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Environmental Sustainability Through Green Supply Chain Management In Small And Medium Enterprises

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Abstract
The objective of Green Supply Chain Management (GSCM) is to enhance the efficiency of supply chains while simultaneously fostering environmental sustainability. This research examines the implementation of environmentally friendly practices by small and medium enterprises (SMEs), with a particular emphasis on aspects such as sustainable procurement, production processes, inventory management, distribution logistics, packaging solutions, and transportation methods. Data were gathered through surveys and interviews conducted with representatives from SMEs located in the Hosur region. The results indicate that, although a significant number of SMEs recognize the importance of GSCM, the actual implementation of such practices is constrained by limited resources, inadequate awareness, and insufficient support from policy frameworks. Notwithstanding these obstacles, numerous SMEs have adopted initiatives aimed at waste reduction, energy efficiency, and sustainable sourcing. The findings underscore that the integration of green strategies not only enhances environmental performance but also contributes positively to employee satisfaction, operational efficiency, and brand reputation. Nevertheless, a more widespread adoption of these practices necessitates proactive support from governmental entities and regulatory bodies. This study enhances the comprehension of GSCM within the context of SMEs and provides actionable recommendations for policymakers, practitioners, and researchers to promote sustainable development in the manufacturing sector, thereby serving as a valuable resource for advancing future improvements in sustainability practices among SMEs.
Keywords: *Green Supply Chain Management, Sustainability, Small and Medium Enterprises, Innovation, Employee Satisfaction, Performance, Manufacturing.*

INTRODUCTION:

Green Supply Chain Management (GSCM) represents an advancing paradigm that incorporates environmentally sustainable practices throughout all dimensions of supply chain operations. The primary objective of GSCM is the mitigation of environmental damage attributable to industrial activities and transportation, which are prominent sources of pollution and climate change. The integration of green practices in procurement, manufacturing, warehousing, packaging, logistics, and distribution is essential, thereby enabling enterprises to contribute to global sustainability goals. Fundamental strategies encompass recycling, material reuse, and waste minimization, thereby cultivating a more integrated and environmentally conscientious supply chain network. The rapid expansion of global manufacturing has underscored the imperative of addressing environmental and social issues within business operations. A structured framework is provided by GSCM to ensure compliance with environmental regulations while simultaneously enhancing operational efficiency. In light of the increasing environmental consciousness observed in recent years, there is a growing recognition among businesses of the necessity to align supply chain operations with environmental objectives. Waste management within the industrial ecosystem is emphasized by GSCM to conserve resources and diminish harmful emissions. As the escalation of environmental degradation and greenhouse gas emissions persists, a re-evaluation of supply chain strategies is being undertaken by companies to ensure resource conservation. This transition is supported by GSCM through practices such as green procurement, sustainable production, responsible distribution, reverse logistics, and environmentally friendly packaging and marketing. The aim of these practices is to curtail energy consumption, emissions, and hazardous waste. Research conducted by Hervani, Helms, and Sarkis (2005) and others substantiates that GSCM can significantly enhance profitability, competitiveness, and risk management by proactively addressing environmental challenges.

The origins of GSCM can be traced back to 1996, when the Manufacturers' Research Association at Michigan State University underscored the necessity for environmentally sustainable designs within

supply chains. Environmental management under GSCM initiates with the sourcing of raw materials and extends through all phases of production, with a focus on minimizing ecological impact. Scholars such as Fahimnia et al. (2015) and Pakurár et al. (2019) emphasize the significance of this comprehensive approach. The implementation of GSCM practices yields dual advantages—environmental protection and business benefits. By diminishing pollution and energy consumption, operational costs can be reduced, efficiency improved, and profitability increased. Furthermore, green transportation and distribution contribute positively to organizational performance. Researchers including Khan (2018) and Al-Sheyadi et al. (2019) assert that sustainable logistics are pivotal in contemporary supply chains. In a fiercely competitive global economy, environmental sustainability is emerging as a strategic imperative. Enterprises that effectively reduce their environmental footprint frequently attain a competitive edge through cost savings, enhanced brand reputation, and increased stakeholder trust. GSCM also serves as a protective measure against reputational harm associated with environmental negligence, as noted by Muma et al. (2014) and others. At its essence, GSCM seeks to minimize or eradicate various forms of waste—including hazardous substances, emissions, energy, and solid waste—across all stages of the supply chain. This encompasses product design, raw material procurement, manufacturing, distribution, and end-of-life disposal. The supply chain itself constitutes a complex network involving suppliers, manufacturers, distributors, retailers, and consumers. It encompasses both upstream and downstream activities, including the flow of goods, information, and finances. Traditional supply chain management is fortified by GSCM through the integration of sustainability into every phase, promoting environmental responsibility without compromising cost, quality, or productivity. Nevertheless, achieving a balance among these objectives remains a critical and ongoing challenge for contemporary businesses.

