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The causes and effects of environmentally friendly practices in the Indian textile industry

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Abstract

The Indian textile industry is one of the oldest and largest sectors in the country, contributing significantly to GDP, employment, and exports. The sector is known for its high-water consumption, chemical use, and waste production. Issues include water pollution, high energy usage, and hazardous waste. This study uses a structural equation modeling-based analytical framework to examine the causes and effects of eco-friendly practices in the Indian textile industry. Using a Google form survey and easy sampling, 230 people made up the sample. This research looks at five different hypotheses on how industrial eco-friendly practices are affected by environmental issues, circular economy principles, regulatory compliance, industrial 5.0 technology, and social responsibility programs. The results indicate that while circular economy principles revealed a statistically negligible link, environmental considerations, regulatory standards, Industry 5.0 technologies, social responsibility efforts, and eco-friendly practices suggest strong positive relationships. The findings have significant significance for the Indian textile industry, as they highlight the role that environmental restrictions, technical improvements, and social responsibility have in promoting sustainability.

Keywords: Eco-Friendly approaches, Technology Adoption, Economic Performance, Social Responsibility, and Regulatory Compliance.

INTRODUCTION

Occupational safety, community safety, and customer safety are all aspects of sustainable manufacturing. Sustainable practices can include a variety of approaches in the Indian textile industry, including the use of environmentally friendly raw materials, waste minimization strategies, energy-efficient procedures, and the implementation of closed-loop recycling systems (Beyers & Heinrichs, 2020). An important part of the Indian economy, the textile sector plays a key role in the world's textile and clothing markets. It is well known for producing a wide variety of goods, ranging from sophisticated synthetic materials to conventional handloom textiles

(Dhonde & Patel, 2021). On the other hand, this industry is also well-known for its large energy consumption, chemical pollution, excessive water demand, and environmental impact. Using eco-friendly practices in the Indian textile sector has become essential as corporate responsibility and environmental sustainability gain momentum on a global scale. (Dukovska-Popovska *et al.*, 2023). The textile sector faces several obstacles in its shift to sustainable manufacturing, even with the rising understanding of its significance. These include the high upfront expenses associated with implementing new technology, SMEs' ignorance and inexperience, and the requirement for significant infrastructure modifications. Nonetheless, effective adoption may result in large long-term benefits, including lower effective costs, enhanced brand reputation, and improved compliance with global standards (Chowdhury *et al.*, 2023). The Indian textile industry is driven towards sustainability by a multitude of causes. Manufacturers are under increasing pressure to comply with tougher environmental requirements due to domestic and worldwide regulatory demands. In addition, growing environmental consciousness and social media campaigning are driving up consumer demand for textiles made sustainably and ethically. Furthermore, international companies that source from India are increasingly requiring their suppliers to meet sustainable standards (Gbolarumi *et al.*, 2021).

In order to encourage sustainable industrial practices and facilitate the shift to a circular economy, green money is essential. Green finance includes investment methods and financial instruments that prioritize sustainability in the environment. Green finance provides incentives for businesses to engage in clean technology and implement environmentally responsible practices by allocating cash to projects and activities that match with sustainability goals. Additionally, green financing directs funds into capacity building, research and development, and infrastructure development, which makes it easier for businesses of all kinds to adopt eco-friendly practices. Green finance promotes systemic transformation toward a more resilient and sustainable economy by incorporating environmental factors into financial decision-making (Agyapong & Tweneboah, 2023).

It is impossible to exaggerate the importance of environmentally friendly practices in India, especially in industries like textiles. India is a major worldwide manufacturer of textiles, and its manufacturing strategy has a significant impact on social justice, economic growth, and environmental sustainability (Singhvi & Dadhich, 2023). Adopting sustainable practices is important in the following main areas: Pollution Reduction: The textile industry is well known for

having a significant negative impact on the environment. It releases harmful chemicals and colors into rivers and other bodies of water, which greatly contributes to water pollution. Environmentally friendly methods, such the use of biodegradable dyes and cutting-edge wastewater treatment systems, can significantly lessen these effects. One way to lessen the strain on natural water supplies is to implement closed-loop water systems, which recycle and reuse water in production. In the manufacturing sector, green financing efforts and the concepts of the circular economy are operationalized through sustainable manufacturing practices. A variety of tactics are used in sustainable manufacturing to lessen the impact on the environment, optimize the use of resources, and promote social responsibility all along the production line. Enhancing energy efficiency, cutting waste, implementing ethical labor standards, and utilizing renewable energy sources are a few examples of these approaches. Businesses may boost their image among environmentally sensitive customers, cut expenses, and increase operational efficiency by giving sustainability top priority in their manufacturing operations. A resilient and sustainable economy depends on sustainable manufacturing practices because they help companies stay competitive over the long run and support larger environmental and social objectives (Muganyi *et al.*, 2021).

