A Study on Operational Barriers and Their Effect on Sustainability in Textile SME's

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Abstract- This research examines how operational challenges affect the sustainability efforts of small and medium-sized textile enterprises. Many textile SMEs encounter difficulties in implementing environmental and social initiatives due to insufficient access to green technologies, financial resources, and managerial expertise. To identify key operational challenges and evaluate their effect on sustainability outcomes, we conducted a survey of Indian textile SMEs and analyzed related literature. Our findings indicate that the implementation of sustainable practices is significantly hindered by technological and financial limitations, while organizational factors such as awareness and training also play a crucial role. We include tables that summarize survey results and regression analyses to illustrate these relationships. Based on our findings, we offer targeted recommendations to help textile SMEs navigate challenges and improve their environmental performance, including financial support, technology transfer initiatives, and capacity development programs. By focusing on the resource-limited SME sector, this study addresses a critical gap and provides valuable insights for managers and policymakers.

Keywords: Textile Small and Medium-sized Enterprises, Environmental Sustainability, Operational Challenges, Financial Limitations, Technological Barriers, Sustainable Growth.

I. INTRODUCTION

In various countries, the textile industry serves as a key source of employment and a driving force for the economy; however, it also significantly affects the environment. Small and medium-sized enterprises (SMEs) are essential for promoting industrial development, innovation, and job creation within the global manufacturing landscape. Indian textile SMEs, in particular, make a notable contribution to economic performance, even in the face of severe cost pressures and competition. Nevertheless, finding a balance between sustainability and cost efficiency proves to be quite difficult. Surya et al. (2025) assert that "the textile sector significantly contributes to

environmental degradation" and underline the necessity of effective supply chain management to comply with sustainability standards. Despite increasing awareness about sustainable development, many textile SMEs struggle to invest in environmentally friendly technologies. A recent review points out that textile SMEs "often lack access to green technologies, sufficient capital, and the managerial knowledge required to implement sustainable practices." Consequently, training and policy initiatives will be ineffective unless these operational challenges are tackled.

This study examines the operational barriers that impede sustainable practices in textile SMEs through a systematic analysis. We start by exploring existing research on obstacles to sustainability in textile firms and SMEs. Following that, we pinpoint specific gaps in the literature and establish objectives to direct our research. Our methodology incorporates secondary data along with a structured survey aimed at SME managers. Ultimately, we present data analysis and tables illustrating the effect of each barrier on sustainability outcomes. The goal is to create concrete, empirically-supported recommendations for enhancing sustainable practices in textile SMEs.

II. REVIEW OF LITERATURE

The academic community has long recognized the technical, financial, and managerial aspects related to sustainable manufacturing. Research focusing on "sustainability-driven manufacturing" has primarily targeted textile production due to its significant environmental impacts, including pollution and water consumption. Studies on major textile corporations often highlight the role of cleaner technologies and advanced process controls. Nevertheless, findings indicate that small and medium-sized enterprises (SMEs) continue to encounter persistent challenges. A systematic review by Alayón et al. (2022)

categorizes two primary obstacles for manufacturing SMEs: organizational limitations and financial restrictions. Likewise, Purvis et al. (2018) stress that operational strategies need to integrate both the social and environmental dimensions of sustainability. Observations by researchers suggest that a lack of capital and expertise often hinders technical advancements in textile SMEs, such as the implementation of efficient looms or water recycling systems . Human-related challenges include resistance to change and insufficient managerial awareness.

The performance of SMEs has been analyzed through theoretical frameworks like Lean Management and Socio-Technical Systems (STS). Surya et al. (2025) found that integrating STS theory with performance models reveals that consistent quality management, employee well-being, and reliability in delivery all contribute to enhancing both sustainability and productivity. Other literature emphasizes the importance of collaboration in supply chains. For instance, Kazancoglu et al. (2020) propose a "circular supply chain" model to overcome challenges within the textile sector, such as involving suppliers in environmentally friendly practices. However, there exists a gap concerning grassroots operations in SMEs, as most research focuses on larger corporations or global networks. In summary, previous studies highlight effective strategies (like green technology, workforce training, and lean practices), yet they also indicate that SMEs with limited resources struggle to implement these strategies without external assistance . This review illustrates that although financial, technological, and human capacity-related operational challenges are frequently cited, the interconnected impact of these factors on the sustainability outcomes for SMEs remains poorly understood.

III.   RESEARCH GAP

Although numerous studies address sustainability, very few examine small textile companies operating in practical environments. Most articles emphasize large-scale supply-chain strategies or theoretical technologies. There is a scarcity of empirical evidence concerning how various limitations faced by micro-operations—like restricted budgets, outdated practices, and skills gaps among workers—lead to inadequate sustainability metrics. In particular, the existing literature lacks comprehensive analyses that connect different operational challenges (financial, technical, and managerial) to sustainability performance indicators in SMEs. Furthermore, Surya et al. highlight that earlier research "mainly focuses on large companies or isolated factors" while neglecting the interactions among social, quality, and delivery aspects that influence operational results in resource-constrained SMEs. By focusing on the less-explored context of textile SMEs and assessing the impact of various limitations on sustainability indicators, our research addresses these gaps.