Green Supply Chain Management (GSCM) in Small and Medium Enterprises (SMEs)

Small and Medium Enterprises (SMEs) play a crucial role in the economy of India, contributing significantly to employment and national development. The impact of these enterprises extends beyond economic factors, influencing social and environmental dimensions as well. The adoption of sustainable practices within SMEs has the potential to yield extensive societal advantages, thereby further facilitating development. Despite their critical role, a considerable number of SMEs exhibit a lag in the implementation of environmentally sustainable operations, particularly in the areas of resource management and pollution mitigation. The predominant focus on profit often results in decisions that favour globalization over locally pertinent, sustainable approaches. In contrast to larger Indian corporations that have adopted Green Supply Chain Management (GSCM), a considerable number of SMEs exhibit reluctance in this regard. A primary factor contributing to this hesitance is the prevailing misconception that green initiatives impose significant financial burdens. Such reluctance may result in inefficient production processes, excessive waste generation, and environmental degradation. Nevertheless, an increasing awareness of environmental issues, coupled with pressure from larger clients, is gradually motivating SMEs to embrace GSCM practices. Compliance with these demands not only enhances their competitive edge but also fosters a heightened interest in comprehending the environmental advantages associated with sustainability. A study conducted in the Hosur region, which focused on SMEs supplying engineering components to larger firms, underscores the positive impact of GSCM adoption on both environmental and economic performance. For SMEs, the effective management of supply chains is becoming increasingly critical, particularly in addressing resource constraints within a globalized marketplace. Although technological advancements present new avenues for growth, SMEs continue to encounter obstacles such as limited operational scale, insufficient human resources, and a lack of awareness regarding environmental strategies. It is imperative to address these challenges to facilitate the broader integration of GSCM, thereby enabling SMEs to align economic success with environmental stewardship.

LITERATURE REVIEW

The existing body of literature concerning Green Supply Chain Management (GSCM) illustrates considerable advancements in the comprehension of environmental assessment within supply chains. A framework was proposed by Maria et al. (2012) that identifies essential dimensions for evaluating environmental performance. This framework was substantiated through a case study on reverse supply

chains, which underscored various measurement techniques and identified deficiencies at different managerial levels. The significance of integrating environmental considerations throughout the supply chain—from design to disposal—was emphasized by Novitasari et al. (2021), with the objective of minimizing waste, conserving energy, and reducing emissions. Supply chains have been characterized as collaborative networks by Tan et al. (2019) and Tseng et al. (2021), demonstrating that GSCM can enhance competitiveness, resource efficiency, and innovation (Çankaya & Sezen, 2019; Shang et al., 2010). GSCM has been advocated by Hassan et al. (2016) as a strategic approach for manufacturers to enhance environmental sustainability, decrease costs, access new markets, and improve relationships with suppliers. Gilbert (2001) noted that such practices have the potential to shape sustainable market trends and influence the behaviour of small and medium enterprises (SMEs). Nevertheless, challenges remain. Sarkis (2006) criticized "end-of-pipe" approaches that merely shift pollution rather than eliminate it, while Rao (2002) cautioned that inadequate supplier performance could adversely affect a firm's green reputation. An increase in attention to sustainability among SMEs has been observed by Bala Subramanyam (2007) as a means to compete on a global scale. Gurudas Nulkar (2013) asserted that the adoption of green practices can enhance the business performance of SMEs, advocating for a comprehensive integration of products and processes (Esty & Winston, 2006). Policymakers are increasingly turning to literature and surveys to promote such strategies.

