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Sustainable Supply Chain Management in SMEs: Analyzing Drivers and Barriers to Green Practices in Nagpur

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Focussing on the main drivers and obstacles impacting green practices, this research investigates the adoption of Sustainable Supply Chain Management (SSCM) performs among SMEs in the Nagpur area. In the face of growing environmental concerns on a worldwide scale, small and medium-sized enterprises (SMEs) are vital to sustainability movement. But establishing green supply chain programs isn't always easy for these businesses. Finding and analysing the variables that help or hurt SSCM adoption in SMEs in Nagpur is the main goal of this study. The research finds that regulatory compliance, consumer demand, and cost savings are the main drivers of green practices. It achieves this using a mixed-methods methodology, which includes surveys and in-depth interviews with SME managers and industry experts. Limitations in access to green technology, high implementation costs, and a lack of technical knowledge are obstacles. The results help in building a specialised model that may benefit small and medium-sized enterprises (SMEs) overwhelmed encounters and make the most of opportunities to integrate sustainable practices into their source chains. In order to help SMEs achieve sustainable development and improve their competitive edge, the research highlights the need of industry cooperation and targeted governmental initiatives.

Keywords: Sustainability, Environmental Management, Supply Chain Framework, Green Technologies, Policy Interventions.

1. Introduction

Rising environmental consciousness, legal demands, and changing customer tastes have all contributed to a sustainability movement in the corporate world in recent years. For businesses that care about the environment and want to keep making money, Sustainable Supply Chain Management (SSCM) is a must-have tactic. Small and Medium Enterprises (SMEs) have distinct obstacles in embracing SSCM owing to their restricted resources, lack of technical

knowledge, and accessibility to sustainable technology, in contrast to giant organisations that have accomplished great gains in executing green practices.

In many countries, including India's, small and medium-sized enterprises (SMEs) play an vital role in pouring financial development, creating jobs, and fostering innovation and regional development. The Nagpur area shares the reputation of having a broad industrial base. But small and medium-sized enterprises (SMEs) in such area have hard time incorporating sustainability into their supply chain processes, even if they are economically important. The complicated interaction of motivations and constraints that impact their capacity to embrace environmentally friendly behaviours is a major factor in this.

This investigation purposes to examine the influences that effect and hinder small and medium-sized enterprises (SMEs) in the Nagpur area from implementing supply chain management methods. The research's overarching goal is to provide a customised framework that may help SMEs overcome obstacles and take advantage of opportunities to integrate sustainable practices into their supply chains by gaining a healthier knowledge of these aspects. The findings of this research add to what is already known about supply chain sustainability management (SSCM) and may be used by policymakers, industry stakeholders, and managers of small and medium-sized enterprises (SMEs) to make their operations more sustainable.

This paper's introduction defines SSCM and its relevance to small and medium-sized enterprises (SMEs), with a emphasis on the Nagpur area. It lays the groundwork for a thorough examination of the elements that promote or discourage the implementation of environmentally friendly practices, drawing attention to the need for focused interventions to assist SMEs on their path to sustainability.

2. Literature review

Businesses across the globe are increasingly interested in Sustainable Supply Chain Management (SSCM) as a way to strike a balance between economic performance and social and environmental responsibility. With an emphasis on SSCM within the setting of Small and Medium Enterprises (SMEs), this literature review compiles important results from studies carried out between 2019 and 2024.

New research highlights the importance of regulatory requirements as a motivator for small and medium-sized enterprises (SMEs) to device sustainable practices. For example, Yadav et al. (2020) brought attention to the growing influence of environmental laws and government regulations in encouraging SMEs to adopt more sustainable supply chains. They state that small and medium-sized enterprises (SMEs) are forced to reevaluate their supply chain activities due to strict restrictions, such those pertaining to waste management and carbon emissions.

Sustainable product demand from consumers has also been a strong driver. Small and medium-sized enterprises (SMEs) are more likely to assimilate sustainability into their supply chains when consumers are aware of and choose environmentally friendly goods, according to Khan, Hussain, and Khan (2021). Dey et al. (2022) adds weight to the argument by arguing that small and medium-sized enterprises (SMEs) are becoming more and more dependent on their

capacity to satisfy the altering expectations of customers in instruction to continue competitive in the market.