IV.   OBJECTIVES

The research aims to assess the current sustainability practices and performance metrics within textile SMEs. By analyzing survey responses, we will document the eco-efficiency initiatives, waste reduction strategies, and energy conservation measures currently implemented.
- Our objective is to pinpoint the primary operational challenges (such as financial, technical, and managerial issues) that impede the adoption of sustainable practices.
- We will investigate the relationship between sustainability outcomes and operational challenges by utilizing statistical methods.
- Our intention is to provide targeted recommendations and strategies, to aid textile SMEs in overcoming challenges and improving their sustainability performance.
Each objective addresses the identified research gap and aligns with the real-world needs of SME stakeholders.

V.   RESEARCH METHODOLOGY

This research employs a mixed-methods framework, combining secondary sources and primary survey information. Data collection involved distributing a structured questionnaire to managers and owners of textile SMEs in Andhra Pradesh, including Guntur and Vijayawada. The survey gathered information on (a) existing sustainability practices, (b) perceived importance of various operational challenges, and (c) fundamental characteristics of the firms (size, age, product type). A total of fifty SMEs participated, with 50% engaged in weaving, 30% in clothing, and 20% in hosiery. For sampling, we utilized convenience sampling through local networks and industry associations to access this specialized population.

This method ensured a diverse representation of SME types, albeit not in a completely random manner.

Instruments: The questionnaire included Likert-scale items (1–5) to measure agreement with assertions about challenges, such as "Limited capital is a major barrier to our sustainable practices." Proxies like progress in resource efficiency, recycling rates, and the launch of new green initiatives were utilized to assess sustainability performance. Additionally, we collected qualitative insights regarding challenges faced. The primary data was complemented by secondary sources, including government documents and industry analyses.

For analysis: In summarizing procedures and constraints, we applied descriptive statistics. We conducted multiple regression and correlation analyses to explore the relationships between sustainability outcomes and obstacles. For example, we employed variables representing each barrier to regress a composite sustainability score. To ensure the internal consistency of the survey scales, we also conducted reliability tests (Cronbach's alpha). All analyses were performed using Excel and SPSS. Reflecting methods utilized in previous research, this methodology ensures we capture both the frequency of challenges and their statistical influence on SME sustainability.

VI. DATA ANALYSIS AND FINDINGS

The results of the survey indicate clear patterns in how operational challenges influence sustainability. Table 1 illustrates the composition of the sample of SMEs. The majority of these businesses have 20 to 50 employees and have been operating for over a decade. Despite more than 70% indicating they engage in basic sustainability practices (like waste segregation and energy audits), only 20% have invested in advanced green technology.

Primary Barriers: Respondents rated technological deficiencies (outdated machinery) and financial limitations (lack of funding/credit) as the most significant obstacles, with average scores of 4.5 and 4.2 out of 5, respectively. Following these, shortages of skilled personnel and managerial knowledge received scores of approximately 4.0 . In open-ended comments, many managers noted that pursuing sustainability innovations is difficult due to insufficient funding and access to modern machinery. One SME owner remarked, "We know what improvements to make, but cannot afford the new equipment."

Statistical Connections: We computed correlations between the overall sustainability score (an aggregation of eco-efficiency and compliance metrics) and each category of barriers. Financial obstacles were found to be strongly negatively correlated with sustainability ($r = -0.65$, $p < 0.01$), as were technological challenges ($r = -0.58$, $p < 0.05$). The influence of managerial awareness was moderate ($r = -0.42$, $p < 0.05$). Regression analysis indicates that financial limitations are the strongest predictor (Table 3). Even when accounting for the size and age of the firm, an increase of one unit in perceived financial constraint correlates with a notable decrease ($\beta = -0.48$, $p < 0.01$) in sustainability scores. Other significant predictors include awareness ($\beta = -0.20$, $p < 0.05$) and technological challenges ($\beta = -0.30$, $p < 0.05$).

These findings align with prior research that identifies "lack of finance and education as primary barriers" to sustainability efforts among SMEs . Conversely, our sample did not show statistically significant impacts from factors such as market pressure or government assistance, possibly due to the lesser presence of these external supports in the regions studied. Overall, the data corroborate theories from previous research, affirming that operational barriers significantly affect sustainable practices among textile SMEs .

Tables

Table 1: Features of Textile SMEs Surveyed (N = 50)

Attribute	Category	Number of Firms	Percentage (%)
Firm Age (years)	<5	5	10%
	5–10	10	20%
	>10	35	70%
Employee Count	<20	15	30%

Attribute	Category	Number of Firms	Percentage (%)
	20–50	25	50%
	>50	10	20%
Main Product	Textile Weaving	25	50%
	Apparel	15	30%
	Hosiery	10	20%
Sustainability Practices	Any formal program	20	40%
(Self-reported)	ISO 14001 or equivalent	8	16%
	Waste recycling initiatives	35	70%

Note: The demographics of the sample and the practices reported are outlined in Table 1..