Green innovations, propelled by market and regulatory pressures, are becoming increasingly prevalent within SMEs (van Hemel & Cramer, 2002). However, Kot (2018) noted that research focusing on sustainable supply chains within SMEs remains scarce. The work of Song (2017) highlighted that the implementation of green practices can bolster innovation and competitiveness by facilitating the development of eco-friendly products and strengthening supply chain relationships.

According to a survey conducted in South Korea, Su-Yol Lee (2008) found that buyer expectations, government support, and supplier readiness significantly influence SMEs' engagement in GSCM. In summary, the literature substantiates the assertion that green supply chain strategies can enhance the performance of SMEs by reducing costs, fostering innovation, and delivering sustainable, competitive products. This strategic transition not only fortifies their market position but also aligns them with evolving environmental expectations.

Green Sourcing and Procurement

Green sourcing and procurement encompass an environmentally responsible methodology for the acquisition of raw materials, with the objective of minimizing ecological damage and fostering sustainability. Traditional procurement processes typically involve the selection of vendors, the choice of materials, contract negotiations, inventory management, and the assurance of efficient delivery. In contrast, green procurement extends beyond these practices by assessing suppliers based on their environmental stewardship (Thoo Ai Chin et al., 2015), emphasizing the procurement of goods and services that are less harmful to both the environment and human health (Hokey Min & Galle, 2001).

Although small-scale suppliers play a crucial role in the supply chain, they frequently lack the environmental management protocols that are characteristic of larger corporations, thereby complicating the implementation of green procurement (Sarkis, 1995). Notwithstanding these obstacles, the adoption of green procurement practices has the potential to enhance environmental performance, diminish waste, and reduce costs. Furthermore, it promotes improved collaboration between businesses and suppliers, increases operational efficiency, and bolsters organizational reputation and competitiveness.

A fundamental tenet of green sourcing is encapsulated in the “3Rs”—reduce, reuse, and recycle—aimed at advancing sustainability. Global research identifies essential strategies for eco-friendly procurement, including the clear communication of environmental expectations to suppliers, collaborative efforts to achieve sustainability objectives, and the prioritization of products with minimal ecological impact (Chen, 2005).Green procurement necessitates responsible purchasing decisions that harmonize ecological and economic objectives. It aims to conserve resources, mitigate disposal and liability expenses, and enhance the public image of the organization (Stock, 1992). Zhu and Geng (2002) regarded green purchasing as a strategic instrument for improving business performance through cost reduction and the enhancement of brand reputation. Similarly, Martha and Houston (2010) emphasized that waste reduction should be a primary objective, with procurement departments concentrating on total value and effective waste

management. Ultimately, green sourcing entails the selection of environmentally friendly materials, the substitution of hazardous substances, the reduction of purchases of items that are difficult to dispose of, and the maximization of the utilization of recycled or recyclable products (Rao & Kondo, 2010). This approach not only supports environmental sustainability but also enables organizations to operate more efficiently and responsibly in a resource-constrained environment.

Green Manufacturing

Green manufacturing is recognized as a crucial component in the advancement of sustainability, achieved through the optimization of production systems that concurrently minimize energy consumption and resource utilization. The reduction of design complexity and the prevention of defects are emphasized, as these factors contribute to inefficiencies and exacerbate environmental impacts. The prioritization of energy conservation not only leads to a decrease in operational expenditures but also mitigates ecological risks. The identification of areas with high energy consumption facilitates targeted modifications in processes or product designs, which frequently results in substantial energy savings with minimal financial investment.Singh and Thakar (2018) assert that green manufacturing transcends the mere enhancement of environmental performance; it necessitates a comprehensive approach to sustainability. Nunes et al. (2010) characterize green manufacturing as the application of technologies and materials that diminish environmental harm while simultaneously improving energy efficiency and production effectiveness. This encompasses the incorporation of clean energy sources and innovative technologies.