Budgetary considerations are another important engine. Green technology and practices may have a large initial investment, but they can save money in the long run due to lower energy usage and waste (Sarkis, Zhu, and Lai, 2019). Supporting this view is research by Sharma and Agarwal (2023) showing that small and medium-sized enterprises (SMEs) who use SSCM methods often see a decrease in production costs and an increase in operational efficiency.

Despite these motivators, SSCM adoption is still a major challenge for SMEs. A common complaint is the hefty price tag associated with making changes. Small and medium-sized enterprises (SMEs) often have financial constraints, which hinder their capacity to invest in sustainable technology and processes (Mitra and Datta, 2020). Because no outside sources of money or incentives are available, this financial limitation is already rather severe.

Another big obstacle is the absence of technical knowledge. Many SMEs may not have the expertise to properly use SSCM processes, according to Alam and Kabir (2021). Not only does this knowledge gap reduce supply chain efficiency, but it also slows down the adoption of environmentally friendly technology.

Another major obstacle is the reluctance to change inside organisations. The study directed by Ahmed et al. (2022) revealed that small and medium-sized enterprises (SMEs) often show resistance when it comes to adopting more sustainable supply chain methods. This resistance stems from concerns about upsetting established procedures and the unpredictability of investment returns.

Additional potential and problems are brought to light by research that is particular to the Indian setting, and more especially to locations like Nagpur. According to Kumar and Singh's (2020) research, SSCM acceptance varies greatly throughout India's regions. For example, small and medium-sized enterprises (SMEs) in cities have easier access to resources and infrastructure, making them more likely to embrace green practices. But those in less developed areas, like Nagpur, have it worse when it comes to logistical and infrastructure issues.

Recent research, however, also suggests that government backing and local efforts might be vital in overcoming these obstacles. Singh and Bansal (2023) stress the need of Nagpur-specific regional policies and assistance programs for small and medium-sized enterprises (SMEs). Facilitating the adoption of SSCM practices is their goal, and they propose targeted interventions like capacity-building programs and subsidies for green technology to achieve this.

Several scholars have put up frameworks to help SMEs implement SSCM techniques, in light of the difficulties highlighted in the literature. Patel and Desai's (2019) model provides a framework for small and medium-sized enterprises (SMEs) to adopt sustainable supply chains via the use of gradual modifications and stakeholder participation. To achieve long-term success, this model stresses the need for providers, consumers, and government agencies to work together.

An integrated approach that merges technical innovation with organisational change management was recently presented by Gupta and Verma (2024). Their methodology proposes

that small and medium-sized enterprises (SMEs) may conquer technical and financial obstacles by implementing SSCM in stages, backed by ongoing learning and adaptation.

There is a complicated interaction between drivers and impediments that affect SSCM practice adoption in SMEs, as is shown in the research from 2019 forward. Although there are strong incentives like customer demand, cost reductions, and regulatory constraints, there are also obstacles like aversion to change, expensive implementation costs, and a lack of knowledge. Furthermore, the study stresses the need of developing frameworks tailored to individual regions in order to help SMEs in places like Nagpur overcome the particular obstacles they encounter. These frameworks should be further refined in future research, and the function of regional policies in encouraging SMEs to adopt sustainable supply chain practices should be investigated.

3. Objectives of the study

- To identify and analyze the key drivers that motivate Small and Medium Enterprises (SMEs) in the Nagpur region to adopt Sustainable Supply Chain Management (SSCM) practices.
- To examine the barriers and challenges faced by SMEs in implementing SSCM practices within their supply chains in the Nagpur region.
- To develop a conceptual framework that addresses the specific drivers and barriers, providing practical guidance for SMEs in the Nagpur region to effectively integrate sustainability into their supply chain operations.

4. Hypothesis of the study

H_0 (Null Hypothesis): There are no significant barriers and challenges faced by SMEs in the Nagpur region in implementing Sustainable Supply Chain Management (SSCM) practices.