Table 2: Average Operational Barrier Rating (1 = Low, 5 = High)

Barrier Category	Mean Score	Standard Deviation
Financial Constraints	4.5	0.6
Technological Limitations	4.2	0.7
Managerial Awareness	4.0	0.8
Skilled Workforce Shortage	3.8	0.9
Regulatory Complexity	3.5	1.0
Market/Customer Pressure	3.0	1.1

Note: Higher scores suggest a greater perception of barriers.

Table 3: Standardized Coefficients for Regression of Sustainability Score on Operational Barriers

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Note: The Sustainability Score reflects the overall evaluation of resource consumption and environmental efficiency.Tables 2 and 3 clearly indicate that financial limitations are the primary challenge to achieving sustainability. This numerical data corroborates qualitative feedback: the most frequently cited reason by managers for not pursuing eco-investments was insufficient funding. The statistical evaluation further reveals that, while issues related to skills and training exist, their influence is comparatively minor. Our results reinforce the assertion that "operational restrictions significantly influence the adoption of sustainability practices" within the framework of existing literature.

VII. RECOMMENDATIONS

Given these findings, we propose several strategies to help textile SMEs navigate challenges:
Financial Assistance and Incentives: Legislators and trade associations should offer low-interest loans or grants aimed at sustainability improvements (e.g., cleaner machinery, energy-efficient tools). By creating financial products tailored to the needs of SMEs, the primary barrier can be directly tackled. Tax incentives for eco-friendly investments and subsidies for green technologies would further promote innovation adoption.

Technology Sharing and Training: Establish partnerships between SMEs and larger manufacturers or technical institutions to facilitate the exchange of sustainable technologies. Increasing awareness among managers and employees can be achieved through workshops and extension initiatives. SMEs can improve their operations without making substantial financial commitments by utilizing training modules focused on lean practices and resource efficiency. For instance, even small investments in waste recycling machinery (supported by government initiatives) could deliver significant environmental advantages at a minimal cost.

Collaborative Networks: Motivate SMEs to form cooperatives or clusters that consolidate resources, such as textile parks or innovation hubs. Shared facilities, like common effluent treatment plants, can help lower expenses. Furthermore, cluster associations can negotiate for lower prices on eco-friendly equipment in bulk. These networks could also facilitate the exchange of information regarding sustainable innovations.

Regulatory and Institutional Assistance: Streamline compliance procedures and provide clear guidelines to small enterprises on environmental regulations. Establish single-point support centers to help SMEs navigate grants, certifications, and reporting obligations. Government bodies and business associations should conduct regular awareness campaigns about sustainability best practices, ensuring that information reaches rural SME operators as well.

Monitoring and Ongoing Enhancement: SMEs ought to integrate basic monitoring of resource usage (such as tracking energy and water usage) into their regular management practices. Opportunities for enhancements can be identified through routine assessments. Encouraging SMEs to set gradual sustainability goals rather than comprehensive ones can make progress more achievable. Local organizations can provide affordable tools, like waste and energy audits.

These initiatives aim to alleviate the specific operational challenges identified in this research by combining financial support with collaboration and skill-building. Programs such as training courses (for example, through MSME Development Institutes) or subsidized green loans could have a direct impact on

the issues reported by SMEs. For example, with even a small amount of funding for dyeing equipment upgrades, SMEs could achieve a "quick win" for sustainability by significantly diminishing water consumption and wastewater output. Each recommendation addresses a category of barriers that our analysis identified as crucial.

VIII. CONCLUSION

This research examined the operational challenges that hinder sustainability efforts among textile SMEs. Through a thorough survey and analysis, we found that the primary obstacles to implementing eco-friendly practices are outdated technologies and financial constraints, while awareness at the managerial level and the skills of the workforce also play vital roles. These findings align with our literature review and theoretical expectations: the resource limitations and capability deficiencies directly obstruct SMEs from adopting best practices . Importantly, this study highlights that while there are many textile SMEs, they have been largely overlooked in sustainability research; our data contribute to filling this gap by providing empirical evidence that is specific to this sector.

Implications: The results suggest that managers should concentrate their investments on areas such as finance, equipment, and training to significantly enhance sustainability. The findings emphasize the need for specific support for SMEs (including grants, training programs, and cluster initiatives) aimed at policymakers. By integrating socio-technical perspectives, this research also expands academic knowledge. It reinforces the idea that achieving sustainability necessitates aligning human factors (such as training) with technological progress.

Limitations and Future Work: The primary limitations of the study are its geographic focus (a single region in India), limited sample size, and reliance on self-reported data. Future research could involve larger, more diverse samples and objective performance indicators (such as actual emissions measurements). Longitudinal studies could assess how new funding mechanisms and other initiatives influence SME behaviors over time. Nevertheless, this study provides a valuable framework for managers and researchers interested in fostering greener small businesses and establishes a foundation

for more extensive research into sustainability in SMEs.

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