Health and Safety: By lowering workers' exposure to dangerous chemicals and pollutants, environmentally friendly practices enhance workers' health and safety. Better working conditions, fewer health problems, and more productivity result from this. Reducing pollution means better air and water for populations near manufacturing facilities, which improves general wellbeing.

Job Creation and Skill Development: The transition to environmentally friendly manufacturing opens up new career paths in sustainable technology development, renewable energy, and environmental management. It also calls for skill development and training, which expands the workforce's potential and creates new job opportunities. India can set a good example by adopting sustainable manufacturing and proving that environmental conservation and economic expansion are compatible. This might encourage other poor nations to implement comparable measures, increasing the influence of sustainability programs on a global scale.

Innovation Drive: New materials, technologies, and industrial methods are driven by the demand for sustainable solutions. For example, investigating substitute fibers like bamboo, recycled polyester, and organic cotton can lead to the creation of novel, eco-friendly fabrics. With this invention, India might lead the world's sustainable textile market.

Waste Management: The sector produces a large amount of garbage, which includes packaging materials, chemical residues, and textile scraps. Eco-friendly methods support zero-waste programs by promoting material recycling and upcycling. Using the concepts of the circular economy reduces the amount of garbage that ends up in landfills and the state of the environment by turning it into new raw resources.

Cost savings: Long-term cost reductions from sustainable technology and processes may be significant, despite their sometimes-hefty initial investment. Water-saving solutions save water costs, energy-efficient machinery lowers power expenditures, and effective waste management lowers disposal costs. For instance, cutting back on water use during dyeing operations lowers water costs and eliminates the need for expensive wastewater treatment.

Penalties and Compliance: Following strict environmental laws might help save money by avoiding fines and business interruptions. Ensuring adherence to global standards such as ISO 14001 (Environmental Management) facilitates commercial relations and market access while mitigating the risk of non-compliance.

MATERIALS AND METHODS

This study evaluates the fundamental factors influencing eco-friendly practices in the Indian textile sector using an analytical framework based on structural equations. It is appropriate for assessing the multifaceted character of sustainability in manufacturing processes as it permits the examination of intricate interactions between latent and observable variables (Singhvi & Dadhich, 2023). The study focuses on both dependent and independent variables in order to evaluate the impact of different factors on eco-friendly practices.

a). Sample Size and Sampling Technique

There are 230 respondents in the sample who work in the Indian textile sector. Because convenience sampling is accessible and feasible, it is used to pick participants based on their willingness to participate and availability. Gujarat and Tamil Nadu, two states renowned for their substantial contributions to the Indian textile industry, provided the respondents for the survey.

b). Data Collection

An online survey is used to collect data. Information regarding the variables of interest, such as those impacting sustainable manufacturing practices, is gathered using the survey questionnaire.

Demographic details, including years of textile industry experience, job within the business, and opinions and experiences with eco-friendly practices, are requested from participants.

c). Measurement Instrument

Validated scales for measuring both dependent and independent variables make up the survey instrument. Utilizing established measuring scales derived from extant research, constructs associated with Eco-Friendly Practices—such as environmental management, social responsibility, and economic performance—are evaluated. Furthermore, demographic inquiries are incorporated to guarantee the representativeness of the sample.

d). Data Analysis

Using Smart-PLS, a statistical method for examining intricate structural models in SEM, the gathered data are examined. Measurement and structural model evaluation is made possible by Smart-PLS, which also sheds light on the connections between latent variables and their observable indicators. In order to verify the measurement model and take the validity and reliability of the constructs into account, the analysis comprises Factor Analysis. In addition, a structural model is created to investigate the connections between independent and dependent variables, clarifying the fundamental factors influencing eco-friendly practices in the textile industry of India.