H_1 (Alternative Hypothesis): SMEs in the Nagpur region face significant barriers and challenges in implementing Sustainable Supply Chain Management (SSCM) practices.

5. Research methodology

Using a mixed-methods strategy, this research delves deeply into the factors that encourage and discourage SMEs in the Nagpur area to use Sustainable Supply Chain Management (SSCM) practices. The study starts with a quantitative survey that aims to collect information from a large number of local SME owners and managers. In order to gauge the importance of different drivers—like regulatory pressure, customer demand, and cost savings—and obstacles—like high implementation costs, a lack of technical knowledge, and organisational reluctance to change—the survey employs Likert scale-based questions. In order to find patterns and correlations among the variables, the survey data will be examined using statistical methods including regression analysis and descriptive statistics.

The study's quantitative results are supplemented by qualitative research that is based on in-depth interviews with a selection of managers and specialists in the SME sector. In order to get a more nuanced picture of the obstacles encountered by SMEs, these interviews will seek to provide deeper insights into the particular difficulties and possibilities associated with SSCM implementation in the Nagpur area. The purpose of the thematic analysis is to find patterns and themes in the qualitative data.

The research will provide a conceptual framework that is unique to the requirements of SMEs in the Nagpur area based on the results of both the quantitative and qualitative assessments. In order to increase the uptake of SSCM practices, this framework will provide actionable advice for removing the highlighted obstacles and capitalising on important motivators. The study's findings and suggestions are well-grounded since the mixed-methods approach covers a wide range of issues impacting SSCM in SMEs.

6. Data analysis and discussion

Table 1: Descriptive Analysis of 75 SMEs

Attribute	Category	Frequency	Percentage (%)
Company Size	Small	45	60.0
	Medium	30	40.0
Industry Sector	Manufacturing	25	33.3
	Retail	20	26.7
	Service	15	20.0
	Logistics	10	13.3
	Others	5	6.7
Annual Revenue	Less than ₹1 crore	20	26.7
	₹1-5 crores	30	40.0
	₹5-10 crores	15	20.0
	More than ₹10 crores	10	13.3
Number of Employees	Less than 50	35	46.7
	50-100	25	33.3
	101-250	10	13.3
	More than 250	5	6.7
Level of SSCM Adoption	High	10	13.3
	Moderate	25	33.3
	Low	40	53.3

Descriptive study of the 75 SMEs sheds light on their traits and the extent to which they have used SSCM strategies.

Business Size: 60% of the sample consists of small businesses, while 40% are medium-sized businesses. In order to comprehend the impact of business size on SSCM adoption, it is crucial to know that this distribution shows that the study covers a wide range of SME sizes.

The manufacturing sector is home to the most numerous small and medium-sized enterprises (SMEs), making up 33.3% of the total sample. On the other hand, we have the retail sector at 26.7%, the service sector at 20.0%, logistics at 13.3%, and other sectors at 6.7%. It is reasonable to assume that the manufacturing and retail industries are major players in SSCM because of the magnitude of their supply chain activities and the damage they do to the environment.

Revenue Distribution: Among SMEs, 40% earn between ₹1–5 crores per year, while 26.7% earn less than ₹1 crore. Among SMEs, a lesser number have sales falling between the range of ₹5-10 crores (20.0%) or over ₹10 crores (13.3%). Small and medium-sized enterprises (SMEs) with larger income may have more resources for sustainable projects, reflecting their diverse capacity to engage in supply chain sustainability management (SSCM) strategies.

Staffing Level: The majority of SMEs are smaller businesses, with almost half of them (46.7% to be exact) employing less than 50 people. Among the remaining SMEs, there is a distribution as follows: 33.3% have between 50 and 100 workers, 13.3% have between 101 and 250 employees, and 6.7% have more than 250 employees. The capacity to efficiently execute and oversee SSCM activities may be affected by the size of the workforce.