The fundamental principles of green manufacturing include the utilization of environmentally benign inputs, the maximization of efficiency, and the minimization of waste and pollution. The implementation of these practices can yield cost reductions, enhanced resource utilization, safer working environments, and an improved brand reputation. Furthermore, remanufacturing, defined as the process of restoring used products to a condition that closely resembles their original state, promotes material reuse and prolongs product life cycles (Lund, 1984). In summary, the overarching objective of green manufacturing is to diminish ecological impact while preserving or enhancing production efficiency and economic viability.

Eco-Friendly Warehousing

The significance of eco-friendly warehousing has grown considerably for small and medium enterprises (SMEs) due to its environmental and economic advantages. The implementation of energy-efficient technologies, waste reduction strategies, and optimized resource utilization enables SMEs to achieve substantial reductions in carbon emissions and operational expenditures. Among the principal strategies employed are the utilization of renewable energy sources, the installation of LED lighting, and the enhancement of insulation, all of which contribute to decreased energy consumption and lower utility costs.Furthermore, sustainable warehousing practices assist SMEs in adhering to increasingly stringent environmental regulations, thereby mitigating the risk of incurring penalties while simultaneously improving public perception and brand reputation. These practices resonate with environmentally conscious consumers and business partners, thereby providing a competitive edge in the marketplace.

In addition, the adoption of green warehousing practices facilitates the streamlining of operations, enhances efficiency, and cultivates a more resilient supply chain. Long-term sustainability is supported through the integration of initiatives aimed at minimizing material usage, promoting recycling, and reducing waste generation.In summary, eco-friendly warehousing represents a contemporary approach that enables SMEs to align with sustainability objectives, decrease costs, and fortify their position within an increasingly environmentally aware business landscape.

Eco-Friendly Packaging

The significance of eco-friendly packaging is increasingly recognized among small and medium enterprises (SMEs) due to its environmental and economic advantages. The adoption of sustainable packaging materials enables SMEs to diminish waste, decrease carbon emissions, and reduce their overall ecological footprint. This transition not only aligns with global sustainability objectives but also resonates with environmentally conscious consumers, thereby enhancing brand reputation and fostering customer loyalty.In addition to its environmental benefits, green packaging presents financial incentives. The utilization of efficient or reusable materials has the potential to lower long-term expenses, enhance operational efficiency, and streamline supply chains. As environmental regulations become more

stringent, SMEs that proactively implement eco-friendly packaging can mitigate compliance risks and avert future penalties. This forward-thinking strategy illustrates a firm's dedication to sustainability while establishing a competitive advantage in the marketplace. Packaging waste is a major contributor to environmental degradation. Eco-friendly alternatives, which are frequently recyclable and pose fewer risks to human health, play a crucial role in addressing this challenge. The enhancement of packaging design minimizes the use of excess materials and promotes a more sustainable supply chain. Furthermore, the integration of sustainable materials facilitates more responsible methods of product delivery.

Ecolabels represent another essential aspect of green packaging, certifying products that exhibit a reduced environmental impact and ensuring compliance with environmental standards. These labels enhance transparency, guiding consumers toward eco-conscious purchasing choices and reinforcing trust in the products offered by SMEs.

Eco-Friendly Distribution and Transportation

The implementation of eco-friendly distribution and transportation practices is crucial for small and medium enterprises (SMEs) aiming to improve environmental sustainability and operational efficiency. Practices such as the utilization of energy-efficient or environmentally friendly vehicles, the optimization of delivery routes, and the minimization of packaging waste can lead to a substantial reduction in carbon emissions and operational costs for SMEs. These strategies not only decrease fuel consumption and maintenance costs but also provide enduring financial advantages while contributing to global sustainability objectives.Furthermore, the adoption of green distribution strategies enhances a company's reputation, thereby attracting customers who prioritize environmental consciousness and offering a competitive advantage. As environmental regulations become increasingly stringent, SMEs that proactively implement sustainable transportation solutions are better positioned to avoid penalties and demonstrate compliance, thereby reinforcing their standing in the market. Additionally, eco-friendly transportation contributes to the establishment of a more resilient and cost-effective supply chain. Critical decisions regarding the location of distribution centers, modes of transportation, and just-in-time practices significantly impact the sustainability of logistics. Al-Odeh and Smallwood (2012) highlight the importance of fuel types, infrastructure, and operational methodologies in advancing green transportation. The incorporation of renewable energy sources and clean vehicles serves to diminish environmental impact, rendering sustainable distribution a strategic imperative for contemporary SMEs.