e). Construct Measurement Model Building (CMB)

It demonstrates how latent conceptions and their indicators are related. By evaluating the measurement model's convergent and discriminant validity, the CMB analysis makes sure that the latent constructs sufficiently account for the variation in the observed variables. A thorough knowledge of the variables impacting sustainability outcomes in the Indian textile sector is made possible by the identification and linking of dependent variables related to sustainable manufacturing methods to their corresponding independent variables (Dadhich & Bhaumik, 2023). In order to explore the fundamental factors influencing eco-friendly practices in the Indian textile sectors, the study approach incorporates rigorous data gathering and analytic methodologies.

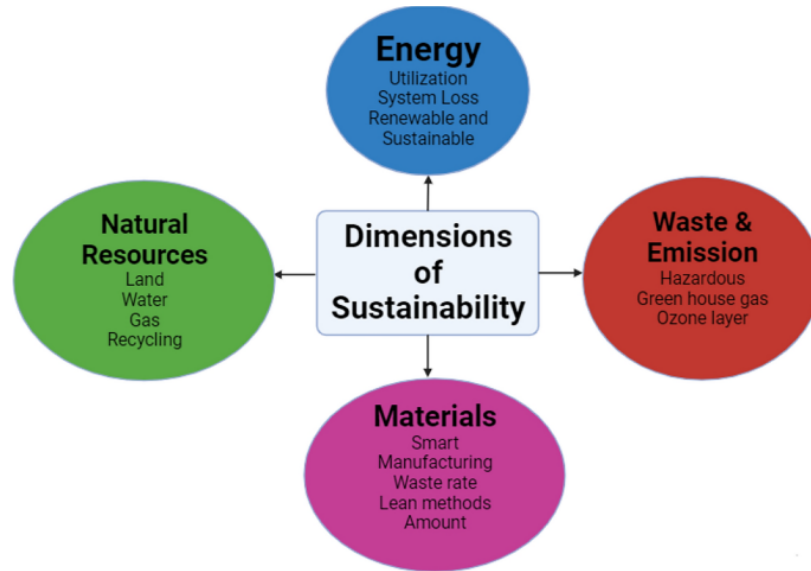


Figure:1. Enables of Eco-friendly practices

RESULT AND DISCUSSION

A comprehensive demographic and professional profile of the 230 respondents is shown in Table 1. The gender distribution shows that there are significantly more men than women in the sample, with 65.40% of the sample being male and 34.60% being female. The majority of respondents—42.00%—are between the ages of 20 and 30. Others in the group are between the ages of 30 and 50, followed by those over 50 (20.00%). The respondents are rather young overall. In terms of education, the majority of respondents (46.60%) and 56.40% of postgraduate degree holders have pursued higher education. This high degree of educational attainment suggests that the sample group is well-educated. The respondents' degrees of professional experience varied, with the majority (54.00%) having between one and five years of experience. In the sample, those with five to ten years' experience make up 24.30%, while those with more than ten years' experience make up 21.70%. In terms of managerial positions, half of the population (48.60%) holds lower management positions, followed by middle management (31.0%) and upper management jobs (20.40%). Remarkably, 92.90% of the respondents are aware of eco-friendly practices, demonstrating this group's strong awareness of sustainability concerns. The aforementioned consciousness highlights the significance of sustainability within their occupational milieu and implies the possibility of extensive adoption of sustainable methodologies.

Table 1: Descriptive Statistics

Factors	Classification	Freq.	%
Gender	Male	155	65.40
	Female	075	34.60
	Total	230	100.00
Age	20-30	095	42.00
	30-50	080	35.00
	Above 50	055	23.00
	Total	230	100.00
Education Level	Graduate	105	43.60
	P.G.	125	56.40
	Total	230	100.00
Experience	1-5 Yrs.	122	54.00
	5-10 Yrs.	058	24.30
	>10 Yrs.	050	21.70
	Total	230	100.00
Current Managerial Level	Lower	114	48.60
	Middle	69	31.00
	Higher	47	20.40
	Total	230	100.00
Awareness of EFP	Yes	216	92.90
	No	014	07.10
	Total	230	100.00