Research demonstrates that most small and medium-sized enterprises (SMEs) are still in the early phases of incorporating sustainable practices into their supply chains, as 53.3% of SSCMs have a low degree of adoption. While 13.3% of SMEs have used SSCM at a high level, 33.3% have adopted it at a moderate level. There is a huge window of opportunity for growth and assistance in embracing sustainable practices that this distribution brings to light.

The data paints a detailed picture of the small and medium-sized enterprises (SMEs) in the Nagpur area, revealing differences in terms of industry, revenue, number of employees, firm size, and SSCM use. These findings are vital for promoting and supporting the adoption of SSCM practices among SMEs via the development of focused initiatives.

Hypothesis testing

Table 2: Factor Analysis of Barriers to SSCM Implementation in SMEs

Factor	Item	Factor Loading
Factor 1: Financial Constraints	High costs of implementing SSCM practices	0.78
	Limited financial resources	0.73
	Return on investment concerns	0.71
Factor 2: Technical Challenges	Lack of technical expertise	0.82
	Inadequate technology and tools	0.77
	Complexity of SSCM systems	0.74
Factor 3: Organizational Resistance	Resistance to change from employees	0.79
	Lack of management support	0.76
	Insufficient training programs	0.72
Factor 4: Regulatory and Compliance Issues	Unclear regulations on SSCM practices	0.70
	High cost of compliance	0.68
	Frequent changes in regulations	0.65

Based on the results of the factor analysis, there are four main considerations that SMEs in the Nagpur area consider when deciding whether or not to implement Sustainable Supply Chain Management (SSCM).

First, there are financial constraints, which include things like the high expenses of SSCM practice implementation, a lack of available funds, and worries about the return on investment. Overall, these items have factor loadings between 0.71 and 0.78, which means that monetary concerns pose a significant barrier for SMEs. This means that the upfront and continuing expenses of implementing SSCM processes are seen as too high.

Issues with technical knowledge, technology, and the intricacy of SSCM systems are brought to light in Factor 2: Technical Challenges. It is clear that technological issues are a major barrier to SSCM implementation, since these items have high factor loadings (0.74 to 0.82). The adoption of SSCM techniques might be challenging for SMEs due to their limited technology resources and lack of specialised skills.

Factor 3: Organisational Resistance includes internal obstacles such staff reluctance to change, unwavering backing from management, and inadequate training programs. Organisational dynamics and change resistance are significant obstacles, as shown by factor loadings ranging from 0.72 to 0.79. Management buy-in and a supportive company culture are just as important as financial and technical resources when it comes to implementing SSCM successfully.

Fourthly, there are regulatory and compliance issues, which deal with obstacles including ambiguous rules, expensive compliance expenses, and frequent rule revisions. These problems show that regulatory uncertainty and compliance costs are major worries, with factor loadings between 0.65 and 0.70. In their pursuit of SSCM best practices, SMEs may encounter obstacles caused by the difficulty they have in understanding and complying with ever-changing legislation.

As a whole, the factor analysis shows that SSCM adoption in SMEs is hindered by regulatory concerns, organisational opposition, budgetary limits, and technological obstacles. Gaining a grasp of these elements helps in formulating focused plans to overcome these obstacles and promote the implementation of sustainable practices in supply chains.

7. Conclusion

The obstacles and problems encountered by small and medium-sized enterprises (SMEs) in the Nagpur area while trying to apply SSCM techniques are thoroughly examined in this research. According to the results, there are four main areas where SMEs face big problems: money, technology, organisational pushback, and rules and regulations. Many small and medium-sized enterprises (SMEs) are hesitant to participate in supply chain sustainability management (SSCM) practices due to financial limitations, such as high implementation costs and inadequate resources. Adoption is already a difficult process, and technical obstacles like insufficient knowledge or tools just make things worse. There are also substantial obstacles caused by organisational resistance, which manifests as staff hesitation and inadequate management backing. The high compliance expenses and ambiguous rules further impede the efficient deployment of SSCM. Financial backing, technical help, organisational change management, and more transparent regulatory standards are all necessary to overcome these

obstacles. By resolving these issues, small and medium-sized enterprises (SMEs) in Nagpur will be better able to incorporate sustainable practices into their supply chains, leading to broader economic and environmental advantages.

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