FINDINGS AND RESULTS

A survey was meticulously crafted to encompass five factors influencing the green supply chain, targeting small and medium enterprises (SMEs) within the Hosur region. The objective was to evaluate their sustainability performance and advancements toward a more environmentally sustainable future. The questionnaire pertaining to green sourcing and procurement comprised five inquiries designed to assess the extent to which sourcing and procurement practices facilitate green initiatives.

Inquiries regarding green manufacturing were formulated to examine the internal aspects of the manufacturing system in relation to environmental considerations, consisting of five questions. Additionally, four questions focused on packaging practices were developed to evaluate their environmental sustainability. The warehousing segment included four questions aimed at investigating the utilization of natural resources and the reduction of inventory. Furthermore, four questions concerning green distribution and transportation were established to assess the adoption of environmentally friendly vehicles. The survey was administered through personal visits, resulting in responses from a total of 77 SMEs.

TABLE 1 Green Sourcing and Procurement

S.NO	Question	Yes	No
1	Are suppliers consistently mandated to employ eco-friendly packaging?	62	15
2	Are environmental policy directives established for suppliers by your organization preference accorded to the utilization of recycled materials in procurement?	58	19
3	Is environmental protection being advanced through the close collaboration of suppliers by your organization?	53	24

4	Are electronic means being employed to diminish paper consumption in procurement and enhance efficiency?	56	21
5	Is preference accorded to the utilization of recycled materials in procurement?	45	32

Table 1 illustrates the responses obtained from small and medium enterprises (SMEs) regarding green sourcing and procurement practices. A significant majority, comprising 62 out of 77 respondents, affirmed that suppliers are mandated to utilize environmentally friendly packaging. Furthermore, 58 participants indicated that their organizations have established environmental policy directives for suppliers. Collaboration with suppliers to foster environmental protection was reported by 53 SMEs. Additionally, 56 respondents indicated the use of electronic methods to minimize paper consumption and enhance operational efficiency. In contrast, only 45 respondents expressed a preference for recycled materials in procurement, while 32 did not. Collectively, the data indicates a favourable trend toward sustainable procurement; however, the integration of recycled materials appears to be less consistent in comparison to other practices.

TABLE 2 Green Manufacturing

S.NO	Question	Very low	Low	Medium	High	Very high
1	How much attention is given by your organization to the reduction of waste in manufacturing processes?	1%	22%	30%	37%	10%
2	What proportion of the organization's operations are dependent on natural resources materials?	18%	30%	38%	12%	2%
3	What level of importance is given by your organization to the reduction of toxic and hazardous materials in manufacturing processes?	3%	8%	46%	32%	11%
4	To what extent is recycled water utilized by your organization?	2%	22%	26%	36%	14%
5	To what extent are renewable energy resources incorporated by your organization?	12%	24%	44%	12%	8%

Table 2 illustrates the responses of small and medium-sized enterprises (SMEs) regarding their engagement with green manufacturing practices. A considerable emphasis is placed on waste reduction, with 47% of participants categorizing this priority as high or very high. Although 50% of operations exhibit a moderate to high reliance on natural resources, only 14% indicate a very high level of dependence. The reduction of toxic materials is identified as a medium to high priority by 89% of the respondents. The utilization of recycled water is noteworthy, as 50% report high or very high levels of adoption. In contrast, only 20% indicate extensive use of renewable energy sources, which implies potential for further development in this area. In summary, a moderate to strong commitment to green manufacturing is evident among SMEs, particularly in the domains of waste management and water conservation.