Environmental Factors, Circular Economy, Regulatory Compliance, Industry 5.0, Social Responsibility, and Eco-Friendly Practices are the six constructs linked to eco-friendly practices in the Indian textile industry. Table 2 lists the dependability metrics for each of these constructs. The reliability of each concept is evaluated using Composite Reliability, AVE, and Cronbach's alpha (CA). With a CA of 0.863 and an AVE of 0.608, Environmental Factors demonstrate great convergent validity and high internal consistency. Cronbach's alpha scores for Regulatory Compliance and Circular Economy are 0.764 and 0.781, respectively, indicating good reliability. While their CR values show reasonable composite reliability, their AVE values imply sufficient convergent validity (Anurag Shukla, Manish Dadhich, Dipesh Vaya, 2024; Hair et al., 2018). Conversely, Industry 5.0 and Social Responsibility have reduced internal consistency, as shown by their respective CA values of 0.581 and 0.665. Even Nevertheless, Social Responsibility exhibits good convergent validity, as evidenced by its high AVE of 0.699. An AVE of 0.548 indicates that eco-friendly activities have sufficient convergent validity and excellent reliability,

with a Cronbach's alpha of 0.757. The CR ratings for these constructs, however, point to regions that may benefit from more refining and indicate moderate composite reliability. Although the majority of the constructs exhibit satisfactory reliability and validity, a few—namely, Industry 5.0 and Social Responsibility—may benefit from further modifications to improve their composite dependability.

Table 2: Reliability Criterion

Constructs	Cron. alpha	AVE	CR	AVE
Environmental Factors	0.863	0.608	0.513	0.585
Circular Economy	0.781	0.595	0.528	0.599
Regulatory Compliance	0.764	0.499	0.577	0.605
Industry 5.0	0.665	0.509	0.588	0.505
Social Responsibility	0.581	0.699	0.509	0.509
Eco-Friendly Practices	0.757	0.548	0.488	0.611

The discriminant validity of six variables pertaining to environmentally friendly practices in the Indian textile sector is clarified using the Fornell-Larcker Analysis. The off-diagonal components show the correlations between the constructs, while the diagonal essentials show the square root of the AVE for each construct. Strong discriminant validity is demonstrated by constructs like Industry 5.0 (ID5), Circular Economy (CIE), and Environmental Factors (ENF), as seen by their AVE square roots, which range from 0.631 to 0.853, and are higher than their correlations with other constructs. To ensure conceptual clarity and distinctiveness, additional research is necessary for certain constructs, such as Regulatory Compliance (RGC) and Social Responsibility (SOR), which exhibit strong correlations and may indicate overlapping dimensions (Sonali Bhati; Manish Dadhich; Anand A Bhasker; Kamal Kant Hiran; Roshni Sharma; Anurag, 2023). Comparably, although Eco-Friendly Practices (EFP) shows a moderate discriminant validity, its correlations with other categories are comparatively weaker, suggesting opportunities for improvement to improve clarity and distinction as well as possible originality (Table 3).

Table 3: Fornell-Larcker Analysis

Constructs	ENF	CIE	RGC	ID5	SOR	EFP
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Environmental Factors	0.743					
Circular Economy	0.685	0.632				
Regulatory Compliance	0.812	0.780	0.725			
Industry 5.0	0.781	0.628	0.744	0.853		
Social Responsibility	0.824	0.571	0.801	0.741	0.658	
Eco-Friendly Practices	0.748	0.623	0.478	0.499	0.625	0.580

CONCLUSION

The Indian textile industry is at a turning point in its history when it may greatly reduce its environmental effect by using eco-friendly practices. The industry may promote a more sustainable future while maintaining its economic growth by using sustainable materials, efficient processes, and waste management procedures. The results illustrate the critical role that environmental considerations, industrial developments, regulatory compliance, and social responsibility programs have in promoting eco-friendly practices and sustainable growth in the sector. Furthermore, policymakers, industry stakeholders, and practitioners stand to gain significantly from the identification of critical variables and pathways impacting sustainable outcomes. This will facilitate the shift towards a more sustainable and socially conscientious textile industry in India. To optimize the impact of sustainability activities, assessing direct and indirect effects also offers helpful recommendations for choosing actions and efficiently allocating resources.

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CONFLICT OF INTERESTS

Authors declare no conflict of interest

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