
Appendix




Find the current pain points of your supply chain
Collaborate with sustainable suppliers
Reuse waste or by-products
Nudge regulators and consumers
1
2
3
4
5
6
7
Optimize transportation
Minimize inventory
Use environmentally friendly packaging materials


Best Practices for Sustainable Supply Chain Management
Technology
Collaboration
Setting Consistent Standards
Market your Success

❑❑❑