TABLE 3 Green Warehousing

S.NO	Question	Yes	No
1	Are solar panels or eco-conscious roofing integrated to diminish energy usage?	22	55
2	Are there enhanced alternatives for lighting and ventilation accessible?	73	4
3	Are reusable receptacles or storage resolutions utilized?	54	23
4	Is there a plan in effect to diminish inventory and enhance product administration?	65	12

Table 3 presents an overview of practices related to green warehousing among small and medium enterprises (SMEs). It is noteworthy that only 22 out of 77 respondents indicated the utilization of solar panels or environmentally sustainable roofing materials. In contrast, a significant majority, comprising 73 respondents, reported the implementation of enhanced lighting and ventilation systems. The adoption of reusable storage solutions was noted among 54 SMEs, reflecting a moderate transition towards sustainable storage practices. Furthermore, 65 respondents have established strategies aimed at reducing inventory levels and enhancing product management. Collectively, the data indicates substantial

initiatives in the realms of energy-efficient infrastructure and inventory optimization; however, the uptake of renewable energy technologies, such as solar roofing, remains constrained within the surveyed SMEs.

TABLE 4 Green Packaging

S.NO	Question	Never	Almost never	Occasionally	Almost every time	Every time
1	Is sustainable packaging primarily perceived as an economic consideration by you?	4%	14%	42%	5%	35%
2	Are environmentally conscious disposal practices encouraged through your packaging?	14%	16%	44%	17%	9%
3	Is there active engagement within your company in collaborating closely with suppliers to reduce the utilization of packaging materials?	3%	6%	53%	4%	34%
4	How often is the advocacy for the utilization of recyclable packaging materials expressed by you?	2%	26%	47%	7%	18%

Table 4 presents the practices of small and medium enterprises (SMEs) concerning environmentally sustainable packaging. A significant 77% of respondents regard sustainable packaging as an economic consideration at least on an occasional basis, with 35% affirming this perspective consistently. Environmentally responsible disposal practices are encouraged by 70% of respondents at least occasionally; however, only 9% adhere to these practices consistently. Collaboration with suppliers aimed at minimizing packaging usage is reported by 91% of respondents on an occasional basis or more frequently, including 34% who engage in such collaboration consistently. Advocacy for recyclable materials is observed at least occasionally among 72% of SMEs. Collectively, the data suggests a moderate level of adoption of green packaging practices, characterized by a greater degree of collaboration with suppliers compared to internal advocacy or disposal initiatives.

TABLE 5 Green Distribution and Transportation

S.NO	Question	Very low	Low	Medium	High	Very high
1	Are the transportation routes optimized for efficiency within your organization?	7%	22%	32%	32%	7%
2	To what degree are advanced propulsion technologies, such as hybrid vehicles, and electric cars etc.,	4%	15%	54%	18%	9%
3	How often is the regular maintenance of vehicles ensured at a service station?	3%	19%	45%	29%	4%
4	What is the extent of usage of fuel efficient vehicles for transportation?	3%	19%	32%	43%	3%

Table 5 illustrates the responses of small and medium-sized enterprises (SMEs) regarding their practices in green distribution and transportation. A medium to high rating for route optimization was assigned by 71% of the respondents, indicating a significant emphasis on operational efficiency. The adoption of advanced propulsion technologies, such as electric or hybrid vehicles, is characterized as moderate, with 54% of participants reporting medium usage and only 27% indicating high or very high levels of utilization. Regular maintenance of vehicles is frequently conducted, with 74% of SMEs engaging in this practice at medium to high frequencies. Furthermore, 46% of SMEs utilize fuel-efficient vehicles at high or very high levels. In summary, a commitment to sustainable transportation is evident among SMEs, particularly in the areas of maintenance and route optimization.

CONCLUSION:

This study underscores the critical significance of Green Supply Chain Management (GSCM) in promoting environmental sustainability within small and medium enterprises (SMEs). Despite a recognized awareness of environmentally sustainable practices, the extensive implementation of such practices is hindered by financial, informational, and institutional barriers. Nevertheless, initiatives aimed at waste reduction and sustainable sourcing demonstrate the potential of SMEs to generate considerable environmental advantages. The necessity for specific policy interventions, enhancement of capacities, and collaboration among various stakeholders is highlighted to enable wider adoption of GSCM. By incorporating GSCM, SMEs are presented with the opportunity to not only reduce their ecological footprint but also to enhance operational efficiency and competitiveness, thereby contributing significantly to sustainable industrial development in their respective regions.

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